FANUC Robot series

R-30*i*B/R-30*i*B Plus CONTROLLER

Servo Gun Function

OPERATOR'S MANUAL

```
●  Original Instructions
```

Thank you very much for purchasing FANUC Robot.

Before using the Robot, be sure to read the "FANUC Robot SAFETY HANDBOOK (B-80687EN)" and understand the content.

The products in this manual are controlled based on Japan's "Foreign Exchange and Foreign Trade Law". The export from Japan may be subject to an export license by the government of Japan. Further, re-export to another country may be subject to the license of the government of the country from where the product is re-exported. Furthermore, the product may also be controlled by re-export regulations of the United States government. Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual, we endeavor to include all pertinent matters. There are, however, a very large number of operations that must not or cannot be performed, and if the manual contained them all, it would be enormous in volume. It is, therefore, requested to assume that any operations that are not explicitly described as being possible are "not possible".

SAFETY PRECAUTIONS

This chapter must be read before using the robot.

For detailed functions of the robot operation, read the relevant operator's manual to understand fully its specification.

For the safety of the operator and the system, follow all safety precautions when operating a robot and its peripheral equipment installed in a work cell.
For safe use of FANUC robots, you must read and follow the instructions in "FANUC Robot SAFETY HANDBOOK (**B-80687EN**)".

1 DEFINITION OF USER

The personnel can be classified as follows.

Operator:
• Turns the robot controller power on/off
• Starts the robot program from operator panel

Programmer or Teaching operator:
• Operates the robot
• Teaches the robot inside the safety fence

Trained maintenance worker:
• Operates the robot
• Teaches the robot inside the safety fence
• Performs maintenance (repair, adjustment, replacement)

- Operator is not allowed to work in the safety fence.
- Programmer/Teaching operator and trained maintenance worker is allowed to work in the safety fence. Works carried out in the safety fence include transportation, installation, teaching, adjustment, and maintenance.
- To work inside the safety fence, the person must be trained on proper robot operation.

Table 1 lists the work outside the safety fence. In this table, the symbol "O" means the work allowed to be carried out by the worker.

Table 1 List of work outside the fence

	Operator	Programmer or Teaching operator	Trained maintenance worker
Turn power ON/OFF to Robot controller	O	O	O
Select operating mode (AUTO, T1, T2)		O	O
Select remote/local mode		O	O
Select robot program with teach pendant		O	O
Select robot program with external device		O	O
Start robot program with operator's panel	O	O	O
Start robot program with teach pendant		O	O
Reset alarm with operator's panel		O	O
Reset alarm with teach pendant		O	O
Set data on teach pendant		O	
Teaching with teach pendant		O	
Emergency stop with operator's panel	O	O	O
Emergency stop with teach pendant	O	O	O
Maintain for operator's panel		O	
Maintain for teach pendant			O

In the robot operating, programming and maintenance, the operator, programmer/teaching operator and trained maintenance worker take care of their safety using at least the following safety protectors.

- Use clothes, uniform, overall adequate for the work
- Safety shoes
- Helmet

2 DEFINITION OF SAFETY NOTATIONS

To ensure the safety of users and prevent damage to the machine, this manual indicates each precaution on safety with "**WARNING**" or "**CAUTION**" according to its severity. Supplementary information is indicated by "**NOTE**". Read the contents of each "**WARNING**", "**CAUTION**" and "**NOTE**" before using the robot.

Symbol	Definitions
⚠**WARNING**	Used if hazard resulting in the death or serious injury of the user will be expected to occur if he or she fails to follow the approved procedure.
⚠**CAUTION**	Used if a hazard resulting in the minor or moderate injury of the user, or equipment damage may be expected to occur if he or she fails to follow the approved procedure.
NOTE	Used if a supplementary explanation not related to any of WARNING and CAUTION is to be indicated.

- Check this manual thoroughly, and keep it handy for the future reference.

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APPENDIX

1   OVERVIEW

1.1   FEATURES OF FANUC SERVO GUN

- Many dedicated servo gun functions (such as manual operation, soft-touch operation, and tip wear compensation).
- Automatic creation of tool paths optimized for spot welding.
- The same operations and instructions are usable for both air and servo guns. The interface for air or servo guns has the same feel.
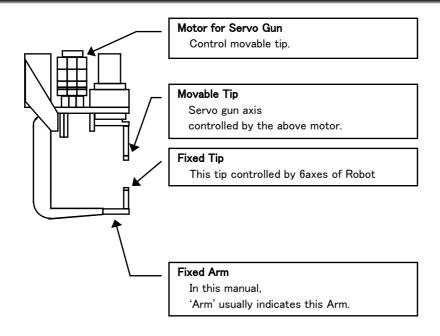
1.2   BASIC SPECIFICATION

Pressure setting range	0.0-9999.9[N, kgf, lbf] (*1)
Stroke limit range	0.0-999.9[mm] (*1)
Gun axis speed setting range	0-2000[mm/sec] (or) 0-100[%] ratio of gun axis speed to its maximum
Number of controlled axes	Number of axes that can be controlled simultaneously: 6 robot axes + 3 extended axes + 1 gun axis Note: For a dual gun, two axes can be simultaneously controlled.

*1 Practical values are determined according to the specification of the servo gun mechanics. User can change pressure unit.

1.3   NAMES OF MAJOR SERVO GUN COMPONENTS

Motor for Servo Gun
   Control movable tip.

Movable Tip
   Servo gun axis
   controlled by the above motor.

Fixed Tip
   This tip controlled by 6axes of Robot

Fixed Arm
   In this manual,
   'Arm' usually indicates this Arm.
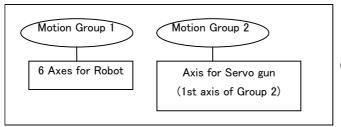
1.4   CONTROL METHOD (MULTI-GROUP)

This system controls a stationary tip (on six robot axes) and a movable tip (on a servo gun axis) in a multi-motion group environment. Unlike extended axis control, multi-motion group control allows control of the six robot axes and the servo gun axis in separate motion groups. This enables separate control of the robot and the gun.

Multi-Motion Group Control

```
┌─────────────────────────────────────────────────┐
│   ⬭ Motion Group 1        ⬭ Motion Group 2         │      **Control method for servo gun system**
│   ┌─────────────┐      ┌──────────────────────┐  │
│   │ 6 Axes for Robot │   │  Axis for Servo gun       │  │
│   └─────────────┘      │  (1st axis of Group 2)   │  │
│                        └──────────────────────┘  │
└─────────────────────────────────────────────────┘
```

2   INITIAL SETTING

The following initialization is necessary to control the servo gun. Usually, the initialization needs to be performed only once when the system is started.

1.   Servo gun axis initialization
Initialize the settings related to the servo gun axis (such as motor size, gear ratio, and maximum speed).

2.   Tool coordinate system setting
Define a tool coordinate system at the end of the stationary tip.

3.   Closing direction of the gun setting
Define a tool coordinate system at the end of the movable tip.

4.   Max pressure setting
Specify the max pressure for the servo gun based on gun mechanical limit. (gun manufacturer must provide this information)

5.   Gun setup utility
- Confirm motion sign of the gun
- Master gun axis
- Setting stroke limits & tip displacement
- Tune the servo parameters using autotuning

6.   Pressure calibration
Calibrate the pressure applied to the tips using a certified and calibrated pressure gauge (load cell).

⚠**CAUTION**
Do not load system file for spot and servo gun : SYSSPOT.SV of other robot controller on 7DC1. Do not load system file for servo gun : SYSSVGN.SV of other robot controller on 7DC2 or later.

⚠**CAUTION**
Do not load R-30*i*A system files for servo gun (SYSSPOT.SV, SYSPRESS.SV, SYSDIST.SV, SYSSTROK.SV).

2.1   SERVO GUN AXIS INITIALIZATION

Outline
This section describes how to start up the servo gun system with a new controller that is properly configured with servo gun software option and hardware.
If additional axis control or multi-group control is being used or added to an existing system, a startup procedure matched to the axis configuration must be evaluated.

Startup Procedure
The servo gun axis configuration begins by performing a Controlled Start. The servo gun axis and servo gun setup procedures are as follows:
1   Perform a Controlled Start
2   Add the axis for the servo gun

3   Define the axis and equipment as a servo gun
4   Perform a Cold Start
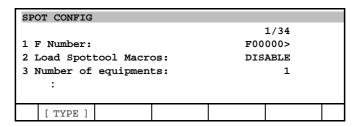
[1] Controlled Start

1   Turn the power ON while you press the [PREV] key and the [NEXT] keys on the teach pendant. The following screen is displayed.

```
----------- CONFIGURATION MENU -----------

  1. Hot start
  2. Cold start
  3. Controlled start
  4. Maintenance

Select >_
```

2   Type "3" and press the [ENTER] key to select "3. Controlled start". This starts the controlled start process. After a while the Controlled Start menu is displayed.

```
SPOT CONFIG
                                      1/34
1 F Number:                        F00000>
2 Load Spottool Macros:            DISABLE
3 Number of equipments:                  1
     :

    [ TYPE ]
```

> **NOTE**
> User can repower on R-30iB controller using Teach pendant.
> Please operate the following.
> Fctn key -> "0 -- Next --" -> "8 CYCLE POWER"
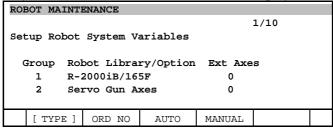
[2] Setting the Gun Axis

To display the Gun Axis Setup screen, perform the following procedure at the Controlled Start menu.

> **NOTE**
> Set values based on the servo gun mechanical specification.

1   Press the [MENU] key, and select "9 MAINTENANCE" to display the Robot Setup screen.

```
ROBOT MAINTENANCE
                                      1/10
Setup Robot System Variables

  Group  Robot Library/Option  Ext Axes
    1     R-2000iB/165F              0
    2     Servo Gun Axes             0

    [ TYPE ]  ORD NO   AUTO   MANUAL
```

2   Move the cursor to "Servo Gun Axes", and press "F4 MANUAL".

3   An FSSB line selection screen will be displayed.

```
**  GROUP 2 SERVO GUN AXIS SET UP PROGRAM

-- FSSB configuration setting --
 1: FSSB line 1 (main axis card)
 2: FSSB line 2 (main axis card)
 3: FSSB line 3 (auxiliary axis board 1)
 5: FSSB line 5 (auxiliary axis board 2)
Select FSSB line >
Default value = 1

_
```

Type the FSSB line for servo gun axis.

For example, when the system has basic hardware like robot axes and servo gun axes, FSSB line usually is "1". If system had special many axis hardware like multi arm or auxiliary axis board, FSSB line usually would be "2" or "3".

4   Type the hardware number for the starting axis. (Type "7" if the robot is a 6-axis robot, and the servo gun axes are assigned to the 7th axis onwards.) Press the [ENTER] key.

```
**  GROUP 2 SERVO GUN AXIS SET UP PROGRAM

-- Hardware start axis setting --
Enter hardware start axis
(Valid range: 1 - 30)
Default value = 7

_
```

If you make a mistake when entering the hardware number for the starting axis, select 4. EXIT in the menu displayed below to temporarily exit setup, and then perform the Servo Gun setting at the Robot Setup screen again.

5   Add an axis for servo gun by the following steps.

Configuration Procedure

```
**  GROUP 2 SERVO GUN AXIS SET UP PROGRAM

*** Group 2 Total Servo Gun Axes = 0
  1. Display/Modify Servo Gun Axis 1~9
  2. Add Servo Gun Axis
  3. Delete Servo Gun Axis
  4. EXIT
Select ==> _
```

Type in 2 and Press the [ENTER] key , then the following screen will be displayed.

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

***** SETUP TYPE *****
  If select 1, gear ratio is pre-set to
  default value, which may be wrong.
  Select 2,to set gear ratio correctly.

  1: Partial (Minimal setup questions)
  2: Complete (All setup questions)
Setup Type ==>
Default value = 1
_
```

5.1 Setup Type
There are (2) modes available.
Please choose "Partial" or "Complete"
The following table is list of setting items in each mode.

Setting items in each mode

Item	Partial	Complete
Motor size	○	○
Amplifier number	○	○
Brake number	○	○
Tip displacement ratio [mm/rev]	×(5.00)	○
Gun close direction	×(＋)	○
Gun open stroke limit [mm]	×(999)	○
Gun close stroke limit [mm]	×(999)	○
Motion sign	×(TRUE)	○
Max gun pressure [kgf], [lbl], [N]	×(500kgf)	○
Servo timeout	△	△
Servo timeout value	△	△
Max joint speed	×	○

○:   Set here.
×:   Not set here. Default value in ( ) is applied. You can change it in another setting screen.
△:   Need setting if you set brake number to a value other than 0.

> **NOTE**
> Specify a valid value based on the servo gun mechanical specification.

> ⚠**WARNING**
> If "Partial" is chosen, gun close direction, Motion sign, stroke limit, tip
> displacement ratio, max gun pressure and max joint speed are not set to valid
> values. (Temporary setting state). In this case, do not operate servo gun axis
> without gun setup utility screen after cold start. "Complete" is recommended.

> **NOTE**
> Even after setting a maximum pressure with Servo Gun Axis Initialization, you can
> change the setting on the Servo Gun Setup screen after cold start.

> **NOTE**
>   Partial setup does not set up max gun pressure. The default value is 500kgf by kgf unit.

> **NOTE**
>   The units of pressure (force) are set by the value of the system variable $SGSYSCFG.$PRS_UNITS:
>   0 = Kilogram-force (kgf)
>   1 = Pound-force (lbf)
>   2 = Newton (nwt)

> **NOTE**
>   If you specify an incorrect value, finish all setup once, and then select "1 Display/Modify Servo Gun Axes". You can specify it again.

In the following case, user should choose "Partial"
-     User can set the items omitted during Partial setup mode, with Gun setup utility

In the following case, user should choose "Complete"
-     As soon as the cold start is performed, gun axis will be jogged without autotuning (Perform autotuning at the end.)
-     User knows gun specification clearly.

5.2   Motor Selection

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

***** MOTOR SELECTION *****

 1:  ACa4/5000is 20A      6: ACAM6/3000 80A
 2:  ACa4/5000is 40A
 3:  ACa8/4000is 40A
 4:  ACa8/4000is 80A
 5: ACa12/4000is 80A    0: Other
Select ==> _
```

The motor IDs for motors supported by the servo gun are listed in advance. Select the motor from the list by typing in the number associated with the motor being used (or the special Motor ID number) and press the [ENTER] key. If you are using a motor that is not included in the list, select "0: Other" to see a more detailed list of FANUC motors. If you select it, the following screen is displayed and any motor can be selected. Operation is different depending on the selected number.

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

-- MOTOR SELECTION --

 1: Standard Method
 2: Enhanced Method
 3: Direct Entry Method
Select ==> _
```

"1: Standard Method"

    i)   Select motor size.

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

-- MOTOR SIZE (alpha iS) --

 60. aiS2       64. aiS22
 61. aiS4       65. aiS30
 62. aiS8       66. aiS40
 63. aiS12
  0. Next page
Select ==> _
```

NOTE

If there is no choice of the appropriate motor type, please consult with FANUC.
Type the number with which we can notify you in this case.

---

    ii)   Select motor type.

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

-- MOTOR TYPE --

 1. /2000      11. /4000
 2. /3000      12. /5000
               13. /6000
Select ==> _
```

    iii)   Select current limit for the motor.

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

-- CURRENT LIMIT FOR MOTOR --

 2.   4A      10.  20A
 5.  40A      12. 160A
 7.  80A

Select ==> _
```

"2: Enhanced Method"
    i)   Select motor size.

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

-- MOTOR SIZE (alpha iS) --

 60. aiS2        64. aiS22
 61. aiS4        65. aiS30
 62. aiS8        66. aiS40
 63. aiS12
  0. Next page
Select ==> _
```

NOTE
If there is no choice of the appropriate motor type, please consult with FANUC.
Type the number with which we can notify you in this case.

    ii)   Candidate motors are displayed. please select motor.

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

-- MOTOR SELECTION --

 1: aiS8/4000 40A
 2: aiS8/4000 80A
 3: aiS8/6000 80A
Select ==> _
```

"3: Direct Entry Method"

NOTE
Direct Entry Method is only used when special case. FANUC will tell it to you if you
need to use Direct Entry Method.

    i)   Input motor ID.

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

-- MOTOR SELECT (Direct Entry) --

 Enter Complete Motor ID.
Select ==> _
```

NOTE
Consult with FANUC about Motor ID.

5.3   Amplifier Number

```
┌──────────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓              │
│                                                    │
│ ** GROUP 2 SERVO GUN AXIS SET UP PROGRAM          │
│                                                    │
│ ***** AMP NUMBER *****                             │
│                                                    │
│ Enter amplifier number (1~56) ==> _                │
│                                                    │
├──────┬──────┬──────┬──────┬──────┬──────┬──────┤
│      │      │      │      │      │      │      │
└──────┴──────┴──────┴──────┴──────┴──────┴──────┘
```

Select the Amplifier Number by typing the number associated with the amplifier used to drive
this motor, then press the [ENTER] key. The amplifier number will depend on the hardware
configuration being used. The robot amplifier is #1 and the 1st auxiliary axis amplifier is #2 and
so on.
If you select "Complete", continue to set the following items. If you select "Partial", please skip
procedure 5.4~5.9, and perform procedure 5.10~5.12.

5.4   Tip Displacement Ratio

```
┌──────────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓              │
│                                                    │
│ ** GROUP 2 SERVO GUN AXIS SET UP PROGRAM          │
│                                                    │
│ ***** TIP DISPLACEMENT RATIO *****                 │
│                                                    │
│ The number of mm's traveled for one                │
│ rotation of the motor (0 if unknown)               │
│ Enter Tip Displacement Ratio (mm) ==> _            │
│                                                    │
├──────┬──────┬──────┬──────┬──────┬──────┬──────┤
│      │      │      │      │      │      │      │
└──────┴──────┴──────┴──────┴──────┴──────┴──────┘
```

Type in the distance that the gun tip moves motor revolution and press the [ENTER] key.

5.5   Motor Direction

```
┌──────────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓              │
│                                                    │
│ ** GROUP 2 SERVO GUN AXIS SET UP PROGRAM          │
│                                                    │
│ ***** MOTOR DIRECTION *****                        │
│                                                    │
│ Servo Gun 1 Motion Sign = TRUE                     │
│ Enter (1: TRUE, 2:FALSE):                          │
│       (Enter 1 if unknown) ==> _                   │
│                                                    │
├──────┬──────┬──────┬──────┬──────┬──────┬──────┤
│      │      │      │      │      │      │      │
└──────┴──────┴──────┴──────┴──────┴──────┴──────┘
```

Set the revolution direction of the motor.
If gun axis moves to plus direction when the motor rotates forward (clockwise as seen from
Pulsecoder), select "1: TRUE". If gun axis moves to minus direction, select "2: FALSE".

Select "1: TRUE" if unknown.

5.6 Gun Close Direction

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

***** GUN CLOSE DIRECTION *****

Servo gun close direction
(1: Positive, 2: Negative) ==> _
```

Configure the axis jog key for closing the gun tip.
- If Positive is chosen, the + jog key will close the gun.
- If Negative is chosen, the - jog key will close the gun.

5.7 Gun Open Stroke Limit

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

***** GUN OPEN STROKE LIMIT *****

Stroke in mm from tip closed position
(positive value)
Enter Open Limit (mm) ==> _
```

Type in the maximum tip opening for the gun in units of mm, then press the [ENTER] key.

5.8 Gun Close Stroke Limit

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

***** GUN CLOSE STROKE LIMIT *****

Stroke in mm past tip closed position
(positive value)
Enter Close Limit (mm) ==> _
```

Type in the maximum tip travel available in the closing direction after the tips touch, then press the [ENTER] key.

5.9 Max Gun Pressure

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

***** MAX GUN PRESSURE *****

Maximum pressure that gun is rated for.
  Default value(nwt): 4900.0
Enter Max gun pressure(nwt) ==> _
```

Type in the maximum pressure and press the [Enter] key.

5.10 Brake Number

```
┌──────────────────────────────────────────────────┐
│ ░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░       │
│                                                    │
│ ** GROUP 2 SERVO GUN AXIS SET UP PROGRAM           │
│                                                    │
│ ***** BRAKE SETTING *****                          │
│                                                    │
│ Enter Brake Number (0~32) ==> _                    │
│                                                    │
├─────┬──────┬──────┬──────┬──────┬──────┬───────────┤
│     │      │      │      │      │      │           │
└─────┴──────┴──────┴──────┴──────┴──────┴───────────┘
```

Type in the Brake circuit number that is used to brake the motor. If no brake is used, type in 0. If a brake is used, the Servo Off setup (5.11–5.12) must be performed. If the brake number is set to 0, go to step 5.13.

5.11 Servo Timeout

```
┌──────────────────────────────────────────────────┐
│ ░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░       │
│                                                    │
│ ** GROUP 2 SERVO GUN AXIS SET UP PROGRAM           │
│                                                    │
│ ***** SERVO TIMEOUT *****                          │
│                                                    │
│ Servo Off is Disable                               │
│ Enter (1: Enable  2: Disable) ==> _                │
│                                                    │
├─────┬──────┬──────┬──────┬──────┬──────┬───────────┤
│     │      │      │      │      │      │           │
└─────┴──────┴──────┴──────┴──────┴──────┴───────────┘
```
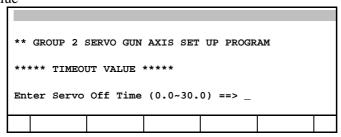
Type in whether to use a servo timeout (This screen is displayed only when a brake number is set).
In the case servo timeout is enabled, an axis is automatically braked if the axis has not been used for a specified time. The brake of the gun axis is released at the time a motion command is given. Loads must always be applied. If there is a possibility that the motor will heat up, enable the servo timeout.
If you want to shorten the cycle time as much as possible, disable the servo timeout. (If servo timeout is enabled, start of movement is delayed 300 ms to wait releasing the brake.)

Servo timeout is enabled if you type in "1: Enable". Servo timeout is disabled if you type in "2: Disable".

5.12 Timeout Value

```
┌──────────────────────────────────────────────────┐
│ ░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░░       │
│                                                    │
│ ** GROUP 2 SERVO GUN AXIS SET UP PROGRAM           │
│                                                    │
│ ***** TIMEOUT VALUE *****                          │
│                                                    │
│ Enter Servo Off Time (0.0~30.0) ==> _              │
│                                                    │
├─────┬──────┬──────┬──────┬──────┬──────┬───────────┤
│     │      │      │      │      │      │           │
└─────┴──────┴──────┴──────┴──────┴──────┴───────────┘
```

If you typed "1" to enable servo timeout in the previous step, a screen is displayed for setting the amount of time before a servo timeout occurs.
Type in the Timeout Value in seconds.

5.13 Max Gun Speed

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

***** MAX GUN SPEED *****

  Gear Ratio (mm/rev) = 10.400
  Def. Max Motor Speed (RPM) = 4000
  Def. Max Gun Speed (mm/sec) = 693.33
  Cur. Max Motor Speed (RPM) = 4000
  Cur. Max Gun Speed (mm/sec) = 693.33
  Enter Max Gun Speed (mm/sec) : _
```

Type in the maximum gun speed and press the [ENTER] key.
Type "Cur. Max Gun Speed" value if you don't want to change maximum gun speed.
"Def. Max Gun Speed" shows maximum gun speed calculated from maximum motor speed and tip displacement.

6   Setup for the gun axis is finished.
     The following screen is displayed.

```
** GROUP 2 SERVO GUN AXIS SET UP PROGRAM

*** Group 2 Total Servo Gun Axes = 1
  1. Display/Modify Servo Gun Axis 1~9
  2. Add Servo Gun Axis
  3. Delete Servo Gun Axis
  4. EXIT
Select ==> _
```

Select 1, to display and/or modify any axis that is already defined
Select 2, to add another Servo Gun axis
Select 3, to delete the last Servo Gun axis
Select 4, to exit setup when done configuring all axes.

⚠**CAUTION**
If existed gun axis that has been set up is replaced to another gun, delete the
setup at once by selecting "3. Delete Servo Gun Axis". After that, re-add gun axis
by selecting "2. Add Servo Gun Axis". If you change the setup by selecting "1.
Display/Modify Servo Gun Axis 1~9" without deleting the setup, then replaced
parameters are completely uninitialized, so it does not work correctly.

7   Auto configuration of gun axis

     When gun axis is correctly added, free equipment number is assigned to group of the added gun axis,
     and the equipment type is changed to servo gun.

```
EQ1 was assigned to this group.

Press ENTER to Continue.
```

- 13 -

According to equipment number, group number and gun axis configuration, please verify / change in servo gun configuration screen.

NOTE

In case of dual gun, when only a gun axis is added, this auto configuration is not performed.

```
┌─────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓         │
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓         │
│                                           │
│ Even number of axes needed for dual gun.  │
│ EQ1 equip_type was changed to AIRGUN.     │
│                                           │
│ Press ENTER to Continue.                  │
│                                           │
├────┬────┬────┬────┬────┬────┬────┤
└────┴────┴────┴────┴────┴────┴────┘
```

In addition, when the software has no gun change option and two gun axes are added, then the dual gun settings are automatically valid.

NOTE

When software does not have gun change option and more than 3 gun axes are added, then this auto configuration is not performed.
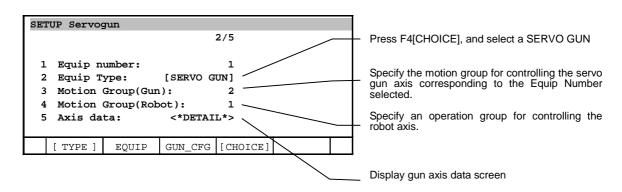
```
┌─────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓         │
│                                           │
│                                           │
│ Gun Change option is not installed.       │
│ EQ1 equip_type was changed to AIRGUN.     │
│                                           │
│ Press ENTER to Continue.                  │
│                                           │
├────┬────┬────┬────┬────┬────┬────┤
└────┴────┴────┴────┴────┴────┴────┘
```
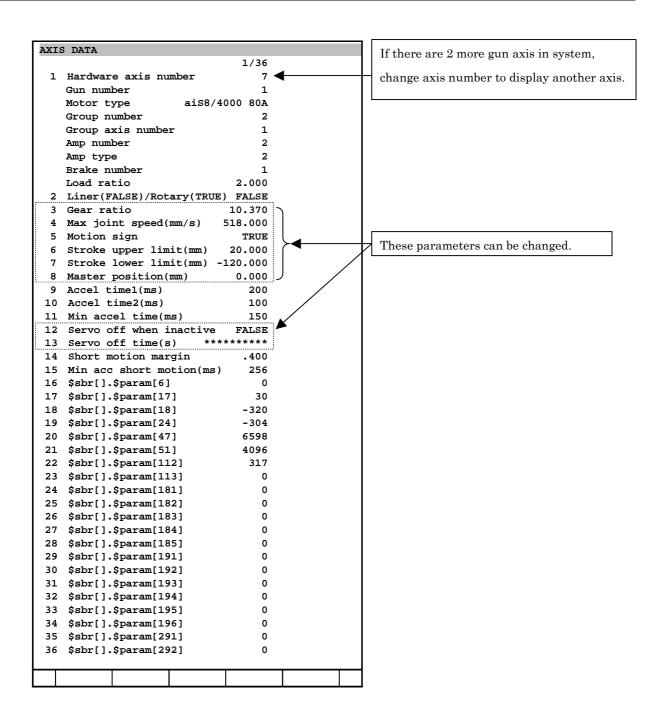
---

[3] Define the Axis and Equipment as a Servo Gun

1. Press the [MENU] key, then select "0 –next -- ", "4 SETUP SERVO GUN".
2. Specify Equipment Type.

```
┌───────────────────────────────────────┐
│ SETUP Servogun                         │
│                          2/5           │
│                                        │
│ 1  Equip number:            1          │
│ 2  Equip Type:      [SERVO GUN]        │
│ 3  Motion Group(Gun):       2          │
│ 4  Motion Group(Robot):     1          │
│ 5  Axis data:        <*DETAIL*>        │
│                                        │
├──────┬───────┬────────┬──────────┬────┤
│[ TYPE ]│ EQUIP │GUN_CFG │[CHOICE]  │    │
└──────┴───────┴────────┴──────────┴────┘
```

Press F4[CHOICE], and select a SERVO GUN

Specify the motion group for controlling the servo gun axis corresponding to the Equip Number selected.

Specify an operation group for controlling the robot axis.

Display gun axis data screen

3 If this is a Gun Change system, the gun change function is enabled from this screen, (when the gun change option has been specified).
4 Select Axis data <*DETAIL*>, then gun axis data screen is displayed. Some gun parameters can be changed in the screen.

```
AXIS DATA
                              1/36
  1  Hardware axis number        7    ◀──────
     Gun number                  1
     Motor type        aiS8/4000 80A
     Group number                2
     Group axis number           1
     Amp number                  2
     Amp type                    2
     Brake number                1
     Load ratio              2.000
  2  Liner(FALSE)/Rotary(TRUE)  FALSE
  3  Gear ratio             10.370
  4  Max joint speed(mm/s)  518.000
  5  Motion sign             TRUE
  6  Stroke upper limit(mm)  20.000
  7  Stroke lower limit(mm) -120.000
  8  Master position(mm)      0.000
  9  Accel time1(ms)            200
 10  Accel time2(ms)            100
 11  Min accel time(ms)         150
 12  Servo off when inactive   FALSE
 13  Servo off time(s)     **********
 14  Short motion margin       .400
 15  Min acc short motion(ms)   256
 16  $sbr[].$param[6]             0
 17  $sbr[].$param[17]           30
 18  $sbr[].$param[18]         -320
 19  $sbr[].$param[24]         -304
 20  $sbr[].$param[47]         6598
 21  $sbr[].$param[51]         4096
 22  $sbr[].$param[112]         317
 23  $sbr[].$param[113]           0
 24  $sbr[].$param[181]           0
 25  $sbr[].$param[182]           0
 26  $sbr[].$param[183]           0
 27  $sbr[].$param[184]           0
 28  $sbr[].$param[185]           0
 29  $sbr[].$param[191]           0
 30  $sbr[].$param[192]           0
 31  $sbr[].$param[193]           0
 32  $sbr[].$param[194]           0
 33  $sbr[].$param[195]           0
 34  $sbr[].$param[196]           0
 35  $sbr[].$param[291]           0
 36  $sbr[].$param[292]           0
```

If there are 2 more gun axis in system, change axis number to display another axis.

These parameters can be changed.

[4] Cold Start
1   Press the FCTN key in the Controlled Start menu, and select Cold Start.

2.2   SETTING THE COORDINATE SYSTEM

Carried gun

Executing the SPOT instruction automatically generates the route of the fixed side tip based upon the tool coordinate system that is set here. Define the tool coordinate system as follows.

1   Take the end of the fixed side tip as the origin of the tool coordinate system. (Figure below: a)
2   Make sure that the close (longitudinal) direction of the fixed side tip is parallel with one of the X/Y/Z axes of the **tool** coordinate system. (Figure below: b)
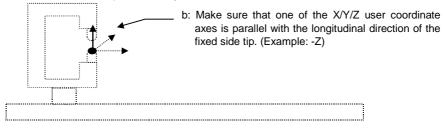
b: Make sure that one of the X/Y/Z tool coordinate axes is parallel with the longitudinal direction of the fixed side tip (Example: +Z)

a: Align the origin of the tool coordinate system with the end of the fixed side tip.

Pedestal gun

Executing the SPOT instruction automatically generates the route of the part based upon the user coordinate system that is set here. Define the user coordinate system as follows.

1   Make sure that the close (longitudinal) direction of the fixed side tip is parallel with one of the X/Y/Z axes of the **user** coordinate system. (Figure below: b)

b: Make sure that one of the X/Y/Z user coordinate axes is parallel with the longitudinal direction of the fixed side tip. (Example: -Z)
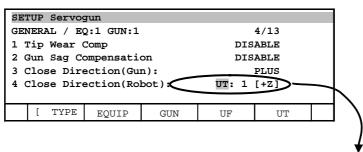
NOTE
When the weight compensation is used, the Z axis both of tool coordinate axes and user coordinate axes should be parallel with the longitudinal direction of the fixed side tip. Refer to Chapter 18 SERVO GUN WEIGHT COMPENSATION for detailed information.
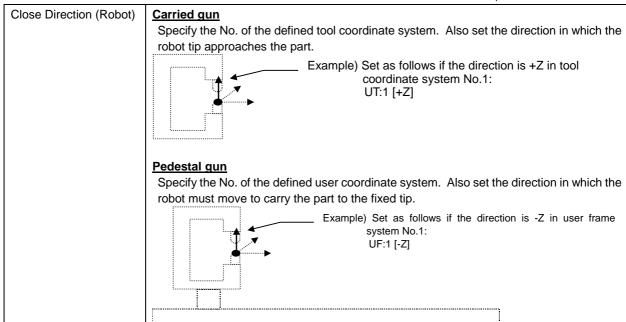
Setting to Robot Close Direction to match the Coordinate System of the Gun

The robot close direction is used generating the proper trajectory to spot locations and for compensation (tip wear down compensation and gun sag compensation).

1   Press the [MENU] key to display the Screen menu, and select 6 SETUP.
2   Press F1 TYPE to display the Screen Selection menu, and select Servo Gun.
3   Move cursor on "General Setup: <*DETAIL*>" and press the [ENTER] key to display General Setup screen.

4   Set the Close Direction (ROBOT) according to the following table.

```
SETUP Servogun
GENERAL / EQ:1 GUN:1                          4/13
1 Tip Wear Comp                    DISABLE
2 Gun Sag Compensation             DISABLE
3 Close Direction(Gun):              PLUS
4 Close Direction(Robot):      UT: 1 [+Z]

   [  TYPE     EQUIP     GUN      UF       UT
```

Close Direction (Robot)	**Carried gun** Specify the No. of the defined tool coordinate system. Also set the direction in which the robot tip approaches the part. Example) Set as follows if the direction is +Z in tool coordinate system No.1: UT:1 [+Z] **Pedestal gun** Specify the No. of the defined user coordinate system. Also set the direction in which the robot must move to carry the part to the fixed tip. Example) Set as follows if the direction is -Z in user frame system No.1: UF:1 [-Z]

2.3   SETTING THE GUN CLOSE DIRECTION

NOTE: If this step was already completed during the Axis setup at the Controlled Start, or with the Gun Setup Utility, this section can be skipped

The gun close direction is used generating the proper trajectory to spot locations and for compensation (tip wear down compensation and gun sag compensation).

Gun tip:
 Operate the gun axis jog to set the **gun close direction (+/-)**.
 In case of gun closing by "+" key, set to PLUS.
 In case of gun closing by "-" key, set to MINUS.

Robot tip:
Specify the No. of the defined tool coordinate system and which direction in that coordinate system is the longitudinal direction (close direction) of the fixed side tip.(see 2.2)

1   Press [MENU] key to display the Screen menu, and select 6 SETUP.
2   Press F1 TYPE to display the Screen Selection menu, and select Servo Gun.
3   Move cursor on "General Setup: <*DETAIL*>" and press the [ENTER] key to display General Setup screen.

```
SETUP Servogun
GENERAL / EQ:1 GUN:1                      3/13
1 Tip Wear Comp                      DISABLE
2 Gun Sag Compensation               DISABLE
3 Close Direction(Gun):                 PLUS
4 Close Direction(Robot):        UT: 1 [+Z]


   [ TYPE ]   EQUIP     GUN     PLUS    MINUS
```

4   Set the Close Direction (GUN) first according to the following procedure.

PROCEDURE
1   Set the Close Direction (GUN) to match the jog key that you want to feed the gun axis closed.
     PLUS for using the +X key to jog gun closed
     MINUS for using the –X key to jog the gun closed
2   If you will be using the Gun Setup Utility to confirm the close direction, skip ahead to step 2.5.

NOTE
   In Gun Setup Utility, user can set motion sign for current gun close direction.
   Please operate according to Gun Setup Utility.

⚠**CAUTION**
   Please confirm max gun pressure before Gun setup utility. Refer to Section 2.4 for
   detailed information.

2.4   SETTING THE MAX PRESSURE

The max pressure of the servo gun should be defined prior to autotuning the gun.

(The screen is same as screen to set up gun close direction)
1   Press [MENU] key to display the Screen menu, and select 6 SETUP.
2   Press F1 TYPE to display the Screen Selection menu, and select Servo Gun.
3   Move cursor on "General Setup: <*DETAIL*>" and press the [ENTER] key to display General Setup
     screen.

```
SETUP Servogun
GENERAL / EQ:1 GUN:1                      5/13
                    ...
5 Max Motor Torque(%):                  100.0
6 Max Pressure(nwt):                   4000.0
  Max Gun Torque:                        45.8
                    ...
   [ TYPE ]   EQUIP     GUN
```

4   Confirm max pressure of the servo gun, and then change the setting value if necessary. (Follow the
     specification form gun manufacturer)

   Pay attention to the working units for Max Pressure. The units of pressure (force)
   are set by the value of the system variable $SGSYSCFG.$PRS_UNITS:
   0 = Kilogram-force (kgf)
   1 = Pound-force (lbf)
   2 = Newton (nwt)

---

5   Confirm the Max Motor Torque and set it if you need.

2. INITIAL SETTING

⚠ **CAUTION**
> Maximum value of the Max Motor Torque is usually 100%.
> If the maximum value of the Max Motor Torque has been specified from us, please make sure that it is less than the specified value to it. Also, do not set a value greater than the maximum value specified in this manual for Max Motor Torque.

2.5 SERVO GUN SETUP AND AUTOTUNING UTILITY

The FANUC servo gun software provides Gun setup utility to tune the servo parameters for the gun without the aid of special tuning equipment, or user intervention.

The Gun Setup utility ensures that the servo gun is set up correctly before you autotune the gun. If you try to autotune a gun that is set up incorrectly it can cause damage to the gun. This utility will take you through some basic setup steps before the actual tuning exercises are initiated. This includes:
- MOTION SIGN SETTING
- MASTERING
- TIP DISPLACEMENT RATIO SETTING
- AXIS LIMIT (Stroke Limit) SETTING

After the above settings are complete, execute automatic adjustment in the utility screen.

⚠ **CAUTION**
> If the BZAL or Pulse Not Establised faults exist, they need to be reset before jogging and mastering of the gun axis can be executed.

⚠ **WARNING**
> This step opens/closes the gun.
> Jogging the gun fully open into the gun's hardstops can cause damage to the gun. Confirm stroke limit and mastering of the gun.

NOTE
> If setting Mastering (Appendix C), Motion sign, tip displacement (gear ratio), gun closing direction, stroke limit (Appendix D) is completed, gun tuning is executed by autotune program. Please refer to Appendix E about more deatil.

NOTE
> About weight comp setup, temperature comp setup, and thickness check calibration, these are allowed to perform on this utility screen. About the above functions, please refer to the function section in this manual.

Gun Setup Utility Execution Procedure

1   Press the [MENU] key.
2   Select UTILITIES.
3   Press F1, [TYPE] and select Gun Setup. The following screen will be displayed.

```
UTILS Gun Setup
EQ:  1 Gun:1                             1/1
1.Set gun motion sign:                 INCOMP
2.Set Gun specs, master gun            INCOMP
       Tip Displacement:      5.000(mm/rev)
       Open stroke limit:      -999.99(mm)
       Close stroke limit:      999.99(mm)
3.Auto Tune:                           INCOMP
4.Pressure Compensation Setup: <*DETAIL*>
5.Thickness Check calibration:         INCOMP


   [ TYPE ]   EQUIP    SKIP    RESTART
```

4   Press F4, RESTART to set steps 1-2 to incomplete if they are not already.

NOTE
The F3 key, SKIP, can be used to set the status of Steps 1-2 to complete (COMP) without actually performing the tasks. This can be done if the user is certain that these items have been set correctly during the controlled start axis setup and that mastering has already been executed. In this case, skip ahead to Step 3 of Gun Setup Utility after these items are set to COMP.

---

5   Move the cursor to item 1 and press the [ENTER] key. The following screen will be displayed.

```
Set Motion Sign
EQ:  1 Gun:1                             1/1
1. HOLD the SHIFT key and SLOWLY Jog
   the Servo Gun movable tip using the
   +X key (+Y if 2nd gun of dual gun)
2. Did the gun OPEN or CLOSE?       *****
   USE F4 or F5 to make selection.
3. Press F3 COMP when finished


   [ TYPE ]            COMP    OPEN    CLOSE
```

NOTE
This screen will allow you to set the gun motion sign. The gun should always close when you press the jog key [+ or -] that matches the Close Direction (Gun) set on the servo gun general setup screen. This step will set the internal motion sign variable to make this happen.

---

6   Follow the steps listed on this screen in order.
7   When you are finished, press F3, COMP. Item 1 status is now complete. The following screen will be displayed.

```
UTILS Gun Setup
EQ:  1 Gun:1                          1/1
1.Set gun motion sign:               COMP
2.Set Gun specs, master gun         INCOMP
      Tip Displacement:      5.000(mm/rev)
      Open stroke limit:      -999.99(mm)
      Close stroke limit:      999.99(mm)
3.Auto Tune:                        INCOMP
4.Pressure Compensation Setup:   <*DETAIL*>
5.Thickness Check calibration:      INCOMP


    [ TYPE ]   EQUIP    SKIP   RESTART
```

8   Move the cursor to item 2 and press the [ENTER] key. You will see two screens consecutively similar to followings.

```
Do you know your gun's Tip
Displacement?


         YES     [NO]
```

```
Do you know your gun's Tip
stroke limits ?


         YES     [NO]
```

⚠**CAUTION**
  Please specify tip displacement and stroke limit according to gun manufactory's specification.
  If gun specification is unknown, set the value according to actual gun.
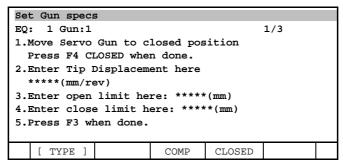
Answer the prompt message to determine the next setting operation.

Tip displacement	Stroke limit	Setting operation
YES	YES	1
NO	YES	2
YES	NO	3
NO	NO	4

If you would like to change setting operation, return by the [PREV] key, press the [ENTER] key again, and then answer the prompt message again.
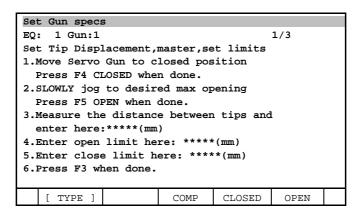
Setting operation -1

```
Set Gun specs
EQ:  1 Gun:1                              1/3
1.Move Servo Gun to closed position
  Press F4 CLOSED when done.
2.Enter Tip Displacement here
  *****(mm/rev)
3.Enter open limit here: *****(mm)
4.Enter close limit here: *****(mm)
5.Press F3 when done.


   [ TYPE ]          COMP   CLOSED
```

a   Jog the gun slowly until the tips are touching each other and press F4, CLOSED. When you press F4, CLOSED, the gun will be mastered.
b   Specify tip displacement into item 2, press the [ENTER] key.
c   Specify open limit into item 3, press the [ENTER] key. And Specify close limit into item 4, press the [ENTER] key.
d   All setting is completed, then press F3 "COMP".
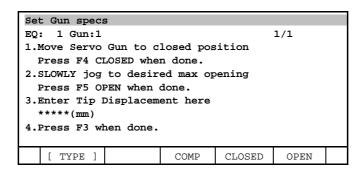
Setting operation -2

```
Set Gun specs
EQ:  1 Gun:1                              1/3
Set Tip Displacement,master,set limits
1.Move Servo Gun to closed position
  Press F4 CLOSED when done.
2.SLOWLY jog to desired max opening
  Press F5 OPEN when done.
3.Measure the distance between tips and
  enter here:*****(mm)
4.Enter open limit here: *****(mm)
5.Enter close limit here: *****(mm)
6.Press F3 when done.

   [ TYPE ]          COMP   CLOSED  OPEN
```

a   Jog the gun slowly until the tips are touching each other and press F4, CLOSED. When you press F4, CLOSED, the gun will be mastered, and one reference position for the tip displacement calculations will be record.
b   Jog the gun SLOWLY until it is at the desired max stroke distance and press F5, OPEN. When you press F5, OPEN, the second reference position for the tip displacement calculation is recorded.
c   Measure the distance in millimeters between the tips. Type that value on line 3, press the [ENTER] key.
d   Specify open limit in item 4 and press the [ENTER] key. Then, specify close limit in item 5 and press the [ENTER] key.
e   All setting is completed, then press F3 "COMP".
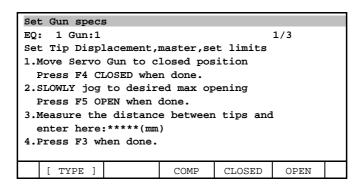
Setting operation -3

```
Set Gun specs
EQ:  1 Gun:1                              1/1
1.Move Servo Gun to closed position
  Press F4 CLOSED when done.
2.SLOWLY jog to desired max opening
  Press F5 OPEN when done.
3.Enter Tip Displacement here
  *****(mm)
4.Press F3 when done.


   [ TYPE ]           COMP   CLOSED   OPEN
```

a   Jog the gun slowly until the tips are touching each other and press F4, CLOSED. When you press
     F4, CLOSED, the gun will be mastered.
b   Jog the gun until it is at the desired max stroke distance and press F5, OPEN.
c   Type the tip displacement in mm/rev on line 3, press the [ENTER] key, then press F3, COMP.

Setting operation -4

```
Set Gun specs
EQ:  1 Gun:1                              1/3
Set Tip Displacement,master,set limits
1.Move Servo Gun to closed position
  Press F4 CLOSED when done.
2.SLOWLY jog to desired max opening
  Press F5 OPEN when done.
3.Measure the distance between tips and
  enter here:*****(mm)
4.Press F3 when done.


   [ TYPE ]           COMP   CLOSED   OPEN
```

a   Jog the gun slowly until the tips are touching each other and press F4, CLOSED. When you press
     F4, CLOSED, the gun will be mastered, and one reference position for the tip displacement
     calculations will be record.
b   Jog the gun until it is at the desired max stroke distance and press F5, OPEN. When you press F5,
     OPEN, the second reference position for the tip displacement calculation is recorded.
c   Measure the distance in millimeters between the tips. Type that value on line 3, press the
     [ENTER] key.
d   Press F3, COMP

9   Completion of setting gun specification, you will see a series of prompt boxes similar to the following.

Prompt Box 1
This prompt box displays the old and new tip displacement so that the user can see how much it should be
changed. If the new tip displacement is acceptable, respond YES. Otherwise respond NO.

```
Tip displacement has changed
FROM:  5.00  TO: 10.00mm/rev
Do you accept the new value?

       [YES]    NO
```

Prompt Box 2

This prompt box displays the old and new max gun torque so that the user can see how much it should be changed. If the new tip displacement is acceptable, respond YES. Otherwise respond NO.
Refer to 14. OVERTORQUE PROTECTION FEATURE about max gun torque.

```
Max gun torque can be
updated, based on new gear
ratio. Torque limit changes
FROM: 55.00  TO: 19.00%
Do you wish to update
max gun torque ?

        YES    [NO]
```

Prompt Box 3

The servo gun setup utility always displays the new and old max tip speed so that the user can see how much it should be changed. Adjusting the max tip speed now, based on the tip displacement ratio (called gear ratio in system variable) allows the user to setup the gun for the correct max speed.
To apply the new velocity, respond YES, otherwise respond NO.

```
Max tip speed can be
updated, based on new gear
ratio. Velocity changes
FROM: 333.3  TO: 666.7mm/sec
Do you wish to update the
max tip speed ?

        YES    [NO]
```

⚠ **CAUTION**
   Power OFF/ON when max velocity of gun axis is changed .Perform auto tuning
   with new velocity.

Prompt Box 4

This box displays what the Open Stroke limit will be set to. Unless this value exceeds the gun specification for max tip opening, respond YES to this prompt. If you have typed the stroke limit directly into setting operation -1 or -2, this prompt message is not displayed.

```
Open Stroke Limit will be
set to magniture 40.00mm
Do you accept this value?

      [YES]    NO
```

Prompt Box 5

This box informs the user that the close stroke limit will be set to 20.0mm if the YES is selected. Yes is the default value.

If the gun manufacturer specified a value that is differs from this, then respond NO. If the close stroke limit has already been set in advance to the correct value, then respond NO to apply the existing stroke limit.

If you have typed the stroke limit directly into setting operation -1 or -2, this prompt message is not displayed.

```
Select YES to set the close
stroke limit magnitude to
20.00mm (default value).

Select NO, if you do not
wish to modify the close
stroke limit

        [YES]    NO
```

If you want to change the existing stroke limit, please refer to Appendix D.

10. After you have completed items 1 and 2, the F3, EXEC button will be displayed, which makes autotuning available.

```
UTILS Gun Setup
EQ:  1 Gun:1                           1/3
1.Set gun motion sign:                COMP
2.Set Gun specs, master gun           COMP
      Tip Displacement:     10.000(mm/rev)
      Open stroke limit:      -150.00(mm)
      Close stroke limit:       20.00(mm)
3.Auto Tune:                        INCOMP
4.Pressure Compensation Setup:  <*DETAIL*>
5.Thickness Check calibration:      INCOMP


  [ TYPE ]   EQUIP    EXEC   RESTART
```

Tuning with the Gun Setup Utility (Step 3 of Gun Setup Utility)

```
UTILS Gun Setup
EQ:  1 Gun:1                                1/3
1.Set gun motion sign:                     COMP
2.Set Gun specs, master gun                COMP
       Tip Displacement:     10.000(mm/rev)
       Open stroke limit:       -150.00(mm)
       Close stroke limit:        20.00(mm)
3.Auto Tune:                             INCOMP
4.Pressure Compensation Setup:  <*DETAIL*>
5.Thickness Check calibration:           INCOMP


  [ TYPE ]   EQUIP     EXEC    RESTART
```

> ⚠**WARNING**
> The Servo gun axis moves at max speed, during autotuning. Autotuning can be performed with the teach pendant enabled or disabled.
> Please make sure that no personnel are in the vicinity of the gun, when you execute autotuning.

> **NOTE**
> The following conditions must be met for the tuning process to start from the Gun Setup Utility:
> - Not in STEP mode
> - No faults exist
> - No holds exist
> - Servo gun is not in machine lock (Enable Group Operation in the test execution screen.)
> - The control reliable key switch is in AUTO or T2.
> - Gun is in STROKE mode. (Please refer to Chapter 10. "Test Execution.")

> **NOTE**
> After Auto tuning is started, the servo gun will perform the following by opening and closing the gun:
> - Acceleration settings
> - Inertia measurements
> - Friction measurements
> - Spring constant measurements
> - Force control gain settings
> - Contact speed settings
> - (If pressure profile control is ordered) Profile internal parameter settings
> - (If spot program touchup is ordered) Spot program touchup internal parameter settings
> - Part thickness check internal parameter settings

> **NOTE**
> Auto tuning program uses No.99 of pressure shcdule and tip distance scheduel.
> Do not use this schedule number in the user program.
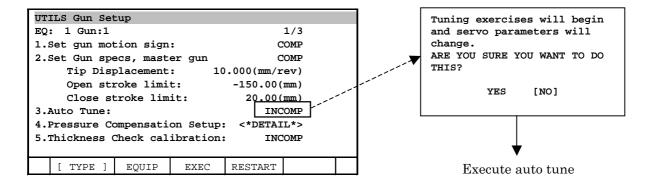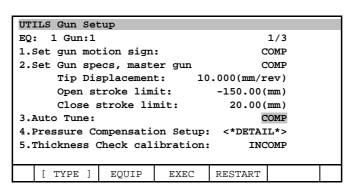
> ⚠ **CAUTION**
> In case of T2 mode, enable TP, and perform autotuning while pressing the [SHIFT] key and the dead-man switch.
> In case of AUTO mode, disable TP, you need NOT press the dead-man switch and the [SHIFT] key during autotuning.

1   Move cursor to autotune, press SHIFT & F3 to start the auto tuning process.
2   Confirmation prompt will be displayed. Respond YES if you want to start autotuning.

```
UTILS Gun Setup
EQ:  1 Gun:1                           1/3
1.Set gun motion sign:                COMP
2.Set Gun specs, master gun           COMP
     Tip Displacement:     10.000(mm/rev)
     Open stroke limit:       -150.00(mm)
     Close stroke limit:        20.00(mm)
3.Auto Tune:                       INCOMP
4.Pressure Compensation Setup:  <*DETAIL*>
5.Thickness Check calibration:      INCOMP

   [ TYPE ]   EQUIP    EXEC   RESTART
```

```
Tuning exercises will begin
and servo parameters will
change.
ARE YOU SURE YOU WANT TO DO
THIS?

        YES     [NO]
```

Execute auto tune

3   If Autotuning completed successfully, the following screen will be displayed.

```
UTILS Gun Setup
EQ:  1 Gun:1                           1/3
1.Set gun motion sign:                COMP
2.Set Gun specs, master gun           COMP
     Tip Displacement:     10.000(mm/rev)
     Open stroke limit:       -150.00(mm)
     Close stroke limit:        20.00(mm)
3.Auto Tune:                         COMP
4.Pressure Compensation Setup:  <*DETAIL*>
5.Thickness Check calibration:      INCOMP

   [ TYPE ]   EQUIP    EXEC   RESTART
```

4   Repower controller so that tuned parameter is applied.
     If autotuning did NOT complete successfully (indicated by status FAILED instead of COMP), then try the following:
     •   Make sure axis limits are set properly.
     •   Check motor selection.
     •   Make sure mastering of the gun axis is correct.
     •   Make sure max pressure of the gun axis is correct.
     •   Re-perform autotuning until it completes successfully.

> **NOTE**
> Please refer to the Servo Gun Weight Compensation section for details of weight compensation. Please refer to the Servo Gun Temperature Compensation section for details of temperature compensation. Please refer to the Part Thickness Check section for details of thickness check calibration.

If autotuning fails:

If autotuning fails, carry out the following procedure according to failure status.

"SRVO-024 Move error excess" or "SRVO-046 OVC alarm" occurs:
Try the following in order of i) ~ iv).
i) Make sure the configuration
   - Check motor selection.
   - Make sure mastering of the gun axis is correct.
   - Make sure the tip displacement is set properly.
   - Make sure the stroke limit and gun close direction are set properly.
   - Make sure the max pressure and max motor torque are set properly.

ii) Make sure the brake off
   If the motor has brake, make sure the brake is released. If the brake is not released, make sure the connection of brake and brake number is correct.

iii) Make sure the auxiliary axis amplifier
   Make sure the amplifier used to drive the servo gun axis is adequate.

Try the following after trying the above i) ~ iii).
iv) Lower limit of accel time setting
Specify the lower limit of accel time by the following procedure

   a. Set $SGSYSCFG.$SHO_ATUN_CF=TRUE from system variables screen. There is no need to power off/on.
   b. Redisplay servo gun setup utility screen, move cursor on autotune, and press the [ENTER] key. The following screen will be displayed.

```
Autotune Setup
EQ:  1 GUN:1                              6/6
1.Reload servo and motion prms:    DISABLE
2.Starting load ratio:                 3.0
3.Pushing depth:                      10.0
4.Init filter:                           0
5.Accel update mode:        AUTO_ESTIMATE2
6.Accel time1 minimum:                  48


      [TYPE]    DEFLT    DONE
```

   c. Move cursor on "Accel time1 minimum" and specify the lower limit of accel time. At first, specify 100 for accel time1.
   d. Press F3 "DONE" after changing the parameter, then return to previous screen.
   e. Perform autotuning again.
   f. If autotuning continues to fail, return to procedure c, then add 50 further to accel time. Then try again autotuning until completing autotuning.
   g. If autotuning cannot be completed with accel time = 350, consult with us.

> ⚠ **CAUTION**
> Do not change the parameters that are not described here. If the parameters are changed by mistake, autotuning cannot adjust parameters correctly. It causes slower cycle time or breaking of the gun.

If alarms except the above occur:
Try the following in order of i) ~ iii).
i) Make sure the configuration
- Check motor selection.
- Make sure mastering of the gun axis is correct.
- Make sure the tip displacement is set properly.
- Make sure the stroke limit and gun close direction are set properly.
- Make sure the max pressure and max motor torque are set properly.

ii) Make sure the brake off
If the motor has brake, make sure the brake is released. If the brake is not released, make sure the connection of brake and brake number is correct.

iii) Make sure the auxiliary axis amplifier
Make sure the amplifier used to drive the servo gun axis is adequate.

2.6   PRESSURE CALIBRATION

This section describes the process for setting up pressure calibration (data). This data is used to obtain the torque and speed settings that are used during execution of the SPOT or PRESS_MOTN instruction.

⚠️**CAUTION**
- Calibration should be carried out with a certified and calibrated force/pressure gage.
- When gun mechanism becomes aging, it pressure accuracy would be changed. In the case, for the desired weld quality, calibration should be performed again.

⚠️**CAUTION**
- When the temperature is low, please do warm-up beforehand to ensure the pressure accuracy of pressure calibration. When the temperature is high, servo gun temperature compensation function can improve the pressure accuracy.

PROCEDURE
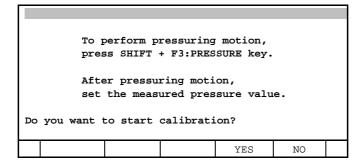
1   Go to the Servo Gun General Setup screen.
2   Select Pressure Cal.
(Move the cursor to <*DETAIL*>, then press the [ENTER] key.)
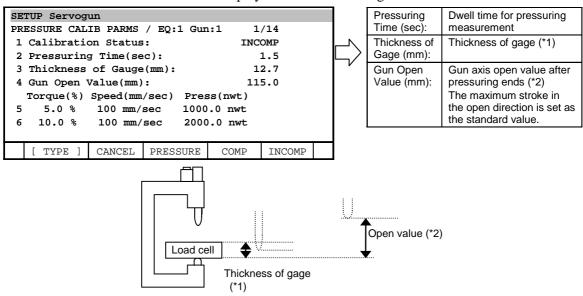
```
SETUP Servogun
GENERAL / EQ: 1 Gun:1                    11/13
                    ...
 9 Pressure Cal:        COMP   <*DETAIL*>
10 Tip Wear Standard:   INCOMP <*DETAIL*>


   [ TYPE ]   EQUIP    GUN
```

3   The Start Message screen is displayed. Select F4 YES.

```
          To perform pressuring motion,
          press SHIFT + F3:PRESSURE key.

          After pressuring motion,
          set the measured pressure value.

     Do you want to start calibration?

                                      YES       NO
```
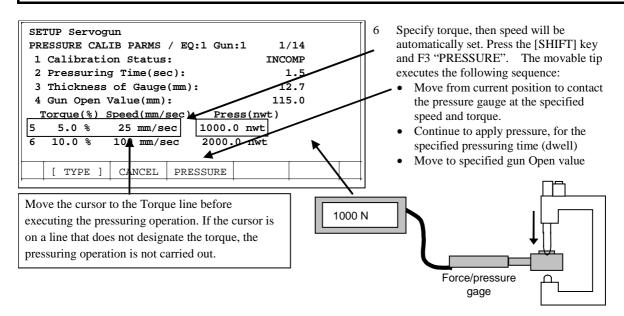
4   The Pressure Calibration screen is displayed. Set the following items.

```
SETUP Servogun
PRESSURE CALIB PARMS / EQ:1 Gun:1        1/14
 1 Calibration Status:            INCOMP
 2 Pressuring Time(sec):              1.5
 3 Thickness of Gauge(mm):            12.7
 4 Gun Open Value(mm):              115.0
   Torque(%)  Speed(mm/sec)  Press(nwt)
 5    5.0 %    100 mm/sec    1000.0 nwt
 6   10.0 %    100 mm/sec    2000.0 nwt

  [ TYPE ]  CANCEL  PRESSURE   COMP   INCOMP
```

Pressuring Time (sec):	Dwell time for pressuring measurement
Thickness of Gage (mm):	Thickness of gage (*1)
Gun Open Value (mm):	Gun axis open value after pressuring ends (*2) The maximum stroke in the open direction is set as the standard value.

Load cell

Thickness of gage (*1)

Open value (*2)

5   Bring the fixed side tip into contact with the base of the force gauge.

> ⚠ **CAUTION**
> At first, execute pressure motion with low override to confirm tip contacts with gauge correctly. To calibrate pressure, execute pressure motion with 100% override.

```
SETUP Servogun
PRESSURE CALIB PARMS / EQ:1 Gun:1        1/14
 1 Calibration Status:            INCOMP
 2 Pressuring Time(sec):              1.5
 3 Thickness of Gauge(mm):            12.7
 4 Gun Open Value(mm):              115.0
   Torque(%)  Speed(mm/sec)  Press(nwt)
 5    5.0 %     25 mm/sec    1000.0 nwt
 6   10.0 %    100 mm/sec    2000.0 nwt

  [ TYPE ]  CANCEL  PRESSURE
```

6   Specify torque, then speed will be automatically set. Press the [SHIFT] key and F3 "PRESSURE".   The movable tip executes the following sequence:
- Move from current position to contact the pressure gauge at the specified speed and torque.
- Continue to apply pressure, for the specified pressuring time (dwell)
- Move to specified gun Open value

Move the cursor to the Torque line before executing the pressuring operation. If the cursor is on a line that does not designate the torque, the pressuring operation is not carried out.

1000 N

Force/pressure gage

7   Speed will be automatically set the recommended value, but you can change it if you need.

```
⚠ CAUTION
    Confirm pressure waveform if you change contact speed.
```

```
⚠ CAUTION
 •  Character of pressure response is affected by character of gun mechanism
    ( Strength of gun arm, Inertia of gun axis ).
 •  If contact speed is too fast, gun tip would make a dent in panel surface. After
    calibration, pressure panel, confirm the surface. Adjust it again if necessary.
 •  If contact speed is too fast, panel or body is vibrated with impact when gun tip
    contacts. Adjust it again if necessary.
```

8   Specify the torque(%) and repeat steps 6, 7, for the desired number of calibration points. Up to 15
     (minimum two) torque and gun close speed values can be set.
     If the your process requires a force of 100-500Kgf , then include measurements at or near 100 kgf and
     500kgf (min and max force).

```
⚠ CAUTION
    In pressure calibration, larger torque than max gun torque is allowed to specify. At
    first, check pressure of max gun torque,  then pressure with over max gun torque if
    the pressure of max gun torque is not larger than max pressure of gun.
```
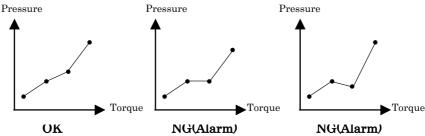
```
NOTE
    New calibration point is allowed to add to the last line.
    The calibration points do not have to be entered in ascending (force) order.
    Calibration points are sorted automatically when pressure calibration is complete.
```
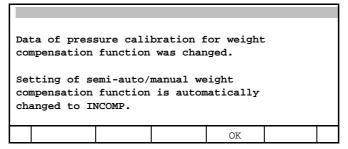
9   After measuring the pressure several times, move the cursor to Calibration Status, and press F4 COMP
     to accept the new calibration data.
10   Calibration points are checked, and if criteria are not met, an alarm is posted, and cal status is set to
     incomplete.
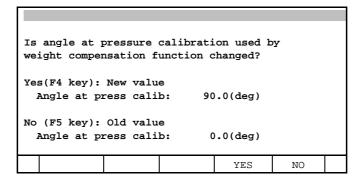
11   After the pressure calibration is completed, the screens(above-mentioned 1 and 2) concerning the
     servo gun weight compensation function are displayed.
     •   Select "OK" in screen 1.

- Select "NO" in screen 2 when you do not use the servo gun weight compensation function.
  Screen1 :

```
Data of pressure calibration for weight
compensation function was changed.

Setting of semi-auto/manual weight
compensation function is automatically
changed to INCOMP.

                                    OK
```

Screen2 :

```
Is angle at pressure calibration used by
weight compensation function changed?

Yes(F4 key): New value
  Angle at press calib:      90.0(deg)

No (F5 key): Old value
  Angle at press calib:       0.0(deg)

                              YES    NO
```
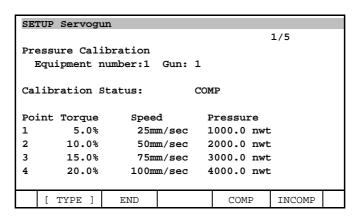
NOTE
   Select "YES" in screen 2 when you use servo gun weight compensation function.
   Please refer to Chapter 18 about servo gun weight compensation function.

12   If calibration points are ok, then calibration complete screen will be displayed. Press either F2 END or
      the [PREV] key to exit pressure calibration screen.

```
SETUP Servogun
                                          1/5
Pressure Calibration
  Equipment number:1  Gun: 1

Calibration Status:        COMP

Point Torque      Speed         Pressure
1       5.0%       25mm/sec   1000.0 nwt
2      10.0%       50mm/sec   2000.0 nwt
3      15.0%       75mm/sec   3000.0 nwt
4      20.0%      100mm/sec   4000.0 nwt

    [ TYPE ]   END            COMP   INCOMP
```

NOTE
   After calibration, confirm pressure accuracy or weld quality with 100% override.

3 SERVO GUN MAIN SETUP SCREEN

This section explains the setup items on the servo gun setup screen.
These items should be set correctly prior to welding operation with the servo gun.
Many of the items in this setup screen are explained in other sections of this document.

> ⚠**CAUTION**
> Do not load system file for SPOT and servo gun : SYSSPOT.SV of another robot controller on 7DC1. Do not load system file for servo gun : SYSSVGN.SV of other robot controller on 7DC2 or later.

> ⚠**CAUTION**
> Do not load R-30*i*A system files for servo gun (SYSSPOT.SV, SYSPRESS.SV, SYSDIST.SV, SYSSTROK.SV) into R-30*i*B.

3.1 SERVO GUN SETUP SCREEN

Specify details of settings related to servo gun-based spot welding by referring to the descriptions of the corresponding items (listed on the subsequent pages):
1   Press the [MENU] key to bring up the screen menu.
2   Select "6 SETUP".
3   Press F1"[TYPE]" to display the pull-up menu.
4   Select "Servo Gun" to display the SERVO GUN SETUP screen.

```
SETUP Servogun
SERVO GUN SETUP                        1/3
1 Equip number:                          1
2 General Setup:             <*DETAIL*>
3 Manual Operation Setup:    <*DETAIL*>


    [ TYPE ]   EQUIP
```

Descriptions of items for spot weld sequence setup

Equip number	Equipment number shows the number of the selected weld controller is displayed.
General setup	The features of the servo gun are set in General setup screen. Put the cursor on the <*DETAIL*>, then press the [ENTER] key to display the General setup screen.
Manual Operation setup	The setups related to the manual operation are set in the Manual Operation setup screen. Put the cursor on the <*DETAIL*>, then press the [ENTER] key to display the Manual Operation setup screen. Refer to the Manual Operation section for more detail

3.2 SERVO GUN GENERAL SETUP SCREEN

Specify the setting details related to the servo gun by referring to the descriptions of the corresponding items (listed on the subsequent pages):
1   Press the [MENU] key to bring up the screen menu.
2   Select "6 SETUP".
3   Press F1"[TYPE]" to display the pull-up menu.
4   Select "Servo Gun" to display the SERVO GUN SETUP screen.

5   Select "8 General Setup" by placing the cursor on <*DETAIL*> and pressing the [ENTER] key. The
     General Setup screen will be displayed.

```
SETUP Servogun
GENERAL / EQ:1 GUN:1                      1/13
 1 Tip Wear Comp:                      DISABLE
 2 Gun Sag Compensation:              DISABLE
 3 Close Direction(Gun):                 PLUS
 4 Close Direction(Robot):      UT: 1 [+Z]
 5 Max Motor Torque(%):               100.0
 6 Max Pressure(nwt):               4900.0
   Max Gun Torque(%):                  10.5
 7 Tip stick detect distance(mm):        5
 8 Tip Wear Detection:          <*DETAIL*>
 9 Pressure Cal:        COMP   <*DETAIL*>
10 Tip Wear Standrd:    INCOMP <*DETAIL*>
11 Thickness check:             <*DETAIL*>
12 Gun Stroke limit:            <*DETAIL*>
13 OverTorque protection        <*DETAIL*>


  [ TYPE ]   EQUIP    GUN    ENABLE  DISABLE
```

NOTE
   Setting items depend on software version and/or software option configuration.

Descriptions of items for servo gun setup

Tip Wear Comp Default value: DISABLE	Tip Wear Down Comp specifies whether to perform tip wear compensation. DISABLE = current tip wear measurement values are NOT applied as compensation to spot locations ENABLE = current tip wear measurement values are applied as compensation to spot locations. To use the tip wear compensation function, it is necessary to acquire a reference position and calculate a compensation value using TP programs. See Tip wear Compensation section for details.
Gun Sag Compensation Default value: DISABLE	Gun Sag Compensation specifies whether to perform the spot gun deflection compensation based on the Gun Sag amount for the pressure schedule selected DISABLE = gun deflection compensation is not performed. ENABLE = the gun deflection compensation is performed. Refer to Gun Sag Compensation section for details.
Close Direction (Gun) Default value: PLUS	Close Direction specifies the direction in which the movable tip is to be closed. Refer to Initial Settings section for details.
Close Direction (Robot) Default value: UT:1 +Z	Close Direction specifies the tool coordinate system frame number and which axis of the tool coordinate system indicates the direction in which the stationary tip closes. Refer to Initial Settings section for details.
Max Motor Torque (%) Default value: 100.0	Max Motor Torque specifies a limit to the maximum torque of the servo gun motor in usual operation. The torque specified here is applied to the servo gun axis when pressurization is not taking place. Usually, the limit should not be adjusted by the user. The valid data range is between 1.0 and 100.
Max Pressure (kgf) Default value: 500.0 kgf	Max Pressure specifies a limit to the pressure to be applied during pressurization. Any pressure higher than specified here will not be generated. A similar limit is also placed during pressure input. **This value should be specified by the gun manufacturer**. Refer to the Initial Settings section for details on how to set this item and change the units. The valid data range is from 1.0 to 9999.9.
Tip stick detect distance [mm] Default: 5	Sets the tip opening after the weld complete signal to check the tip stick detection signal, if used. Set the tip stick detection signal in the weld I/O screen. Refer to tip stick detection section for more details.

Tip Wear Detection	Items in this screen are used to specify how tip wear measurements are executed and how to process tip wear related alarms. Refer to Tip Wear Compensation section for details. Put the cursor on the <*DETAIL*>, then press the [ENTER] key to bring up this screen.
Pressure Cal	Open the pressure calibration screen. Pressure Cal specifies the motor torque to be generated, then measuring the pressure applied by the specified torque can yield a relational expression between the motor torque and pressure. When pressure adjustment is completed, the display changes from INCOMP to COMP. If the display remains at INCOMP, it is impossible to perform a spot welding sequence, manual welding, manual pressurization, and pressurization operation. Refer to Initial Settings section for more detail. Put the cursor on the <*DETAIL*>, then press the [ENTER] key to bring up this screen.
Tip Wear Standard	This screen displays information about the status of tip wear compensation including data recorded during tip wear setup/initialization. When the reference positions are set, the display changes from INCOMP to COMP. See Tip wear Compensation section for details. Put the cursor on the <*DETAIL*>, then press the [ENTER] key to bring up this screen.
Weight compensation	This screen displays the weight compensation setting. Refer to Appendix D and the weight compensation section for more details.
Thickness Check	This screen displays information about the setup of the Part Thickness Check. Refer to Part Thickness Check Function section for more details.
Gun Stroke Limit	This screen displays the stroke limits for the gun axis. These limits comprise the "reference zero position" when tip wear compensation is initialized. During tip wear compensation, the actual axis limit is determined based on these limits. Refer to Appendix D and the tip wear compensation section for more details.
Overtorque Protection	This screen displays the Overtorque Protection status and settings. We recommend that this function remain enabled to protect the gun axis from damage by the user jogging the tips to a high pressure. Refer to Overtorque Protection section for more details.

4   MANUAL OPERATIONS

The following functions are available for manual operations, at the teach pendant.

1   Manual Pressurization (Shift + GUN)
Close gun to a specific pressure by pressing Shift + GUN keys on the teach pendant

2   Manual Backup (Shift + BU)
Move to a specific gun open distance by pressing Shift + BU keys on the teach pendant.

3   Manual Welding
Execute weld with condition specified on the manual welding screen.

4   Jog operation
Move gun to any open distance by jogging in the same manner as a robot axis.

5   Thickness measurement
Measure thickness of panel between gun tips automatically and reflect this measurement in the settings.

4.1   MANUAL PRESSURIZATION (Shift + GUN)

Close the gun to a pre-defined pressure via the GUN key on the teach pendant

Specify the following items prior to operation
1   Pressuring time, start distance, and end distance type. See Detail [1].
2   Pressure value (and other Pressure Schedule parameters).   See Detail [2]
3   Thickness value.   See Detail [3]
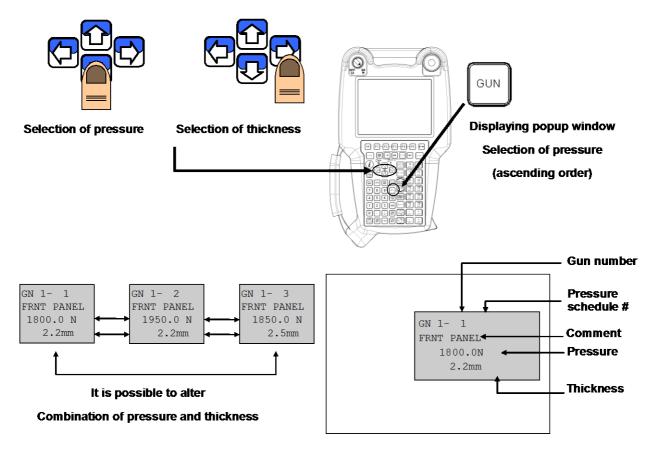
```
SETUP Servo gun
   MANUAL / EQ:1 Gun:1                      1/6
      Manual Pressure
   1    Pressuring Time(sec):         0.0
   2    Start distance type:INITIAL DIST
   3    End distance type:   INITIAL DIST
   4    Thickness table(presets): <*DETAIL*>
      Manual Backup
   5    Backup Speed(%):              100
   6    Backup stroke:        <*DETAIL*>


   [TYPE]    EQUIP    GUN
```

```
SERVO GUN DATA
   PRESSURE / EQ:1 Gun:1                    1/99
      No.    Press(Nwt)     Manual    Comment
       1       100.0        TRUE    [          ]
       2       200.0        TRUE    [          ]
       3       300.0        TRUE    [          ]
       4         0.0        FALSE   [          ]
       5         0.0        FALSE   [          ]
       6         0.0        FALSE   [          ]
       7         0.0        FALSE   [          ]
       8         0.0        FALSE   [          ]
       9         0.0        FALSE   [          ]
      10         0.0        FALSE   [          ]


   [TYPE]    EQUIP    GUN    DETAIL    COPY
```
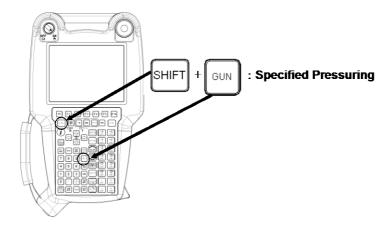
```
SERVO GUN DATA
  THICKNESS / EQ:1 Gun:1              1/10
   No.    Thickness(mm)        Comment
    1              1.0        [thk1     ]
    2              2.0        [thk2     ]
    3              3.0        [thk3     ]
    4              4.0        [thk4     ]
    5              5.0        [thk5     ]
    6          ******        [         ]
    7          ******        [         ]
    8          ******        [         ]
    9          ******        [         ]
   10          ******        [         ]


    [TYPE]    EQUIP    GUN    RECORD   MEAS THK
```

Procedure

- Press the GUN key.
- A popup window showing the current pressure schedule and thickness is displayed.
- Press one of the following keys to change **pressure value (schedule),** while popup window displays.
    - **GUN** to select **next** manual pressure in table.
    - **Down arrow** to select **next** manual pressure in table.
    - **Up arrow** to select **previous** manual pressure in table.
- Press one of the following keys to change **thickness value,** while popup window displays.
    - **Right arrow** to select **next** thickness value in table.
    - **Left arrow** to select **previous** thickness value in table.
- Popup window is cleared.
    - If a key other than GUN, or Up/Down/left/right arrow is pressed.
    - If no key has pressed for a certain period of time.

Selection of pressure   Selection of thickness

Displaying popup window
Selection of pressure
(ascending order)


```
GN 1- 1          GN 1- 2          GN 1- 3
FRNT PANEL       FRNT PANEL       FRNT PANEL
  1800.0 N         1950.0 N         1850.0 N
    2.2mm            2.2mm            2.5mm
```

It is possible to alter

Combination of pressure and thickness

Gun number

Pressure schedule #

```
GN 1- 1
FRNT PANEL
   1800.0N
     2.2mm
```

Comment

Pressure

Thickness

- Press GUN key while also pressing SHIFT to execute manual pressurization by combining the selected pressure schedule with the thickness conditions. Only the movable tip will operate.

- GUN key can be released, after pressurization starts - pressurization persists until pressure time expires.
- Release the [SHIFT] key, to stop pressuring.
- After the specified pressuring time expires, the gun will open to the specified End distance.
- If the SHIFT key is kept pressed, the gun will open after the pressurization time expires.
- The stationary tip (on the robot) does not move during pressurization - gun sag compensation and fixed tip wear compensation are NOT performed.

⚠**CAUTION**
User macros assigned to UK1, SU1, UK3, and SU3 have precedence over manual pressurization function. If a user macro is assigned to one of these keys, user MACRO will execute, instead of manual pressurization, when key is pressed.
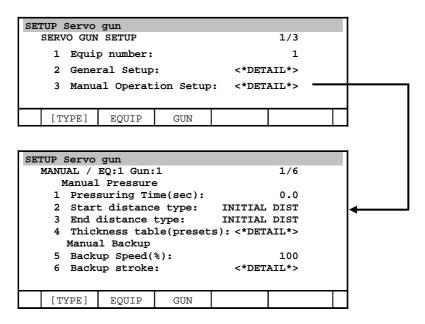
NOTE
In dual gun case, UK3, and SU3 operate Gun "B".
UK3, and SU3 are not used if equipment type = Single.

Detail [1]
Specify Pressuring details

1   MENU key → "6 SETUP" → F1"[TYPE]"→ "Servo Gun"
2   Select "Manual Operation Setup" (place cursor on <*DETAIL*>, then pressing the [ENTER] key).

```
SETUP Servo gun
  SERVO GUN SETUP                        1/3

    1  Equip number:                       1
    2  General Setup:          <*DETAIL*>
    3  Manual Operation Setup: <*DETAIL*>


    [TYPE]   EQUIP    GUN
```

```
SETUP Servo gun
  MANUAL / EQ:1 Gun:1                     1/6
    Manual Pressure
    1  Pressuring Time(sec):             0.0
    2  Start distance type:    INITIAL DIST
    3  End distance type:      INITIAL DIST
    4  Thickness table(presets): <*DETAIL*>
     Manual Backup
    5  Backup Speed(%):                  100
    6  Backup stroke:          <*DETAIL*>


    [TYPE]   EQUIP    GUN
```

3   Specify the following items:

Pressuring Time	Duration of pressurization (dwell time) (default value : 0 s)
Start Distance Type	Gun position before pressuring starts • INITIAL DIST: loc=current position. Gun closes to pressure, directly from current position • BACKUP STROKE: loc=backup distance. Gun moves to selected manual backup (*1), then closes to pressure
End Distance Type	Gun position after pressuring ends • INITIAL DIST: loc=original position: Gun opens to the position at gun key press • BACKUP STROKE: loc=backup distance. Gun opens to the selected Manual Backup(*1) • PART THICKNESS: loc=panel surface. Gun opens to the programmed part thickness. This is equivalent to the old gun–open–disabling function.
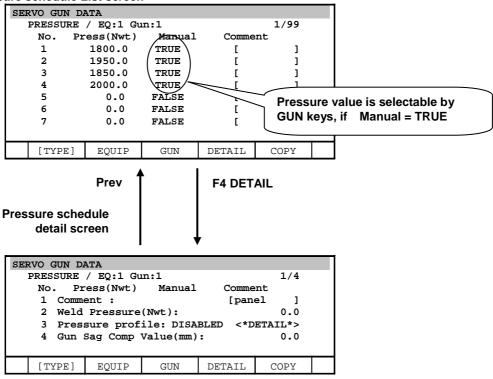
*1: Selected manual backup: Backup distance specified by manual backup condition which is selected by BU keys.

Detail [2]

Specify Pressure value (and pressure schedule) details

1   Display the Pressure Schedule screen.
    [DATA] key → F1"[TYPE]" → "Pressure"
    A Pressure Schedule list or detail screen is displayed.
2   On the Pressure Schedule list screen., enable the "MANUAL" option for the schedule to be used for manual pressurization

Pressure schedule List screen

```
SERVO GUN DATA
  PRESSURE / EQ:1 Gun:1                    1/99
   No.   Press(Nwt)    Manual     Comment
    1      1800.0      TRUE       [        ]
    2      1950.0      TRUE       [        ]
    3      1850.0      TRUE       [        ]
    4      2000.0      TRUE       [        ]
    5         0.0      FALSE      [
    6         0.0      FALSE      [
    7         0.0      FALSE      [

   [TYPE]    EQUIP    GUN     DETAIL    COPY
```

Pressure value is selectable by GUN keys, if Manual = TRUE

Prev   **F4 DETAIL**

**Pressure schedule
detail screen**

```
SERVO GUN DATA
  PRESSURE / EQ:1 Gun:1                    1/4
   No.   Press(Nwt)    Manual     Comment
    1  Comment :               [panel    ]
    2  Weld Pressure(Nwt):              0.0
    3  Pressure profile: DISABLED  <*DETAIL*>
    4  Gun Sag Comp Value(mm):          0.0

   [TYPE]    EQUIP    GUN     DETAIL    COPY
```

> **NOTE**
>   Depending on your software or setup, displayed screen structure may differ.

Detail [3]

Specify Thickness details

1   Display the Thickness table screen by one of the following procedures.
    Procedure A: [DATA] key → F1"[TYPE]" → "Thickness"
    Procedure B: [MENU] key → F1"[TYPE]" → "Servo gun" → "Manual Operation Setup" →
                 "THICKNESS" (preset).
                 A list of available thicknesses for manual pressurization is displayed.
2   Set the desired thickness for manual pressurization.

List screen

```
SERVO GUN DATA
 THICKNESS / EQ:1 Gun:1                    1/10
  No.    Thickness(mm)         Comment
   1             1.0        [thk1      ]
   2             2.0        [thk2      ]
   3             3.0        [thk3      ]
   4             4.0        [thk4      ]
   5             5.0        [thk5      ]
   6          ******        [          ]
   7          ******        [          ]
   8          ******        [          ]
   9          ******        [          ]
  10          ******        [          ]


   [TYPE]    EQUIP    GUN    RECORD   MEAS THK
```

- Set one or more values into the thickness table. You can choose No. from number which is set thickness.
- You can initialize (****) set value by pressing F6"CLEAR".
- You can set thickness value up as current gun open distance by pressing F4"RECORD".
- You can measure thickness by pressing Shift + F5"MEAS THK". Pressing shift + F5"MEAS THK", movable tip automatically closes and measures thickness. Please refer to 4.5 'Thickness measurement' for detail.

⚠**CAUTION**
  Use measure thickness function in the condition where robot tip is on the work.

4.2   MANUAL BACKUP (Shift + BU)

The open position of the Servo gun can be changed to pre-set values by operating the BU key on the teach pendant.

1   Set a manual backup using one of the following procedures.
     Procedure A: [DATA] key → F1"[TYPE]" → "6 Manual Bkup"
     Procedure B: [MENU] key → "6 SETUP" → F1 "[TYPE]" → "Servo gun" → "Manual Operation
               Setup" → 6 Backup stroke."
2.   Place cursor on stroke number and specify the gun open distance.
3.   Place cursor on "Manual" and select "TRUE" to make a backup position selectable.
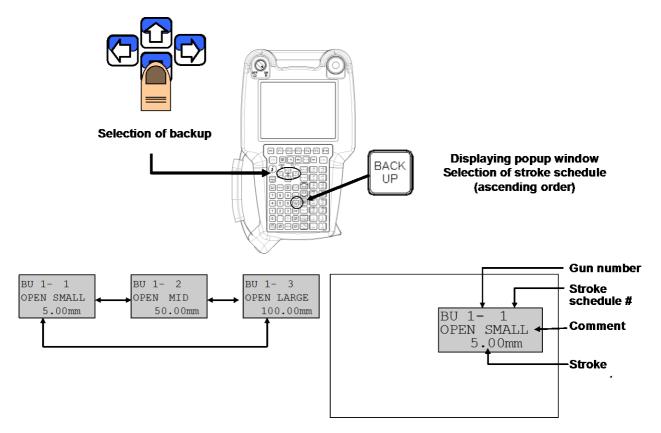
```
SERVO GUN DATA
 BACKUP / EQ:1 Gun:1                       1/30
  No.    comment        Stroke(mm)      Manual
   1  [OPEN SMALL]         5.000         TRUE
   2  [OPEN  MID ]        50.000         TRUE
   3  [OPEN LARGE]       100.000         TRUE
   4  [          ]        10.000         FALSE
   5  [          ]        10.000         FALSE
   6  [          ]        10.000         FALSE
   7  [          ]        10.000         FALSE
   8  [          ]        10.000         FALSE


   [TYPE]    EQUIP    GUN
```
Change the stroke speed if required. Default = 100%.
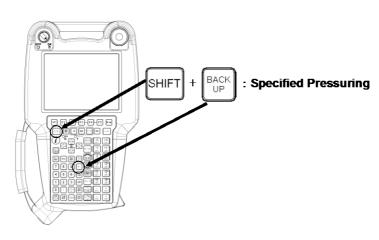
Procedure

- Press the **BU1** key.
- A popup window showing the current backup value will be displayed.
- After popup window displays, press one of the following keys to change **backup value (open distance)**
    - **BU1** to select **next** backup in table
    - **Down arrow** to select **next** backup in table
    - **Up arrow** to select **previous** backup in table
- Popup window is cleared
    - If a key other than **BU1**, Up/Down arrow is pressed
    - If no key has been pressed for a certain period of time.

Selection of backup

**Displaying popup window
Selection of stroke schedule
(ascending order)**

BACK
UP

```
BU 1- 1          BU 1- 2          BU 1- 3
OPEN SMALL       OPEN  MID        OPEN LARGE
     5.00mm           50.00mm         100.00mm
```

Gun number

**Stroke
schedule #**

```
BU 1- 1
OPEN SMALL
     5.00mm
```

Comment

Stroke

- Press the **BU1** key while also pressing SHIFT to move to the backup position. The gun will move the specified open distance.

SHIFT + BACK UP : **Specified Pressuring**

- Once motion starts, the **BU1** key can be released – gun will continue to move until specified open distance is reached
- Release the [SHIFT] key, to stop motion
- The stationary tip (on the robot) does not move during backup operation
- Tip wear compensation is NOT performed

⚠️**CAUTION**
User macros assigned to UK2, SU2, UK4, and SU4 have precedence over manual backup function. If a user macro is assigned to one of these keys, user MACRO will execute, instead of manual backup, when key is pressed.

NOTE
In dual gun case, press UK4, and SU4 operate Gun "B".
UK4, and SU4 not used if equipment type = Single.

4.3   MANUAL WELDING
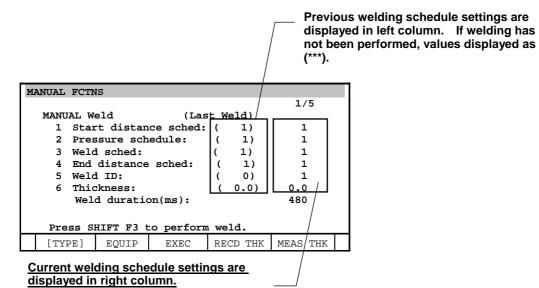
Welding can be performed manually by using the Manual welding screen.

⚠️**CAUTION**
Weld schedule is asserted during welding. Refer to Spot Welding OPERATOR'S MANUAL (B-83284EN-4) for weld schedule setup. Alternatively, use weld IO simulation if weld controller is not configured. Please refer to 10.TEST EXEXUTION for weld IO simulation.

Procedure
1   Press the [MENU] key to bring up the screen menu.
2   Select "MANUAL FCTNS".
3   Press F1"[TYPE]" to display the pull-up menu.
4   Select "Manual weld". The MANUAL FCTNS Spot screen will be displayed.

Previous welding schedule settings are displayed in left column.   If welding has not been performed, values displayed as (***).

```
MANUAL FCTNS
                                        1/5
  MANUAL Weld            (Last Weld)
    1 Start distance sched: (    1)       1
    2 Pressure schedule:    (    1)       1
    3 Weld sched:           (    1)       1
    4 End distance sched:   (    1)       1
    5 Weld ID:              (    0)       1
    6 Thickness:            ( 0.0)      0.0
       Weld duration(ms):              480


   Press SHIFT F3 to perform weld.
 [TYPE]   EQUIP    EXEC   RECD THK  MEAS THK
```

Current welding schedule settings are displayed in right column.

- Specify the parameters to use during welding
- Execute manual welding.

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- Press F3"EXEC" while pressing the [SHIFT] key, to causes pressurize, and weld
- Once welding has started, you need not keep pressing F3"EXEC".
- If you want to discontinue the movement, release the [SHIFT] key.
- The stationary tip (on the robot) does not move during this operation.
- You can set thickness value up as current gun open distance by pressing F4"RECORD".
- You can measure thickness by pressing Shift + F5"MEAS THK". Pressing shift + F5"MEAS THK", movable tip automatically closes and measures thickness. Please refer to 4.5 'Thickness measurement' for detail.
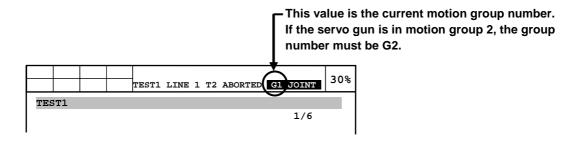
⚠**CAUTION**
    Perform thickness measure with fixed tip that touch up the panel lower face.

4.4   GUN JOG OPERATION

Servo gun movable tip can be move to any position via jogging. Usually, "manual stroke" is used to change the stroke of the servo gun. Jogging is used to adjust the movable axis to master the zero-position and perform a gun close direction check. This section describes the general operating procedures.

Procedure A – jogging when gun group is selected

1. Confirm the motion group number. Check that the motion group of the servo gun you want to operate is selected.

**This value is the current motion group number.
If the servo gun is in motion group 2, the group number must be G2.**

```
┌──┬──┬──┬──┬──────────────────────────┬──────┐
│  │  │  │  │ TEST1 LINE 1 T2 ABORTED G1 JOINT │ 30% │
├──┴──┴──┴──┴──────────────────────────┴──────┤
│ TEST1                                        │
│                                         1/6  │
│                                              │
└──────────────────────────────────────────────┘
```

 Change the group number if needed.

Change group by toggle style
i.   Press the FCTN key while in the sub-menu, and select "CHANGE GROUP".
     The value G# changes each time CHANGE GROUP is selected such as G1, G2, G3, …, G1.
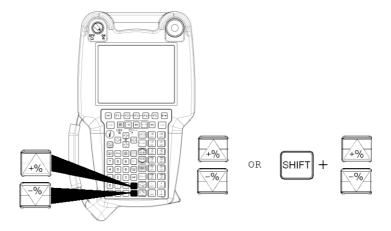
ii. Press group key
     The value G# changes each time group key is selected such as G1, G1S, G2, G2S, G3, …, G1. In this regard, if selected group has sub group, current selected group changes to sub group when group key is pressed.
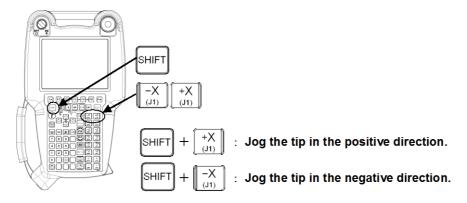
Change group directly
iii. Type in group number in "GROUP" on the jog menu.
     The value G# changes to typed value.

iv. Press number key with pressing group key.
     The value G# changes to pressed number.

2.   Decrease the override value for safety.
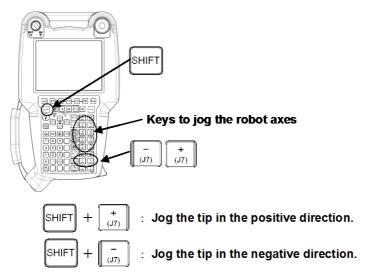
3.   Use the keys shown below to jog the movable tip.
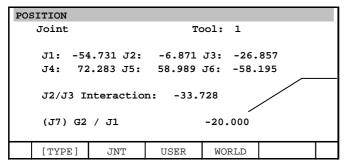
Procedure B – jogging when robot group is selected

Teach pendant has keys to jog 8 axes. When using a 6-axis robot and servo gun, the J7 key is automatically assigned to servo gun axis, for convenience. I.E. jogging of robot and gun can be performed while robot group is selected, so robot and gun can be jogged, without changing group.

1   Confirm that motion group number corresponds to robot. Change group if needed. The procedure to confirm and change is same with procedure A.
2   Decrease the override value for safety. This procedure is same with procedure A.
3   Use the keys shown below to jog the movable tip.

The POSITION screen shows the positions of both the robot and servo gun.

```
POSITION
   Joint                      Tool:  1


   J1:  -54.731 J2:   -6.871 J3:  -26.857
   J4:   72.283 J5:   58.989 J6:  -58.195


   J2/J3 Interaction:   -33.728


   (J7) G2 / J1               -20.000


     [TYPE]     JNT      USER     WORLD
```

Servo gun axis is assigned.

Assignment of servo gun axis to J7/J8 key

In the case where servo gun option is ordered, J7/J8 jog key is preferentially assigned as servo gun axis.
In the case where servo gun axis is only one, J7 key is assigned as servo gun axis. In the case where servo gun axes which can move at same time are two such as dual gun, J7 and J8 key are assigned as servo gun axes automatically.
To disable automatic assignment and change assignment, perform the following procedure.

1   **Set $SGSYSCFG.$MAPKY78_2SG = FALSE.**
2   When the cursor is moved to the item "J7, J8 jog key Setup" in the system configuration menu. and the [ENTER] key is pressed in the system configuration menu, the following screen will be displayed.
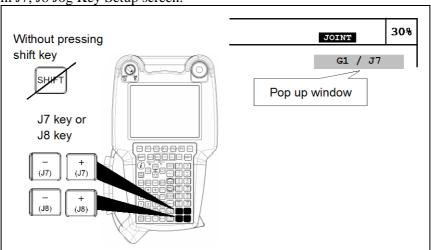
```
System/Config
     J7 J8 Jog keys                      1/6
       Group:        1        R-2000iB/165F

       1 J7 Group:    2        SVGUN system
       2 J7 Axis:     1
       3 J7 Label:    Gun:1
       4 J8 Group:    1        R-2000iB/165F
       5 J8 Axis:     0
       6 J8 Label:


                         GROUP
```

Item	Description
Group	The group number and the robot name that setting is done currently is displayed. In order to setup in another group, press F3 GROUP to change the group. Note: In default setting(automatic assignment is enabled), J7/J8 key for servo gun group is assigned to servo gun axis.
J7 Group	This is the group number and the robot name of the axis that is jogged by pressing J7 key. The group number can be changed.
J7 Axis	This is the axis number that is jogged by pressing J7 key. The axis number can be changed. If this item is set to 0, J7 key is disabled.
J7 Label	This is the label name that is displayed beside "J7" in the current position screen. The label name can be changed within 15 characters. When this item is not set, or the null character is specified to this item, the group number and the axis number are displayed in the current position screen. (Example: G1 /J7).
J8 Group	This is the group number and the robot name of the axis that is jogged by pressing J8 key. The group number can be changed.
J8 Axis	This is the axis number that is jogged by pressing J8 key. The axis number can be changed. If this item is set to 0, J8 key is disabled.
J8 Label	This is the label name that is displayed beside "J8" in the current position screen. The label name can be changed within 15 characters. When this item is not set, or the null character is specified to this item, the group number and the axis number are displayed in the current position screen. (Example: G2 /J1).

3.   Change assignment setting you need.
      Also, the setting of J7 and J8 keys can be confirmed in any screen. When J7 key or J8 key is pressed
      without pressing the [SHIFT] key, the pop up window is displayed at the upper right corner of the
      screen as follows. The name displayed in the pop up window can be changed by setting "J7 Label" or
      "J8 Label" in J7, J8 Jog Key Setup screen.

For example, robot: 6 axes (group1) + rail (extend axis of group1) + servo gun (group2) , in such case if you
want to assign J7 key to servo gun and J8 key to rail to jog, assign as following.

Robot motion group

```
System/Config
      J7 J8 Jog keys                        1/6
        Group:         1        R-2000iB/165F

      1 J7 Group:      2        SVGUN system
      2 J7 Axis:       1
      3 J7 Label:    Gun:1
      4 J8 Group:      1        R-2000iB/165F
      5 J8 Axis:       7
      6 J8 Label:    Rail


 |      |      |      | GROUP |      |      |      |
```

Servo gun motion group

```
System/Config
      J7 J8 Jog keys                        1/6
        Group:         2        SVGUN system

      1 J7 Group:      2        SVGUN system
      2 J7 Axis:       1
      3 J7 Label:    Gun:1
      4 J8 Group:      1        R-2000iB/165F
      5 J8 Axis:       7
      6 J8 Label:    Rail


 |      |      |      | GROUP |      |      |      |
```

⚠ **CAUTION**
     When system has multi motion groups, switch motion group with F3key, confirm
     appreciate assignment for all motion groups.
     It is recommended to set common assignment of j7/j8 key for all motion groups in
     order to not change assignment when any jog group is selected.

4.5   THICKNESS MEASUREMENT

Thickness value is needed as an input on several screens, and in spot instruction. Thickness measurement function can be used to determine the value automatically. There are two options for thickness measurement:

1. Close Gun Tip: The movable tip automatically stops at the workpiece surface to measure the panel thickness. Manually move the fixed tip to the workpiece surface in advance.
2. Close Both Tips: Both tips automatically stop at the workpiece surface to measure the panel thickness. Fix the workpiece to the jig.

Type of measurement used is specified when measure thickness key is pressed.

4.5.1   Initial Setting

Execute the items in the order listed below, prior to initial thickness measurement.

- Autotuning
- Pressure calibration
- Setting the tool coordinate system
- Tip wear standard
- Tip wear detection
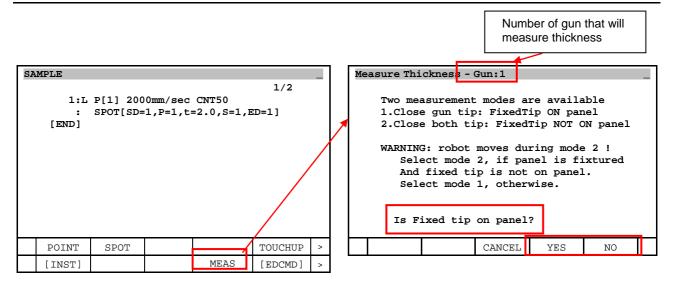
> **NOTE**
> Master position of the gun axis must be accurate to use thickness measurement. Execute tip wear detection to ensure that wear amount and mastering are correct.

> **NOTE**
> To measure thickness accurately, execute thickness check calibration again after pressure calibration.

4.5.2   Thickness Measurement from Editor

Action at MEAS THK keypress

To measure the panel thickness, use the following procedures.

"Is Fixed tip on panel?"

     If Answer = CANCEL: Thickness measurement is aborted.

     If Answer = YES: Execute measure thickness mode1. (Gun tip is closed.)

     If Answer = NO: prompt "Close both tips and measure thickness?"

          If Answer = YES: Execute measure thickness mode2. (Both tips are closed.)

          If Answer = NO: prompt "Thickness measurement declined."

Thickness measurement status info

The following screens are displayed as while thickness is measured.

Confirm measured thickness and press F4 YES to update thickness. If measured thickness is wrong, press F5 NO to NOT update thickness.

```
Measurement Thickness – Gun:1          _

   Measurement mode:        Close GunTip
   Original thickness(mm):         1.5
   Measured thickness(mm):         2.0
   Measurement pressure(kgf):        0
   Measurement deflection(mm):     -.0
   Gun tip StartPos(mm):         -50.0
   Gun tip EndPos(mm):            -2.0


   Change thickness from:1.5mm to 2.0mm ?

|      |      |      |      | YES  |  NO  |      |
```

1. Close GunTip

```
Measurement Thickness – Gun:1              _

   Measurement mode:       Close Both Tips
   Original thickness(mm):         2.5
   Measured thickness(mm):         2.0
   Measurement pressure(kgf):        0
   Measurement deflection(mm):     -.0
   Gun tip StartPos(mm):         -50.0
   Gun tip EndPos(mm):            -2.0
   Fixed tip offset(mm):          24.8

   Change thickness from:2.5mm to 2.0mm ?

|      |      |      |      | YES  |  NO  |      |
```

2. Close Both Tips

Item	Description
Measurement Mode	Selected mode is displayed. • Close Gun Tip: Panel thickness is measured with the movable tip closed. Position the fixed tip so that it is touching the bottom surface of the workpiece at the start of the measurement. • Close Both Tips: Panel thickness is measured with both tips closed. The fixed tip does not need to be touching the workpiece, but the workpiece must be fixed to the jig.
Original thickness	Set thickness before thickness measurement.
Measured thickness	Result of thickness measurement.
Measurement pressure	Pressure for thickness measurement.
Measurement deflection	Deflection of fixed tip during thickness measurement.
Gun tip StartPos	Gun tip open distance at start of thickness measurement.
Gun tip EndPos	Gun tip open distance at end of thickness measurement.
Fixed tip offset	Move distance of fixed tip at thickness measurement mode2.

> ⚠ **CAUTION**
> In "Close Both tip" mode, both of robot and gun move. Confirm safety around robot before execution。

> **NOTE**
> Parameters EndPos, Measured and Fixed tip offset display as *****, when process starts. Actual value for each parameter is written, when it is determined.
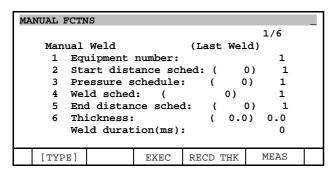
4.5.3   **Thickness Measurement from MANUAL Screen**

Thickness measurement is available on following screens: manual weld, thickness table, pressure calibration. Thickness measurement is initiated via F5 on these screens, instead of F9 in editor.
However, measurement process is operationally identical to editor-initiated measurement.

NOTE
1. Two-sided thickness measurement is disabled by default on manual screens.
2. "MANUAL" screens include thickness RECORD function (F4). F4 records thickness based on current gun tip position (thickness = gun open distance).
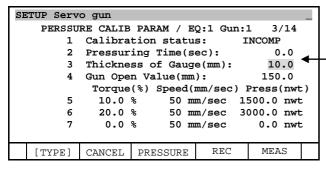
```
MANUAL FCTNS                                _
                                        1/6
    Manual Weld            (Last Weld)
    1  Equipment number:            1
    2  Start distance sched: (    0)  1
    3  Pressure schedule:    (    0)  1
    4  Weld sched:      (       0)    1
    5  End distance sched:   (    0)  1
    6  Thickness:         (   0.0)  0.0
       Weld duration(ms):           0

  [TYPE]         EXEC  RECD THK   MEAS
```

Manual weld

```
SERVO GUN DATA                              _
     THICKNESS TABLE / EQ:1 Gun:1      1/10
     No.  Thickness(mm)         Comment
      1          1.0        [          ]
      2          2.0        [          ]
      3        ******       [          ]
      4        ******       [          ]
      5        ******       [          ]
      6        ******       [          ]
      7        ******       [          ]

  [TYPE]  EQUIP   GUN    RECORD    MEAS
```

Thickness table

```
SETUP Servo gun                             _
    PERSSURE CALIB PARAM / EQ:1 Gun:1   3/14
      1  Calibration status:      INCOMP
      2  Pressuring Time(sec):       0.0
      3  Thickness of Gauge(mm):    10.0
      4  Gun Open Value(mm):       150.0
         Torque(%) Speed(mm/sec) Press(nwt)
      5   10.0 %    50 mm/sec   1500.0 nwt
      6   20.0 %    50 mm/sec   3000.0 nwt
      7    0.0 %    50 mm/sec      0.0 nwt

  [TYPE]  CANCEL  PRESSURE   REC    MEAS
```

Pressure calibration

Thickness functions are provided on F4, F5 for pressure calibration screen. However, unlike manual weld screen and thickness table, F4, F5 change based on cursor position - F4, F5 display REC THK MEAS THK only if cursor is on "Thickness of gauge".

4.5.4 Dual Gun

Gun number is specified by value identified in gun index, for that equipment.
In dual gun case, gun index is specified per table below:

Screen	Selection criteria

Editor	Instruction parameter
	GunA:
	  SPOT[S=(1,0)], SPOT[S=(1,1)], SPOT[S=(0,0)]
	  PRESS_MOTN[SEL=1,0],PRESS_MOTN[SEL=1,1]
	GunB:
	  SPOT[S=0,1]
	  PRESS_MOTN[SEL=0,1]
	Thickness measurement is executed by a gun that is set weld schedule or SEL. When both guns are set or not, Gun A has a priority.

Manual weld	Weld schedule specified on screen GunA: S=1,1, S=1,0, S=0,0 GunB: S=0,1 Thickness measurement is executed by a gun that is set weld schedule. When both guns are set or not, Gun A has a priority.
Thickness table	Gun# selected on screen. Gun# displayed on the upper side of the screen.
Pressure calibration	Gun# selected on screen. Gun# displayed on the upper side of the screen.

5   PROGRAMMING

This section describes programming operation related to spot weld of servo gun.

5.1   SPOT WELDING INSTRUCTIONS

Instructions used in a program to specify servo gun operation are generically called spot welding instructions. Processes (such as pressing, welding, and opening) specified using a spot welding instruction are called a spot welding sequence.
Spot welding instructions perform tip wear compensation and arm deflection compensation as well as the following welding sequences.

5.1.1   SPOT Instruction Format

The following is SPOT instruction format for servo gun.

SPOT [SD=m, P=n, t=i, S=j, ED=m]

---

m : Distance schedule numbers (1 - 99)
n : Pressure schedule number (1 - 99)
i : Part thickness (0.0 - 999.9)
j : Welding schedule number (0 - 255)
* The maximum tip distance and pressurization numbers are both 99 by default.

This instruction specifies Start distance (SD), pressure schedule (P), part thickness (t), weld schedule (S), and End Distance (ED) directly.

·**Start Distance**:	The specified Start Distance (**SD**) openings are passed through on the way to the taught spot location
·**Pressurization**:	Pressurization (clamping, squeezing) is performed according to the specified pressure schedule number (**P**).
·**Thickness**:	Pressurization (clamping, squeezing) is performed according to the specified thickness value (**t**).
·**Welding**:	The specified weld schedule number (**S**) is sent to the weld controller.
·**End Distance** :	The gun is opened in response to the welding completion signal. The gun opens through the specified End Distance (**ED**).
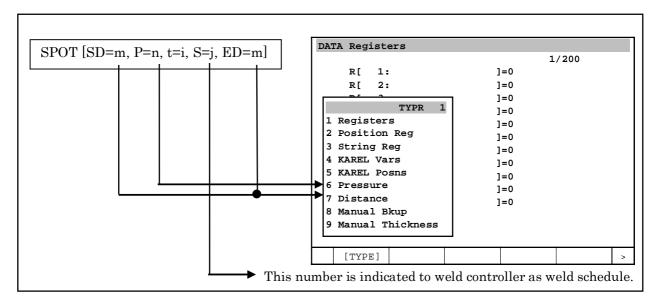
Set each schedule for SPOT instruction in DATA screen. The setting procedures are described in subsequent sections.
1.   Press the [DATA] key, display DATA screen
2.   Press F1 [TYPE] to select the desired schedule.

```
                                              ┌──────────────────────────────────────────┐
                                              │ DATA Registers                           │
┌─────────────────────────────────────┐      │                                  1/200    │
│ SPOT [SD=m, P=n, t=i, S=j, ED=m]     │      │    R[  1:              ]=0                │
└─────────────────────────────────────┘      │    R[  2:              ]=0                │
        │       │      │   │   │                  ┌──────────────────┐  ]=0
        │       │      │   │   │                  │      TYPR   1     │  ]=0
        │       │      │   │   │                  │ 1 Registers      │  ]=0
        │       │      │   │   │                  │ 2 Position Reg   │  ]=0
        │       │      │   │   │                  │ 3 String Reg     │  ]=0
        │       │      │   │   │                  │ 4 KAREL Vars     │  ]=0
        │       │      │   ▼   ▼ ───────────────▶│ 5 KAREL Posns    │  ]=0
        │       │      ● ──────────────────────▶ │ 6 Pressure       │  ]=0
        │       │                     ─────────▶ │ 7 Distance       │  ]=0
        │       │                                │ 8 Manual Bkup    │
        │       │                                │ 9 Manual Thickness│
        │       │                                └──────────────────┘
        │       │                              │ ┌────┬────┬────┬────┬────┬──┐│
        │       │                              │ │[TYPE]│    │    │    │    │ >││
        │       │                              └──────────────────────────────┘
        │       └──────────▶  This number is indicated to weld controller as weld schedule.
```

Pressure Schedule Setting

To program a spot instruction, it is necessary to specify the pressure schedule number that determines the weld pressure.

        1: L P[1] 2000mm/sec CNT100
         : SPOT [SD=m, **P=n**, t=i, S=j, ED=m]

1   Press the [DATA] key to display the DATA screen.
2   Press F1"[TYPE]" to display the pull-up menu.
     Select "Pressure".
3   The servo gun Pressure Schedule list setting screen will be displayed.

F4 DETAIL	Displays the detail setting of the Pressure schedule for edition.
F5 COPY	Pressing this key with the cursor on the schedule of a copy source displays a prompt for the schedule number for a copy destination.

```
┌────────────────────────────────────────────────┐
│ SERVO GUN DATA                              _   │
│    PRESSURE / EQ:1 Gun:1                1/99    │
│    No.  Press(kgf)    Manual    Comment         │
│     1       350.0     FALSE   [spot 1-10 ]      │
│     2       200.0     FALSE   [spot 11-15]      │
│     3         0.0     FALSE   [          ]      │
│     4         0.0     FALSE   [          ]      │
│     5       150.0     FALSE   [tip dress ]      │
│     6         0.0     FALSE   [          ]      │
│     7       200.0      TRUE   [gage check]      │
│     8         0.0     FALSE   [          ]      │
│     9         0.0     FALSE   [          ]      │
│                                                 │
│ ┌──────┬───────┬──────┬────────┬───────┬──┐     │
│ │[ TYPE ]│ EQUIP │ GUN  │ DETAIL │ COPY  │ >│    │
│ └──────┴───────┴──────┴────────┴───────┴──┘     │
└────────────────────────────────────────────────┘
```

4   Pressing F4"DETAIL". The servo gun Pressure Schedule detail screen will be displayed. Pressing F4"LIST" brings you back to the Pressure Schedule list screen.

```
┌────────────────────────────────────────────────┐
│ SERVO GUN DATA                              _   │
│    PRESSURE / EQ:1 Gun:1 No:1       1/3         │
│    1  Comment:             [spot 1-10 ]         │
│    2  Weld Pressure(kgf):        350.0          │
│    3  Gun Sag Comp Value(mm):      0.0          │
│                                                 │
│ ┌──────┬───────┬──────┬────────┬─────┬──┐       │
│ │[ TYPE ]│ EQUIP │ GUN  │ LIST   │     │  │      │
│ └──────┴───────┴──────┴────────┴─────┴──┘       │
└────────────────────────────────────────────────┘
```

Descriptions of items to be set up

Comment	A comment can be added to each Pressure Schedule.
Weld Pressure (Kgf) Minimum: 0.0 Maximum: 9999.9	Weld Pressure specifies the pressure to be applied when a spot welding instruction is executed.
Gun Sag Comp Value (mm) Minimum: -1000.0 Maximum: 1000.0	Gun Sag Comp Value specifies a compensation amount if "Gun Sag Comp Value" has been set to ENABLE on the General Setup screen.
Weight compensation type	This item is displayed by setting gun type to Weight Compensation in detail of Pressure Compensation setup in UTILITIES Gun setup screen. Select gun axis weight compensation type. Please refer to Section 18 about gun axis weight compensation function.
Adjusted (%) Default: 100%	This item is displayed by $SGSYSCFG.$SHO_PRS_SPD_=TRUE. The following screen is displayed. This item can adjust contact speed at pressure. The speed rate can be changed based on speed which is calibrated in pressure calibration. Contact speed can be increased/decreased by maximum/minimum joint speed. If you want to perform tip dressing during pressurization, decrease this speed value.

```
SERVO GUN DATA                                  _
     PRESSURE / EQ:1 Gun:1 No:1        1/5
       1  Comment:            [spot 1-10 ]
       2  Weld Pressure(kgf):        3500.0
       3  Gun Sag Comp Value(mm):       0.0
          Contact speed:
            Calibrated(mm/sec):      100.0
       4    Adjusted: (  60.0mm/sec) 60.0%
       5  Weight compensation type: DISABLE


    [ TYPE ]   EQUIP     GUN     LIST
```

NOTE
   System file of pressure schedule: SYSPRESS.SV can be loaded from another robot controller to copy schedule. (Note: R-30iA System file cannot be loaded.)

Distance Schedule Setting
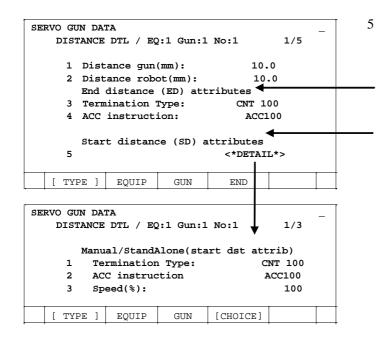
To program a spot instruction, it is necessary to specify the Distance schedules used for both Start Distance (SD) and End Distance (ED). Start Distance specifies the clearance trajectory for both tips of the servo gun when closing to the spot weld and End Distance specifies the clearance when opening after the spot weld.

```
SERVO GUN DATA                                  _
    DISTANCE / EQ:1 Gun:1            1/99
    No.  Gun(mm) Robot(mm)     Comment
      1    10.0      10.0    [          ]
      2    10.0      10.0    [          ]
      3    10.0      10.0    [          ]
      4    10.0      10.0    [          ]
      5    10.0      10.0    [          ]
      6    10.0      10.0    [          ]
      7    10.0      10.0    [          ]
      8    10.0      10.0    [          ]
      9    10.0      10.0    [          ]
     10    10.0      10.0    [          ]


   [ TYPE ]   EQUIP    GUN    DETAIL   COPY    >
```

1   Press the [DATA] key to display the DATA screen.
2   Press F1"[TYPE]" to display the pull-up menu.
    Select "Distance".
3   The servo gun Distance table will be displayed.
4   Edit the tip clearance distances here. Press F4 – Detail to see the detail screen.

```
SERVO GUN DATA                                    _
   DISTANCE DTL / EQ:1 Gun:1 No:1          1/5

   1  Distance gun(mm):              10.0
   2  Distance robot(mm):            10.0
      End distance (ED) attributes
   3  Termination Type:         CNT 100
   4  ACC instruction:          ACC100

      Start distance (SD) attributes
   5                            <*DETAIL*>

   [ TYPE ]   EQUIP    GUN    END
```

```
SERVO GUN DATA                                    _
   DISTANCE DTL / EQ:1 Gun:1 No:1          1/3

      Manual/StandAlone(start dst attrib)
   1    Termination Type:       CNT 100
   2    ACC instruction         ACC100
   3    Speed(%):                  100

   [ TYPE ]   EQUIP    GUN    [CHOICE]
```
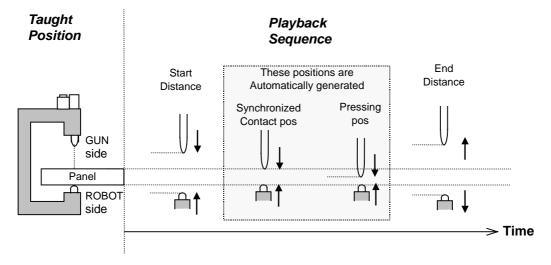
5 Edit the attributes to define how the selected distance schedule will perform when used
End distance (ED) attributes – defines the attributes used when the schedule is used as an End distance
Start distance (SD) attributes – defines the attributes used **only** when the schedule is used in a stand alone instruction or a manual operation.

NOTE

System file of distance schedule: SYSDIST.SV can be loaded from another robot controller to copy schedule. (Note: R-30*i*A System file cannot be loaded.)

Servo Gun SPOT Trajectory with Distance Schedule

The following positions are created from the taught position and the specified Start and End Distance schedule.

(Start/End Distance Setting)		
Gun [mm] Min.: 0.0 Max.: 1000.0	Specify the approach position of the movable side tip as a distance from the part	<u>Start and End Distance</u>
Robot [mm] Min.: 0.0 Max.: 1000.0	Specify the approach position of the fixed side tip as a distance from the part.	

> **NOTE**
> If distance between two spot welding positions is too short, open distance will be shorter than specified open distance in the schedule. Then tip would drag with panel surface. To avoid the dragging , specify larger open distance.

Closing and Opening Trajectory according to SPOT termination type

When executing a motion option SPOT, both tips of the servo gun arrive at the metal surface for the specified spot location at the same time.
The trajectory of the tips will vary according to the specified Start/End Distance and termination type

Specifying term type
FINE/CNT0 : tips will pause momentarily at the specified start/end distances
CNT1-100 : tips will round the corner through the start/end distance with less deceleration. CNT100 specifies the minimum deceleration to and from the spot.
Term type for starting pressure motion and ending pressure motion is decided individually. Refer to following explanation.
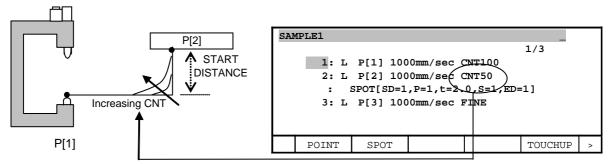
Term type for starting pressure motion (Start Distance motion)
If SPOT instruction is added to motion instruction, robot tip trajectory is decided by specified term type of the motion instruction.


```
SAMPLE1                                      _
                                          1/3
      1: L  P[1] 1000mm/sec CNT100
      2: L  P[2] 1000mm/sec CNT50
       :    SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
      3: L  P[3] 1000mm/sec FINE


    POINT    SPOT              TOUCHUP   >
```
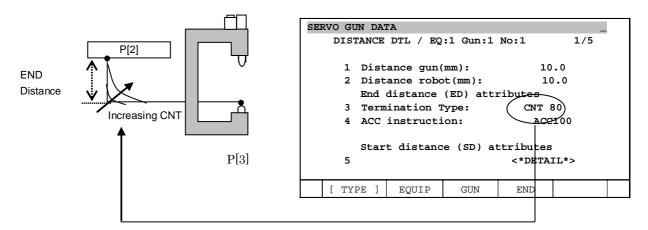
The term type of motion instruction is applied.

In case of a standalone SPOT or PRES_MOTN instruction, this term type can be specified in "Start distance (SD) attributes."

Term type for ending pressure motion (End Distance motion)
robot tip trajectory after pressure is decided term type that is specified with "End distance (ED) attributes" in distance schedule screen.


```
SERVO GUN DATA                               _
   DISTANCE DTL / EQ:1 Gun:1 No:1      1/5

    1  Distance gun(mm):           10.0
    2  Distance robot(mm):         10.0
       End distance (ED) attributes
    3  Termination Type:         CNT 80
    4  ACC instruction:          ACC100

       Start distance (SD) attributes
    5                          <*DETAIL*>

   [ TYPE ]   EQUIP    GUN     END
```
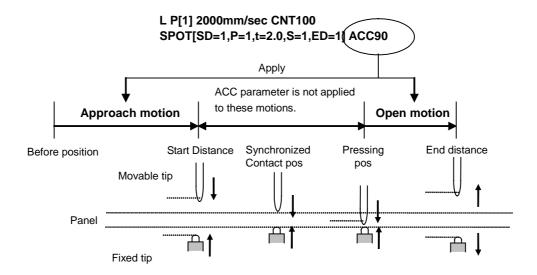
> **NOTE**
> If there is gap between actual panel position and taught position due to variations in
> the workpiece installation, gun tip would early-contact panel without synchronization,
> or robot tip would drag panel surface.
> In this case, decrease CNT of SD motion and ED motion. It could prevent form
> early-contact and dragging.
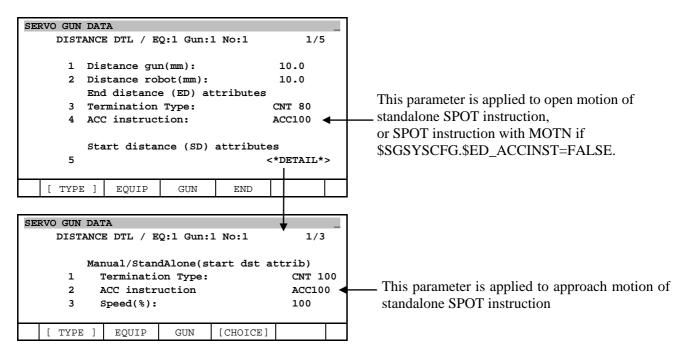
Using ACC instruction for SPOT instruction

According to SPOT instruction with MOTN instruction, ACC instruction attached the MOTION instruction
effects approach motion to pressure start position and open motion to end position.

If it needs to specify ACC parameter to each motion, set $SGSYSCFG.$ED_ACCINST=FALSE. In this
case, ACC parameter for approach motion is specified by ACC instruction, ACC parameter for open
motion is specified by "ACC instruction" in distance schedule screen.

This parameter is applied to open motion of standalone SPOT instruction, or SPOT instruction with MOTN if $SGSYSCFG.$ED_ACCINST=FALSE.

This parameter is applied to approach motion of standalone SPOT instruction

Instruction format	$SGSYCFG. $ED_ACCINST	Method to specify ACC	
		Approch	**Open**
SPOT instruction with Motion	TRUE(Default)	ACC instruction	ACC instruction
LP[1]2000mm/sec CNT100 SPOT[SD=1,P=1,t=0.0,S=1,ED=1]	FALSE	ACC instruction	In Distance Sch.
Standalone SPOT instruction	TRUE(Default)	In Distance Sch.	In Distance Sch.
SPOT[SD=1,P=1,t=0.0,S=1,ED=1]	FALSE	In Distance Sch.	In Distance Sch.

Part thickness

To program a spot instruction, it is necessary to specify the part thickness that determines the thickness of the workpiece to be weld.

> 1: L P[1] 2000mm/sec CNT100
> : SPOT [SD=m, P=n, **t**=**i**, S=j, ED=m]

"******" is displayed to a part thickness right after add a spot instruction. This means the parts thickness is not initialized. Set the part thickness to appropriate value

> **NOTE**
> When a spot instruction is performed at uninitialized thickness, the WARNING message "SVGN-372 Uninitialized thickness: t=** " will be displayed.

> **NOTE**
> When spot instructions are loaded from a program made by an old-type controller, part thicknesses are set to uninitialized thickness. After load, set the part thicknesses of all spot instructions to appropriate values.
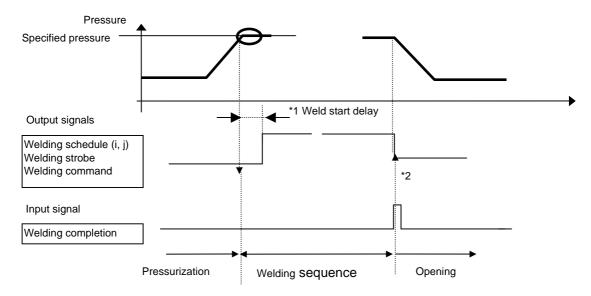
5.1.2   Welding Sequence

This section describes a welding spot instruction-based welding sequence.

1: L P[1] 2000mm/sec CNT100
 : SPOT[SD=1,P=3,**S=5**,ED=2]

· A welding sequence is executed when the specified pressure is reached.
· The welding sequence outputs welding schedule signals between the robot controller and welding machine timer, and waits for the Weld completion signal.
· The welding sequence is specified using the same screens (SETTING menu and "Spot welding") as for the air gun except integral weld timer.

*1) After expiration of the weld delay time, if the specified pressure is reached, all signals from the additional signal to the welding permission signal are output sequentially. If the specified pressure is not reached, the WARNING message "SVGN-020Pressure shortage" will be displayed, resulting in program execution being discontinued.
Weld start delay can be set in SETUP/Spot Equip screen. Default setting is 0ms.
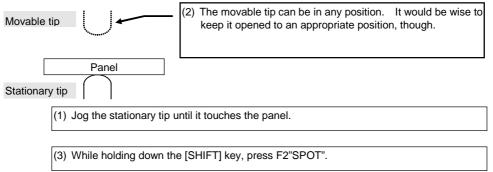
*2) When the Weld completion signal is input, it turns off all output signals, and triggers an opening sequence. When the opening sequence ends, the next instruction is executed

---

NOTE
During pressure, gun position on current position screen does not indicate actual gun position.

5.1.3   Teaching Position

・ When a spot welding instruction is taught, the stationary (robot) tip should be touching the panel.

・ To teach a position, be sure to set the tip wear and tip status to the same value.

NOTE
Even if new tip is installed, wear amount would not be 0 completely. Because there are new tip settlement error and/or deformed shank.
Therefore when new tip is installed, it is better to measure tip wear amount. And teach position with enabled tip wear compensation.
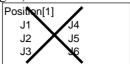
・ If you want to provide instruction while using a worn tip, measure the appropriate amount of wear and compensate for that wear before teaching.

・ Use the Cartesian representation of position data. If spot welding instruction is attached to the Joint angles representation of position data, an alarm is issued when the instruction is executed. (Usually, the Cartesian representation of position data is taught.)

5.1.4   Hold

・ When an alarm or pause occur during execution of the SPOT instruction (during the spot sequence), both the robot axis and the gun axis decelerate and come to a stop.
・ When execution of the program is paused during pressure control, program execution is stopped and the pressure is maintained by default. The following system variable can be used to set the specification to be used when the hold input signal is input during pressurization:

$SGSYSCFG. $REL_PRESS
     = 0: Maintains the pressure.
     = 1: Releases the pressure.

> ⚠ **CAUTION**
> When releasing pressure at HOLD is enabled, the following variable can specify delay time until pressure is released since HOLD is received.
> $SGSYSCFG.$REL_PRS_DRY (DEFAULT 2000ms)
> However, too long delay time would cause OVC alarm.
> Also, if pressure profiling is enabled, the delay time is always 0 and any pressure is released immediately.

・ When program execution is paused, the weld signal and weld condition signal turn OFF.
・ A restart resumes program execution from the spot sequence.
  When program execution is paused between start of pressuring and end of welding, a restart executes pressuring again (initial pressure), and welding is carried out after the specified pressure is reached.

5.1.5   E-Stop
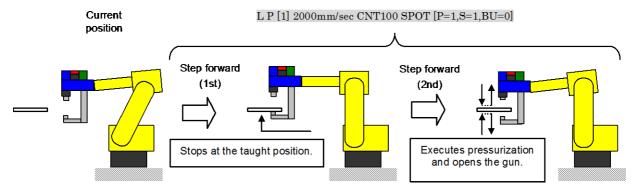
・ If pressure control is stopped because of an emergency stoppage, immediately power down or a severe alarm will occur when the pressure is lost.
・ If servomotor has brake, when an emergency stop or power down occurs during pressure control, the pressure position is maintained. However it dose not guarantee the pressure accuracy.
・ When an emergency stop or power down occurs, the weld signal and weld condition signal turn OFF.
・ A restart resumes program execution from the spot sequence. When an emergency stop or power down occurs between start of pressuring and end of welding, a restart executes pressuring again (initial pressure), and welding is carried out after the specified pressure is reached. (In the case of a power interruption, power fail recovery must be enabled.

5.1.6   Single-Step

When an operation instruction with the SPOT option is executed in the single-step mode, the machine first passes through the approach position and stops at the taught position.

Then, it restarts the spot welding sequence from the approach position and completes the sequence (including pressurization) by the 2nd single step execution.

> ⚠ **CAUTION**
> The taught position is reproduced only in step and backward execution mode. In the continuous execution mode, taught position is not passed through.

Changing the taught position reproduction mode

The following system variable can be used to specify whether to pass through the taught position when the spot welding instruction is executed in the single-step mode:

> **$SGSYSCFG.$STEP_TCHPT=TRUE**(Enabled)**/FALSE**(Disabled)
> **TRUE**: Stops at the taught position. (default setting)
> **FALSE**: Does not stop at the taught position.

Stop positions during execution of step forward (details)

Taught position show mode ($SGSYSCFG.$STEP_TCHPT	Gun Stroke	Start Distance / Taught position		Start Distance		Opening position
Enabled (TRUE)	Enabled	Pass→ CNT0	Stop <1>	Pass→ CNT 0	Pass→ (pressurization)	Stop <2>
	Disabled	Pass→ CNT0	Stop <1>	---	---	Stop <2>
Disabled (FALSE)	Enabled	Stop <1>	---	---	Pass→ (pressurization)	Stop <2>
	Disabled	Stop <1>	---	---	---	Stop <2>

Pass→: Position at which the machine does not stop and passes through
Stop : Position at which playback stops until FWD is pressed again
--- : Position at which the machine neither stops nor passes through

⚠ **CAUTION**
When Step statement type is [MOTION] in TEST CYCLE screen, robot and gun do not pause at opening position.

Servo gun motion setting in single step mode
Servo gun motion in single step can be specified via SPOT WELD screen. SPOT WELD screen can be displayed with the following procedure.
・   Press the [MENU] key, select 2.TEST CYCLE, then press F1[TYPE] and select [2 SPOT WELD]

```
SPOT WELD
                                        1/10
    1 Gun operation:                STROKE
    2 Weld controller mode:         NOWELD
    3 Tryout mode:                  DISABLED
    4 Weld IO sim:                  ENABLED
    5   Weld Duration (ms):         500   ms
    6   Inform output to PLC        DO[  0]
    7 Force process complete:       DISABLED

      Servo Gun Motion in Single Step
    8   Press Motion:               ENABLED
    9   Stop @ Taught Pos:          ENABLED

      Servo Gun Motion in Backward
    10   STOP @ Taught Pos:         ENABELD


  [ TYPE ]                 STROKE   NOSTROKE
```
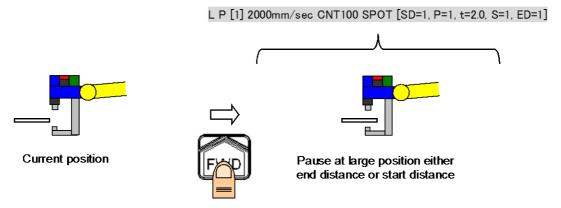
Servo gun motion in single step	Description
Pressure motion	**ENABLE(DEFAULT) :** When SPOT instruction in program is executed with single step, gun closes. **DISABLE:** When SPOT instruction in program is executed with single step, gun does not closes. Note: Pressure utility (Manual pressure, manual weld etc) executed gun closing even if this is disabled.
Stop @ Taught Pos	**ENABLE(DEFAULT) :** When SPOT instruction in program is executed with single step, robot and gun pauses at taught position. This is same as $SGSYSCFG.$STEP_TCHPT=TRUE **DISABLE(DEFAULT) :** When SPOT instruction in program is executed with single step, robot and gun does not pause at taught position. This is same as $SGSYSCFG.$STEP_TCHPT=FALSE

5.1.7   Backward

Servo gun motion in backward has two modes.
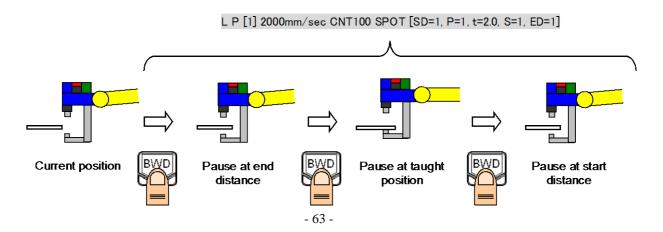
Taught position unreproduction mode

When motion option with spot instruction is executed in the backward mode, the robot moves to large position either of end distance (ED) or start distance (SD) and pauses. Even if next backward execution is done, the robot doesn't move to taught position.

Taught position reproduction mode

When motion option with spot instruction is executed in the backward mode, robot first pauses at end distance (ED). By next backward execution, robot moves to taught position and pauses. By next backward execution, robot moves to start distance (SD) and pauses.

> **⚠ CAUTION**
> The taught position is reproduced only in step and backward execution mode. In the continuous execution mode, taught position is not passed through.

Switching taught position reproduction mode
Taught position reproduction mode can be switched on SPOT WELD screen. SPOT WELD screen can be displayed with the following procedure.
・   Press the [MENU] key, select [2.TEST CYCLE], then press F1[TYPE] and select [2 SPOT WELD]

```
SPOT WELD
                                             1/10
   1 Gun operation:                        STROKE
   2 Weld controller mode:                   WELD
   3 Tryout mode:                        DISABLED
   4 Weld IO sim:                         ENABLED
   5    Weld Duration (ms):             500   ms
   6    Inform output to plc            DO[  0]
   7 Force process complete:            DISABLED

     Servo Gun Motion in Single Step
   8    Pressure Motion:                  ENABLED
   9    Stop @ Taught Pos:                ENABLED

     Servo Gun Motion in Backward
  10    Stop @ Taught Pos:               DISABLED


    [TYPE]                      ENABLED   DISABLED
```

Servo gun motion in backward	Description
Stop @ Taught Pos	**DISABLED(DEFAULT) :** When SPOT instruction in program is executed with backward, robot and gun does not pause at taught position. This is the taught position unreproduction mode. **ENABLE :** When SPOT instruction in program is executed with backward, robot and gun pauses at taught position. This is the taught position reproduction mode.

Touchup in backward execution
In taught position unreproduction mode, robot restarts from either largeness of start distance(SD) or end distance(ED) at next backward execution when manual touchup or Guntouchup are occurs during while backward is executing. In taught position reproduction mode, robot restarts from the start distance(SD) at next backward execution when manual touchup or Guntouchup are occurs during while backward is executing.

> **⚠ CAUTION**
> In the teaching position reproduction mode, the robot restarts from the end distance (ED) at the next backward execution when Guntouchup is canceled during backward execution. In the teaching position unreproductive mode, the robot restarts from either the greatest start distance (SD) or end distance (ED) at the next backward execution when Guntouchup is canceled during backward execution.

5.1.8   **Tips to Using SPOT Instruction**

This section provides notes for those using SPOT instruction.

Offset taught position of SPOT with Offset instruction
If you want to offset taught position of SPOT, refer to the following.

OK: L P[1] 2000mm/s CNT100 **Offset** SPOT[SD=1,P=1,S=1,ED=1]

NG: L P[1] 2000mm/s CNT100 SPOT[SD=1,P=1,S=1,ED=1] **Offset**

Add offset instruction just behind motion instruction like OK format to offset taught position of SPOT.
SPOT instruction needs offset position data beforehand to generate the path.
With NG format, SPOT instruction can not generate the path via offset position.

Synchronization between robot and gun axis.
Robot tip and gun tip are controlled synchronously so that these contact panel surface simultaneously. It prevents robot tip from dragging, or gun tip from early-contacting.
The synchronize control is effective to robot axis and gun axis. Extend axis is not controlled synchronously. For example, there is robot or stationary gun on slide rail in system. In the system, rail motion is not controlled synchronously with SPOT instruction. When gun approaches with slide rail, the tip would drag panel surface.
The workaround are;
- Do not make slide rail approach with separating slide rail motion from SPOT instruction.
- Decrease CNT of motion instruction includes SPOT instruction. It separate pressure motion from approach motion.

5.2   **OTHER INSTRUCTIONS**

This section describes other instructions for servo gun function except SPOT instruction.

5.2.1   **Press Motion Instruction**

The Press Motion instruction is intended to perform pressurization of the servo gun without performing welding.
The Press Motion instruction does not open the gun or perform welding after pressurization is completed.
Like spot welding instructions, the Press motion instruction carries out tip wear compensation and arm deflection compensation when it is used as a motion option.

Instruction format
Stand Alone format:
1: PRESS_MOTN [SD=l, P=m, t=n]
Motion Option format:
1: L P[1] 2000mm/sec FINE Press_motn [SD=1, P=1, t=2.0]

- Pressurization is performed according to the Start distance and pressure schedule numbers specified.
- "**" is displayed to a part thickness right after add a press motion instruction. This means the parts thickness is not initialized. Set the part thickness to appropriate value.
- The pressurization instruction can be used as both motion option and standalone instructions.
    - Motion option instruction

The additional-operation instruction controls both movable and stationary tips during a pressurization sequence.   It also performs tip wear compensation and gun deflection compensation.

・   The pressurization instruction performs only pressurization. So, it is necessary to teach Pressuring time and gun opening separately. (See the sample program.)

Sample Program

1:L P[1] 100mm/sec FINE	Line 1: Closes to pressure at taught position
: Press_motn [SD=1, P=2]	Line 2: Pressuring time
2: WAIT 2.00sec	Line 3: Gun Opening
3:L P[2] 100mm/sec FINE	

> **NOTE**
> When a press motion instruction is performed at uninitialized thickness, the WARNING message "SVGN-372 Uninitialized thickness: t=** " will be displayed.

> **NOTE**
> When press motion instructions are loaded from a program made by an old-type controller, part thicknesses are set to uninitialized thickness. After load, set the part thicknesses of all press motion instructions to appropriate values.

5.2.2   Pressure Instruction

The pressure instruction is intended to limit the maximum torque of the servo gun to the specified pressure when ordinary motion statements rather than spot welding and pressurization instructions are used to control gun motion. It can be used when load becomes too heavy if the maximum torque is applied to the servo gun axis, for example, to press the servo gun against the workpiece for a purpose other than spot welding. It cannot be used to control the pressure used in a spot welding or pressurization instruction.

Instruction format

Pressure specification instruction

Pressure[tl]kgf
└──────────── Pressure condition number (1 to 9999) gun 1

> **NOTE**
> Maximum Pressure is limited by "Max Pressure" in Servo Gun Setup screen at executing the instruction.

Pressure standard instruction
Pressure standard gun 1

・   The pressure standard instruction changes the motor torque limit for the movable tip by calculating it by multiplying the specified pressure by a conversion factor (pressure-torque).
     It also modifies the excessive-error threshold value in order to prevent excessive error at pressurization.

・   The pressure standard instruction cancels changes made by the pressure specification instruction to the torque limit value and excessive-error threshold value, and resumes their previous values. If the current pressure has been modified using the pressure specification instruction, resume its previous value, using the pressure standard instruction. Otherwise, the operation continues with a low torque, which will result in an increased cycle time.

> **NOTE**
> If the pressure specification instruction is used to lower the pressure applied to grasp the workpiece, keep the newly specified pressure until the workpiece is conveyed and released. If the previous pressure is resumed when the workpiece is held on the gun, the torque limit is lifted, causing the maximum torque to be generated, which is likely to lead to an excessive load to be laid on the workpiece

Sample program

1: Pressure[100]Kgf	Line 1: Pressure change
2: L P[1] 100mm/sec CNT50	Line 2: grasp workpiece
3: L P[2] 100mm/sec CNT50	Line 3: Move to a point
4: L P[3] 100mm/sec FINE	Line 4: Release workpiece
5: Pressure standard gun1	Line 5: Resume to the previous value

5.2.3   Gun Zero Master Instruction

The gun zero mastering instruction performs zero-point mastering for the gun axis at the current position.

Instruction format

Gun Zero Master ［#］

#: Gun number (1 to 6)

Sample program

1:L P[1] 100mm/sec FINE	Line 1: 0 kgf must be specified for pressure condition
: Press_motn [SD=1, P=98]	P=[98].
2: WAIT 0.5 sec	Line 2: waits to let the position settle
3. Gun Zero Master [1]	Line 3: sets the mastering for gun 1.
4: L P[2] 100mm.sec FINE	Line 4: opens the gun

> **⚠ CAUTION**
> The above sample program cannot perform zero-point mastering for a gun of which the mastering position is completely shifted or that for which mastering is not complete.

5.2.4   TIPDRESS Instruction

TIPDRESS can be used in coordination with a tip dressing operation on a tip dresser. This instruction enables the user to close, pressurize, and open a servo gun without welding.

Instruction format
Stand Alone format:
      1: TIPDRESS [SD=m, P=n, t=i, TD=j, ED=m]

      m: Distance schedule numbers (1-99)
      n: Pressure schedule number (1-99)
      i :   Thickness of dresser (mm)(0.0 - 999.9)
      j: Tip dress schedule number* (0-2)
           *Tip dress schedule can be set on the Tip dress setup menu.
Motion Option format:
      1: L P[1] 2000mm/sec FINE TIPDRESS [SD=m, P=n, t=i, TD=j, ED=m]

- Close the gun using the specified start distance in the (SD), pressure specified in the Pressure (P) and Thickness (t) field.
- "**" is displayed to a thickness of dresser right after add a TIPDRESS instruction. This means the thickness of dresser is not initialized. Set the thickness of dresser to appropriate value
- Once pressure is achieved, hold pressure for the time specified in the schedule assigned in the Tip Dress (TD=) field.
- Once the Tip Dress time has expired, open the gun to the end distance specified in the (ED=) field, and turn off the blowoff valve in the TIPDRESS SETUP menu
- TIPDRESS instruction can be executed in both Motion Option and Stand Alone formats. In the Motion Option format, both the movable and fixed tips move during the pressurization sequence.

NOTE
   When a TIPDRESS instruction is performed at uninitialized thickness, the WARNING message "SVGN-372 Uninitialized thickness: t=** " will be displayed.

NOTE
   When TIPDRESS instructions are loaded from a program made by an old-type controller, thicknesses of dresser are set to uninitialized thickness. After load, set the thicknesses of dresser of all TIPDRESS instructions to appropriate values.

Tip Dress Setup menu

Display the TIPDRESS SETUP menu, using the procedure below:
1   Press the [MENU] key. Select "6 SETUP".
2   Press F1"[TYPE]" to display the pull-up menu.
    Select "9 Tip Dress".

TIPDRESS SETUP menu will be displayed.

```
TIP DRESS
                                      1/16
          - Dresser   #:1
            Current # of cuts:          0
            Max # of cuts:              0
            Max Cuts alarm Sev:      FAULT
            Blow Off Valve:      DO[    0]
            Fault oupput:        DO[    0]
            Alert output:        DO[    0]
            Fault/Alert Reset:   DI[    0]

          - Gun #:1
            Dresser number for gun:     1
            Current # of dresses:       0
            Max # of dresses:           0
            Max dress alarm Sev:     FAULT

          - Sched  #:1
            Step #1:
             Duration (ms):             0
             Comment:

    [ TYPE ]
```

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The SETUP menu is broken up into 3 sections.

・ Dresser info

ITEM	DESCRIPTION
Dresser # Default setting : 1	Number of currently displayed dresser info items. Users can have dresser info for each dresser. To increase the number of dressers, set $sgtdcfg.$num_dresrs, and then perform a CTRL start, then FCTN START COLD.
Current number of cuts Default setting : 0	Used to count the number of dressings performed. This item is incremented automatically after each successful dress. If you move cursor to the item then set it to 0, or programmatically by setting $sgtdset[Dresser_num].$cut_count, you can reset this count on this screen
Max # of cuts Default setting : 0	This is the maximum cuts for the cutter blade to perform before it requires to be changed. When current cuts is greater than max cuts, then the system will post a Fault or Warning depending on the Max cuts alarm sev. Setting. SPOT-075 The maximum number of cuts has been exceeded.
Max Cuts Alarm Sev. Default setting : Alarm	This is the severity of the alarm which occurs when the max number of dresses on the specified dresser is exceeded. It can be a Fault or Warning.
Blow off Valve Default setting : 0	This is the index of the DOUT to control the blow off valve when a dress is being performed.
Fault output Default setting : 0	This is the index of the DOUT that will turn on when there is a TIPDRESS error, and the severity has been configured as a FAULT.
Alert output Default setting : 0	This is the index of the DOUT that will turn on when there is a TIPDRESS error, and the severity has been configured as an Warning.
Fault/Alert Reset Default setting : 0	The reset input can turn off Fault output and Alert output

・ Gun info

ITEM	DESCRIPTION
Gun # Default setting : 1	Number of the currently displayed gun info items. Users can have gun info for each gun.
Dresser number for gun Default setting : 1	This maps the gun to a specific dresser so that when this gun executes a TIPDRESS instruction, the correct dresser can be controlled.
Current # of dresses Default setting : 0	Used to count the number of TIPDRESS instructions executed. This item is incremented automatically after each successful dress. If you move cursor to the item then set it to 0, or programmatically by setting $sggun#.$setup.$dress_cnt, you can reset this count on this screen.
Max number of dresses Default setting : 0	This is the maximum dresses for this gun's tips to perform before they require to be changed. When current dresses is greater than max dresses, then the system will post a Fault or Warning depending on the Max dress alarm severity setting SPOT-076 The maximum number of TIPDRESS counts has been exceeded.
Max Dress Alarm Sev Default setting : Alarm	This is the severity of the alarm which occurs when the max number of dresses is exceeded. It can be a Fault or Warning.

Schedule info

ITEM	DESCRIPTION
Sched # Default setting : 1	Number of currently displayed tip dress schedule info items. There are 2 schedules by default. To increase the number of schedules, set $sgtdcfg.$num_sched, and then perform a CTRL start, then FCTN START COLD. The maximum number of schedules is 10.
Duration (ms) Default setting : 0	This is the duration in ms for the dress. This time begins once pressure is achieved with the servo gun tips.
Comment	Allows you to associate a comment with this tip dress schedule.

⚠ **CAUTION**
When the push depth is set to be greater than the standard value and TIPDRESS is executed with low override, the pressurizing time might become longer than the specified duration. Change the push depth to 5mm when you want to evade this. The push depth can be changed by the system variable $sgsch#[pressure schedule number].$pushing_depth. A default value of the push depth is 10mm.

6   TIP WEAR DOWN COMPENSATION

6.1   OVERVIEW

Tip Wear Compensation is used to compensate for changes at the servo gun tips. These changes include wear resulting: from welding, dressing, etc. and growth resulting from tip change, electrode change, etc. Tip Wear Compensation adjusts the final position of both weld tips when executing the SPOT or PRESS_MOTN instruction.
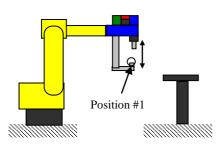
It is necessary to measure the amount of tip wear down in order to use this function. The tip wear compensation function works by using Teach Pendant programs and macros that are included with the Servo Gun software option.

The following are the two standard methods of tip wear measurement available:
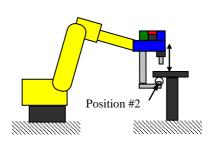
TWO-STEP (i.e. fixture-based, fixture-touch)

First, the gun is closed and re-mastering is done. Subsequently, the gun is brought to measure the gun opening while making the tip touch the fixture.

1st Step (Re-Master/Calibrate)   2nd Step (fixture-touch)

Position #1   Position #2

ONE-STEP (i.e. fixture-less)

The gun is closed and re-mastered. The fixture-touch step in the 2 step method is skipped, and the robot itself does not move. Each tip's unique wear amount is then estimated by applying the user-defined "wear ratio".

With both methods, there are two main tasks for using tip wear compensation:
INITIAL SETUP – Initialize wear amount-related data and set the reference wear amount value.
UPDATE – Measure the wear amount from the reference value.

When tip wear compensation is initialized, and this function is enabled, wear amount is always considered on all SPOT taught position. Before performing position compensation, perform wear amount measurement to match the amount with the current situation.

NOTE
 After soon initial setup, it is not necessary to execute update wear down continuously.

6.2   STANDARD TIP WEAR MEASUREMENT PROGRAMS

The following TP programs are provided as servo gun functions by standard to allow the use of the tip wear compensation function. Use these programs to perform the wear measurement initial setup and wear amount update tasks.

The TP programs are setup to perform a specific tip wear function on gun #1. These programs can be copied or re-named by the user for special cases such as:

- Multi-gun systems
- To support a customer specified TP program naming convention
- To support indirect argument assignments
- Etc.

The MACRO programs should generally not be re-named or deleted since they are used as sub-routines of the main tip wear programs.

Default TP program name	Main Macro That is Run	Function
The following programs are always loaded		
TW_SET01	TW_SETUP	Initialize tip wear data for the 2-step method on gun 1.
TW_UPD01	TW_UPDAT	Measure the tip wear using the 2 step method and update the current wear amount.
TW_MV2PT	N/A	Teach the positions for blank punching and fixture touch steps in the 2 step method. The taught positions are used in TW_SET01 and TW_UPD01. These are used as sub-routines and should not be re-named!
To use the following programs, set $SGSYSCFG. $LOAD_TWD = 11 and cycle the power.		
WR_SET01	WR_SETUP	Initialize tip wear data for the 1 step method.
WR_UPD01	WR_UPDAT	Measure the tip wear using the 1 step method and update the current wear amount.
To use the following program, set $SGSYSCFG. $LOAD_TWD = 12 and cycle the power.		
TW_CMP01	TW_PRSRT	Assist attachment of the tip. Please refer to Appendix F about more details.

The purpose of this document is to describe how to use the TP & macro programs and Tip Wear UIF screens to properly measure and compensate for tip wear.

> **NOTE**
> Some program loaded by setting $SGSYSCFG.$LOAD_TWD > 0 is KAREL program and then these KAREL program is not saved to backup files. Therefore even if all backup files is restored after initial start, please set $SGSYSCFG.$LOAD_TWD again to load KAREL program.

6.3 PREPARATIONS FOR TIP WEAR DOWN COMPENSATION

6.3.1 Preparations
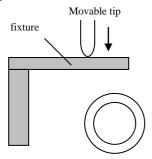
- Complete servo gun autotune and pressure calibration.
- Check the setting of the gun close direction.
- Set Tip Wear Comp 'to ENABLE in Servo gun general setup screen.
- Perform Gun zero mastering with new tip before measurement setup.
- Confirm if gun stroke limit is correct.
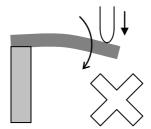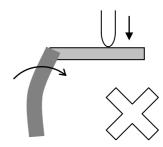
> ⚠**CAUTION**
> When this compensation is enabled, the whole gun and movable axis are offset by
> the wear amount in the direction of pressurization when spot welding is performed.
> Check that the workpiece does not interfere with tooling and fixtures when tip wear
> amount is the largest.

6.3.2 Preparation of TWO-STEP

A fixture for measurement is required in the 2 step measurement method. Press the movable tip to this fixture with a force of 100 to 200 kgf when measuring the wear amount. For accurate measurement, a fixture that does not deflect even when pressed upon by the tip is required. (If it has sufficient rigidity, it is okay to use a dress table.)

6.3.3   Confirmation of Register & Position Register Number

The macro programs for tip wear down measurement use R[10] and PR[20],PR[21] as the default registers. Don't use these registers for another purpose.
If you want to change the register and position register numbers to be used, directly edit the numbers specified in the wear measurement macro list. See following table and details about the macro programs. The arguments specified in program CALL instructions in the macro correspond to the register and position register numbers (the arguments in frames are the register and position register numbers). See comments in the macro programs for details of the arguments.

⚠ **CAUTION**
    When you change the register and position register numbers, be sure to change the numbers used at all locations in all macro programs to the same numbers at same time.

Macro Name	Used Register	Used Position Register
TW_SETUP	R[10]	PR [21]
TW_UPDAT	R[10]	PR [21]
WR_SETUP	R[10]	PR [20], PR [21]
WR_UPDAT	R[10]	PR [20], PR [21]

```
TW_SETUP

1/64
   1:  !Program description ;
   2:  !  Setup fixture-based wear measm ;
   3:   ;
   4:  !Input parameter(s) ;
   5:  !  AR[1]: Gun number ;
   6:   ;
   7:  !Data register(s) used ;
   8:  !  R[10] ;
   9:   ;
  10:  !Position register(s) used ;
  11:  !  PR[21] ;
  12:   ;
  13:  !Version info / revisions ;
  14:  !v6.22: multi-gun support ;
  15:  !v6.31: parameter reduction ;
  16:   ;
  17:  !Initialize gun data ;
  18:  !parm1:gun number   ;
  19:  CALL TWKINIT(AR[1]) ;
  20:   ;
  21:  !Move to posn away from fixture ;
  22:  !  parm1: gun number    ;
  23:  !  parm2: posn number   ;
  24:  !  parm3: data register ;
  25:  CALL TW_MV2PT(AR[1],1,10) ;
  26:   ;
  27:  !Set force threshold ;
  28:  !NOTE:Gun is opened via TWTTHOLD ;
  29:  !  parm1: gun number   ;
  30:  !  parm2: data register ;
  31:  !  parm3: position register ;
  32:  CALL TWKTHOLD(AR[1],10,21) ;
  33:   ;

[ INST ]                      [EDCMD]
```

```
TW_SETUP

34/64
  34:  !Move to posn away from fixture ;
  35:  !  parm1: gun number    ;
  36:  !  parm2: posn number    ;
  37:  !  parm3: data register ;
  38:  CALL TW_MV2PT(AR[1],1,10) ;
  39:   ;
  40:  !Calibrate 0 with master tips ;
  41:  !  parm1: gun number    ;
  42:  !  parm2: data register1 ;
  43:  !  parm3: position register ;
  44:  CALL TWKZRCLB(AR[1],10,21) ;
  45:   ;
  46:  !Move to fixture position ;
  47:  !  parm1: gun number    ;
  48:  !  parm2: posn number    ;
  49:  !  parm3: data register ;
  50:  CALL TW_MV2PT(AR[1],1,10) ;
  51:  CALL TW_MV2PT(AR[1],2,10) ;
  52:   ;
  53:  !Measure open distance ;
  54:  !  parm1: gun number    ;
  55:  !  parm2: data register1 ;
  56:  !  parm3: position register1 ;
  57:  CALL TWKFXTCH(AR[1],10,21) ;
  58:   ;
  59:  !Move to posn away from fixture ;
  60:  !  parm1: gun number    ;
  61:  !  parm2: posn number    ;
  62:  !  parm3: data register ;
  63:  CALL TW_MV2PT(AR[1],2,10) ;
  64:  CALL TW_MV2PT(AR[1],1,10) ;
[END]

[ INST ]                      [EDCMD]
```

```
TW_UPDAT

1/48
  1:  !Program description ;
  2:  !  Update fixture-based wear meas ;
  3:   ;
  4:  !Input parameter(s) ;
  5:  ! AR[1]: Gun number ;
  6:   ;
  7:  !Data register(s) used ;
  8:  ! R[10] ;
  9:   ;
 10:  !Position register(s) used ;
 11:  ! PR[21] ;
 12:   ;
 13:  !Version info / revisions ;
 14:  !v6.22: multi-gun support ;
 15:  !v6.31: parameter reduction ;
 16:   ;
 17:  !Move to posn away from fixture ;
 18:  !  parm1: gun number    ;
 19:  !  parm2: posn number    ;
 20:  !  parm3: data register ;
 21:  CALL TW_MV2PT(AR[1],1,10) ;
 22:   ;




    [ INST ]                          [EDCMD]
```

```
TW_UPDAT

23/48
 23:  !Calibrate 0 with worn tips ;
 24:  !  parm1: gun number     ;
 25:  !  parm2: data register1 ;
 26:  !  parm3: position register ;
 27:  CALL TWKZRCLB(AR[1],10,21) ;
 28:   ;
 29:  !Move to fixture position ;
 30:  !  parm1: gun number     ;
 31:  !  parm2: posn number    ;
 32:  !  parm3: data register ;
 33:  CALL TW_MV2PT(AR[1],1,10) ;
 34:  CALL TW_MV2PT(AR[1],2,10) ;
 35:   ;
 36:  !Measure open distance ;
 37:  !  parm1: gun number     ;
 38:  !  parm2: data register1 ;
 39:  !  parm3: position register1 ;
 40:  !  parm4: new-1/worn-0 ;
 41:  CALL TWKFXTCH(AR[1],10,21,AR[2]) ;
 42:   ;
 43:  !Move to zero calibration posn ;
 44:  !  parm1: gun number     ;
 45:  !  parm2: posn number    ;
 46:  !  parm3: data register ;
 47:  CALL TW_MV2PT(AR[1],2,10) ;
 48:  CALL TW_MV2PT(AR[1],1,10) ;
[END]

    [ INST ]                          [EDCMD]
```

```
WR_SETUP

1/64
  1:  !Program description ;
  2:  !  Setup fixtureless wear measmt ;
  3:  !  Version:6.40 ;
  4:   ;
  5:  !Input parameters ;
  6:  ! AR[1]: Gun number ;
  7:   ;
  8:  !Data registers R[] used ;
  9:  ! R[10]: Work register ;
 10:  ! R[11]: Work register ;
 11:   ;
 12:  !Position registers used ;
 13:  ! PR[20]: Position at wr start ;
 14:  ! PR[21]: Work position register ;
 15:   ;
 16:   ;
 17:  !Initialize gun data ;
 18:  !  Parm1:gun number ;
 19:  CALL TWKINIT(AR[1]) ;
 20:   ;
 21:  !Update grp mask for motn prog ;
 22:  !  Parm1: gun number ;
 23:  !  Parm2: program name ;
 24:  CALL TWKGPMSK(AR[1],'TW_MVGUN') ;
 25:   ;
 26:  !  Write present posn to PR ;
 27:  !  Parm1: Gun # ;
 28:  !  Parm2: Position register index ;
 29:  !  Parm3: Typ(1=opndist,2=curpos) ;
 30:  CALL TWKWRTPR(AR[1],20,2) ;
 31:   ;

    [ INST ]                          [EDCMD]
```

```
WR_SETUP

32/64
 32:  !Write open distance to PR ;
 33:  !  Parm1: Gun # ;
 34:  !  Parm2: Position register index ;
 35:  !  Parm3: Typ(1=opndist,2=curpos) ;
 36:  !  Parm4: Magnitude of open dist ;
 37:  CALL TWKWRTPR(AR[1],21,1,25) ;
 38:   ;
 39:  !Move gun to PR ;
 40:  !  Parm1: Velocity label ;
 41:  !  Parm2: Position register index ;
 42:  CALL TW_MVGUN(1,21) ;
 43:   ;
 44:  !Skip threshold measurement ;
 45:  !Increment phase(step) ;
 46:  !  Parm1:gun number ;
 47:  CALL TWKINCPH(AR[1]) ;
 48:   ;
 49:  !Calibrate 0 with master tips ;
 50:  !  parm1: gun number ;
 51:  !  parm2: data register1 ;
 52:  !  parm3: position register ;
 53:  !  parm4: data register2 (<v6.31) ;
 54:  CALL TWKZRCLB(AR[1],10,21) ;
 55:   ;
 56:  !Skip fixture measurement ;
 57:  !Increment phase(step) ;
 58:  !  Parm1:gun number ;
 59:  CALL TWKINCPH(AR[1]) ;
 60:   ;
 61:  !Move gun to PR ;
 62:  !  Parm1: Velocity label ;
 63:  !  Parm2: Position register index ;
 64:  CALL TW_MVGUN(1,20) ;
[END]

    [ INST ]                          [EDCMD]
```

```
 WR_UPDAT


 1/65
   1:  !Program description ;
   2:  !  Update fixtureless wear measmt ;
   3:  !  Version:6.40 ;
   4:   ;
   5:  !Input parameters ;
   6:  !  AR[1]: Gun number ;
   7:  !  AR[2]: New tip ( reset wr ) ;
   8:   ;
   9:  !Data registers R[] used ;
  10:  !  R[10]: Work register ;
  11:  !  R[11]: Work register ;
  12:   ;
  13:  !Position registers used ;
  14:  !  PR[20]: Position at wr start ;
  15:  !  PR[21]: Work position register ;
  16:   ;
  17:  !Update grp mask for motn prog ;
  18:  !  Parm1: gun number ;
  19:  !  Parm2: program name ;
  20:  CALL TWKGPMSK(AR[1],'TW_MVGUN') ;
  21:   ;
  22:  !Write present position to PR ;
  23:  !  Parm1: Gun # ;
  24:  !  Parm2: Position register index ;
  25:  !  Parm3: Typ(1=opndist,2=curpos) ;
  26:  CALL TWKWRTPR(AR[1],20,2) ;
  27:   ;
  28:  !Write open distance to PR ;
  29:  !  Parm1: Gun # ;
  30:  !  Parm2: Position register index ;
  31:  !  Parm3: Typ(1=opndist,2=curpos) ;
  32:  !  Parm4: Magnitude of open dist ;
  33:  CALL TWKWRTPR(AR[1],21,1,25) ;
  34:   ;
 [ INST ]                              [EDCMD]
```
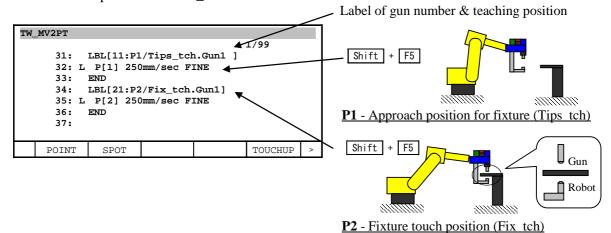
```
 WR_UPDAT


 35/65
  35:  !Move gun to PR ;
  36:  !  Parm1: Velocity label ;
  37:  !  Parm2: Position register index ;
  38:  CALL TW_MVGUN(1,21) ;
  39:   ;
  40:  !Calibrate 0 with worn tips ;
  41:  !  parm1: gun number    ;
  42:  !  parm2: data register1 ;
  43:  !  parm3: position register ;
  44:  !  parm4: data register2 ;
  45:  CALL TWKZRCLB(AR[1],10,21) ;
  46:  WAIT     0.00(sec) ;
  47:   ;
  48:  !Reset ref to 0 before checking ;
  49:  !for wear error, if new tip ;
  50:  R[10] = AR[2] ;
  51:  IF R[10] <> 1,JMP LBL[1]  ;
  52:  CALL TWKRSWDN ;
  53:  LBL[1] ;
  54:   ;
  55:  !Update wear amounts ;
  56:  !Parm1: 0<=Robot wear ratio<=1.0 ;
  57:  !RbtTipWear = ( rbtwr_ratio *  ;
  58:  !             total wear ) ;
  59:  !Parm2: New tip installed ;
  60:  CALL TWKCALC2(0.5,AR[2]) ;
  61:   ;
  62:  !Move gun to PR ;
  63:  !  Parm1: Velocity label ;
  64:  !  Parm2: Position register index ;
  65:  CALL TW_MVGUN(1,20) ;
 [END]



 [ INST ]                              [EDCMD]
```

6.4   TWO-STEP MEASUREMENT METHOD

This section describes the initial procedures for the case of gun number 1.

6.4.1   Teaching Position

1   Teach two positions in **TW_MV2PT**

Label of gun number & teaching position

```
 TW_MV2PT
                                        1/99
  31:   LBL[11:P1/Tips_tch.Gun1 ]
  32: L  P[1] 250mm/sec FINE
  33:   END
  34:   LBL[21:P2/Fix_tch.Gun1]
  35: L  P[2] 250mm/sec FINE
  36:   END
  37:


  POINT    SPOT              TOUCHUP   >
```

Shift + F5

P1 - Approach position for fixture (Tips_tch)

Shift + F5

Gun

Robot

P2 - Fixture touch position (Fix_tch)
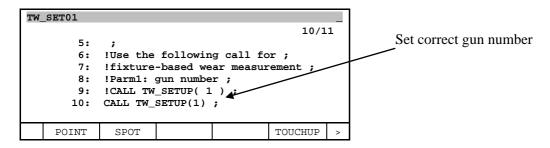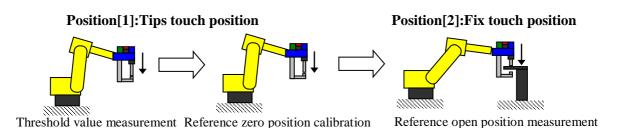
> ⚠ **CAUTION**
>
> Notice the following for teaching positions.
> - TW_MV2PT is pre-installed in controller.
> - Confirm/Set robot group and gun group is match to group mask of TW_MV2PT.
> - Position teaching is performed per gun number. Refer to the label in the program.
> - Position indexes [1] and [2] are provided per gun number. Teach position with the correct index for the gun.
> - Place robot tip away fixture with about 5-10 mm when teaching 2nd position. Do not place gun tip on fixture when teaching 2nd position.
> - The above teaching positions are used in the 2 step method. Ensure not to cause interference from the wear measurement start position to the abovementioned teaching position when teaching.
> - Teach the positions so that the robot and gun will not interfere with the fixture when moving them between teaching positions.

6.4.2   Initial Setup

1   Select TW_SET01 from the program list screen. TW_SET01 is a program for initial setup for gun 1. To initialize the settings for a different gun, change the gun number. This gun number may be specified indirectly using data register.

```
TW_SET01                                              _
                                               10/11
        5:   ;
        6:   !Use the following call for ;
        7:   !fixture-based wear measurement ;
        8:   !Parm1: gun number ;
        9:   !CALL TW_SETUP( 1 ) ;
       10:   CALL TW_SETUP(1) ;


    POINT    SPOT                       TOUCHUP    >
```

Set correct gun number

2   Execute user program that was copied from TW_SET01.TP for each gun. Check teaching positions and gun axis speed, then execute it finally with override 100% (AUTO mode or T2 mode). This completes the initial setup.

Position[1]:Tips touch position   **Position[2]:Fix touch position**

Threshold value measurement   Reference zero position calibration   Reference open position measurement

Robot positions in TW_MV2PT.TP

> ⚠ **CAUTION**
>
> If a gun character is changed when the motor is replaced or gun hardware is overhauled in maintenance (which affects the measurement with the gun touching the fixture) or if the dimensions are changed because a shank or arm is attached to the gun, TW_SET01 must be re-executed.
> If the dimensions of the shank or arm are changed, the tool coordinate system that has been set in the gun close direction (fixed side) after the initial setup must be corrected.

> **NOTE**
> When setup program of tip wear measurement is performed, the following
> WARNING is posted.
> **SVGN-178 Open/CloseLim = XXmm/YYmm**
> This indicates standard stroke limit that is compensated according to wear down.
> If this stroke limit is not correct, gun could not press correctly.
> About compensated stroke limit, refer to 6.10 for more detail.
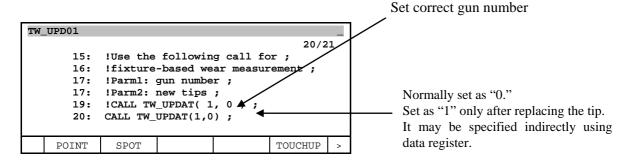
6.4.3   **Wear Amount Measurement**
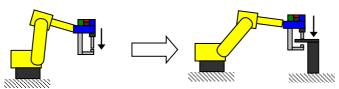
1   Select TW_UPD01 from the program list screen. TW_UPD01 is a program for wear measurement of gun 1. To measure the wear amount of a different gun, change the gun number. This gun number may be specified indirectly using data register.

Set correct gun number

```
TW_UPD01                                          _
                                              20/21
      15:  !Use the following call for ;
      16:  !fixture-based wear measurement ;
      17:  !Parm1: gun number ;
      17:  !Parm2: new tips ;
      19:  !CALL TW_UPDAT( 1, 0 ) ;
      20:  CALL TW_UPDAT(1,0) ;

   POINT    SPOT              TOUCHUP   >
```

Normally set as "0."
Set as "1" only after replacing the tip.
It may be specified indirectly using data register.

2   Execute TW_UPD01.

Position[1]:Tips touch position   **Position[2]:Fix touch position**

Reference zero position calibration   Wear down amount measurement

Robot positions in TW_MV2PT.TP

Measure the wear amount any time the measurement is needed:
- After tip change (set new tip flag to 1)
- After tip dress
- After pre-determining the number of welds
- Whenever the tip wear amount is updated

> ⚠ **CAUTION**
> TWTHOLD2.TP, TWZRCLB2.TP, and TWFXTCH2.TP, which are used when
> performing measurement or initial setup, are displayed. These are internal
> programs for tip wear measurement that are in a temporary visible status. **Do not
> edit or delete these**.

> **NOTE**
> Perform setup/update for per gun. Confirm gun number is correct.
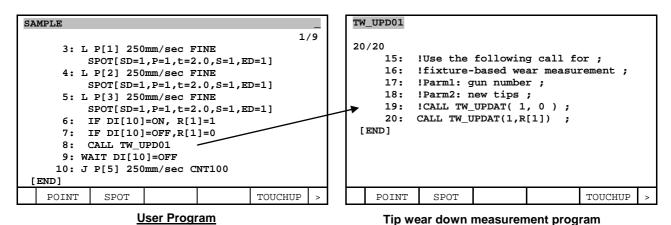
> **NOTE**
> If wear update program is executed with new tip and initial setup program is
> executed again with the new tip, then SVGN-187 occurs. Because once wear
> update program is executed, the tip is regarded as worn tip. Before initial setup
> program is executed, perform gun zero mastering or reset wear down amount.

The following is a sample for this function.

6.4.4   Example of Tip Wear Down Measurement

1   TP program "SAMPLE.TP" executes motion instruction and SPOT instruction, then calls tip wear
     down measurement program "TW_UPD01".
2   When tip is replaced to new tip, new tip measurement is executed by turning on DI[10].

```
SAMPLE                                       _
                                          1/9
    3: L P[1] 250mm/sec FINE
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    4: L P[2] 250mm/sec FINE
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    5: L P[3] 250mm/sec FINE
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    6:  IF DI[10]=ON, R[1]=1
    7:  IF DI[10]=OFF,R[1]=0
    8:  CALL TW_UPD01
    9: WAIT DI[10]=OFF
   10: J P[5] 250mm/sec CNT100
 [END]
┌──────┬──────┬──────┬──────┬────────┬───┐
│POINT │ SPOT │      │      │TOUCHUP │ > │
└──────┴──────┴──────┴──────┴────────┴───┘
```

User Program

```
TW_UPD01
                                         20/20
    15:   !Use the following call for ;
    16:   !fixture-based wear measurement ;
    17:   !Parm1: gun number ;
    18:   !Parm2: new tips ;
    19:   !CALL TW_UPDAT( 1, 0 ) ;
    20:   CALL TW_UPDAT(1,R[1])  ;
 [END]
┌──────┬──────┬──────┬──────┬────────┬───┐
│POINT │ SPOT │      │      │TOUCHUP │ > │
└──────┴──────┴──────┴──────┴────────┴───┘
```

Tip wear down measurement program

6.5   ONE-STEP MEASUREMENT METHOD

This section describes the initial procedures for the case of gun number 1.

6.5.1   Initial Setup

1   Select WR_SET01 from the program list screen. WR_SET01 is a program for initial setup for gun 1.
     To initialize the settings for a different gun, change the gun number. This gun number may be
     specified indirectly using data register.

```
WR_SET01                                      _
                                          10/11              Set correct gun number
    7:  !fixture-based wear measurement ;
    8:  !Parm1: gun number ;
    9:  !CALL WR_SETUP( 1 ) ;
   10:  CALL WR_SETUP(1) ;
┌──────┬──────┬──────┬──────┬────────┬───┐
│POINT │ SPOT │      │      │TOUCHUP │ > │
└──────┴──────┴──────┴──────┴────────┴───┘
```

2   Execute WR_SET1. The gun close operation is performed immediately (the robot does not move).
     Check gun axis speed, and then execute it **finally with override 100%** (AUTO mode or T2 mode).
     This completes the initial setup.

> **NOTE**
> If WR_SET01 is not found on program list, set $SGSYSCFG.$LOAD_TWD = 11, and then repower controller.

> ⚠ **CAUTION**
> If gun character is changed when the motor is replaced, or gun hardware is overhauled in maintenance (which affects the measurement with the gun touching the fixture) or if the dimensions are changed because a shank or arm is attached to the gun, WR_SET01 must be re-executed.
> If the dimensions of the shank or arm are changed, the tool coordinate system that has been set in the gun close direction (fixed side) after initial setup must be corrected.

> **NOTE**
> When initial setup program is executed, the following WARNING is posted:
> **SVGN-178 Open/CloseLim = XXmm/YYmm**
> This indicates standard stroke limit that is compensated according to wear down.
> If this stroke limit is not correct, gun could not press correctly.
> About compensated stroke limit, refer to 6.10 for more detail

6.5.2 **Wear Amount Measurement (Update)**

1 Set wear ratio (This step is not necessary if default wear ratio (= 0.5) is used.). The wear ratio is defined as the ratio of the fixed tip wear amount to the total wear.
   a. Press F1 [MENU] key and select "MACRO" in the program list screen.
   b. Open **WR_UPDAT** in edit mode in the program list screen, and move the cursor over the line of CALL TWKCALC2.
   c. Set the 1st argument to the wear ratio. (Default = 0.5, equal wear on each tip)

```
WR_UPDAT                                    _
                                      60/66
      53:   LBL[1] ;
      54:    ;
      55:   !Update wear amounts ;
      56:   !Param1: 0<=Robot wear ratio<>1.0 ;
      57:   !RbtTipWear = ( rbtwr_ratio *  ;
      58:   !                total wear ) ;
      59:   !Parm2: New tip installed ;
      60:   CALL TWKCALC2(0.5,AR[2]) ;
      61:    ;
      62:   !Move gun to PR ;
      63:   !  Parm1: Velocity label ;
      64:   ! Parm2: Position register index ;
      65:   CALL TW_MVGUN(1,20) ;

     [INST]                      [EDCMD]   >
```
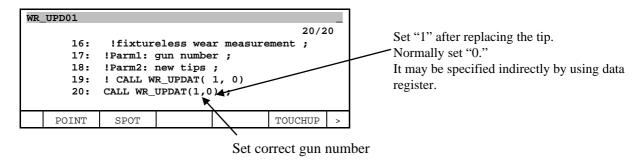
Set the wear amount.
Wear amount = 0.5: all wear is evenly assigned to both tips.
Wear amount = 1: all wear is assigned to the fixed tip only.
Wear amount =0: all wear is assigned to the movable tip only.

2   Select **WR_UPD01** from the program list screen. **WR_UPD01** is a program for wear measurement of gun 1. To measure the wear amount of a different gun, change the gun number. This gun number may be specified indirectly using data register.

```
WR_UPD01                                        _
                                         20/20
     16:    !fixtureless wear measurement ;
     17:   !Parm1: gun number ;
     18:   !Parm2: new tips ;
     19:   ! CALL WR_UPDAT( 1, 0)
     20:   CALL WR_UPDAT(1,0) ;


|    | POINT | SPOT |    |    | TOUCHUP | > |
```

Set "1" after replacing the tip.
Normally set "0."
It may be specified indirectly by using data register.

Set correct gun number

3   Execute **WR_UPD01**. The gun close operation is performed immediately (the robot does not move).

Measure the wear amount any time the measurement is needed:
- After tip change (set new tip flag)
- After tip dressing
- After pre-determining the number of welds
- Whenever the tip wear amount is updated

⚠ **CAUTION**
During performing setup/update, **TWZRCLB2.TP** which are internal program for tip wear measurement, is visible status. **Do not edit or delete these.**

NOTE
Perform setup/update for per gun. Confirm gun number is correct.

⚠ **CAUTION**
In case of 1 step measurement method, replace both tip at installing new tip, and then update wear down. If only one side tip is replaced, wear down is not match to actual wear down.
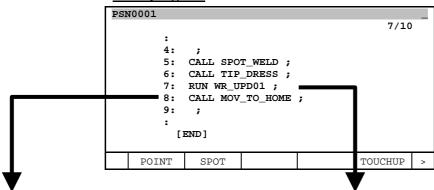
NOTE
If wear update program is executed with new tip and initial setup program is executed again with the new tip, then SVGN-187 occurs. Because once wear update program is executed, the tip is regarded as worn tip. Before initial setup program is executed, perform gun zero mastering or reset wear down amount.

6.5.3   ONE-STEP Measurement with Multi Task

During 1 step measurement method, only gun axis moves. Using multi task, 1 step measurement method can be executed together robot motion. For example, during robot returns to home position after tip dressing, 1 step measurement method can be executed. Please refer to the following sample.

Main program

```
PSN0001                                    _
                                    7/10
          :
      4:   ;
      5:  CALL SPOT_WELD ;
      6:  CALL TIP_DRESS ;
      7:  RUN WR_UPD01 ;
      8:  CALL MOV_TO_HOME ;
      9:   ;
          :
        [END]

    POINT    SPOT                    TOUCHUP  >
```

Return to HOME

```
MOV_TO_HOME                           _
                                    1/5
      1:  L P[1] 1500mm/s イチギ゙メ ;
      2:  L P[2] 1500mm/s ナメラカ100 ;
      3:  L P[3] 1500mm/s ナメラカ100 ;
      4:  L PR[1:HOME] 1500mm/s ナメラカ100 ;
      5:  WAIT R[2:UPDT COMP]= 1
 [END]

  POINT   SPOT              TOUCHUP  >
```

Update wear down

```
TW_UPD01

20/21
     18:   !Parm2: new tips ;
     19:   ! CALL WR_UPDAT( 1, 0)
     20:   CALL WR_UPDAT(1,R[1]) ;
     21:   R[2:UPDT COMP]=1 ;
  [END]

  POINT    SPOT              TOUCHUP  >
```

Both of returning to home position and updating wear down is performed at same time. In this sample, the robot waits at the home position for completion of measurement.

NOTE
In the case of using multitask for wear measurement, do not specify a gun group for the servo gun group to the program that is executed in parallel (MOV_TO_HOM in the above sample).

⚠ CAUTION
During wear measurement with multitask method, do not change the servo gun posture largely with the robot motion (for example, change its horizontal posture to a vertical posture). Largely changing the posture would disturb appropriate wear measurement and cause misdetection, wear amount error, or mis-mastering.

In other instances, the wear amount can be measured with a stationary gun while the robot handles the workpiece to the next process in the handling spot system.

6.6   COMBINATION 2 STEP METHOD AND 1 STEP METHOD

6.6.1   Overall

Combination 2 step method and 1 step method bring in the following benefit.
- Decrease cycle time by decreasing the number of executions with the 2 step method.
- Improve accuracy of 1 step method.

> **NOTE**
> Please refer to section 6.8 about auto updating wear ratio.

6.6.2   Initial Procedures

1   Specify initial wear ratio via tip wear standard screen.
     See section 6.7.2.

> **NOTE**
> Definition of wear ratio for 1 step method is decided by initial setup.
> If initial set up of 1 step method (WR_SETUP) is executed, wear ratio is defined on WR_UPDAT macro.
> If initial set up of 2 step method (TW_SETUP) is executed, wear ratio is defined on tip wear standard screen.

2   Perform initial setup with 2 step method. **Execute TW_SETUP macro program.**
     The procedure and notice of execution are the same as normal 2 step method.

> **NOTE**
> After initial setup of 2 step method complete, this function can switch auto updating wear ratio to enable/disable in any time.
> Please refer to section 6.7.1.3 about auto updating wear ratio.
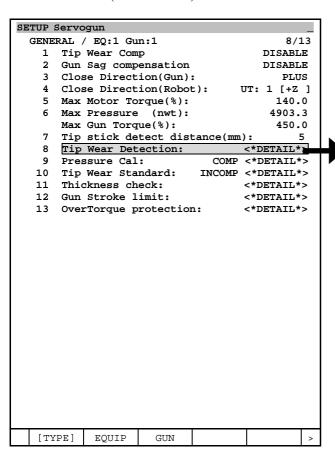
3   After tip dressing, the wear amount can be measured with the 1 step or 2 step method. In both methods, the procedure and notice for measurement are the same as normal use of each step measurement method.

4   When the tip has been replaced, perform the 2 step method to measure wear amount. Execute TW_UPDAT macro program with the new tip flag.

6.7   SETUP SCREEN FOR TIP WEAR DOWN COMPENSATION FUNCTION (SERVOGUN GENERAL SETUP SCREEN)

6.7.1   Tip Wear Detect Setup Screen

In this screen, you can set up the tip wear measurement (items 1 to 5) and alarm process during the tip wear measurement (items 6 to 11).

```
SETUP Servogun                          _
 GENERAL / EQ:1 Gun:1                 8/13
  1  Tip Wear Comp                  DISABLE
  2  Gun Sag compensation           DISABLE
  3  Close Direction(Gun):             PLUS
  4  Close Direction(Robot):    UT: 1 [+Z ]
  5  Max Motor Torque(%):             140.0
  6  Max Pressure  (nwt):            4903.3
     Max Gun Torque(%):              450.0
  7  Tip stick detect distance(mm):      5
  8  Tip Wear Detection:        <*DETAIL*>
  9  Pressure Cal:         COMP <*DETAIL*>
 10  Tip Wear Standard:  INCOMP <*DETAIL*>
 11  Thickness check:           <*DETAIL*>
 12  Gun Stroke limit:          <*DETAIL*>
 13  OverTorque protection:     <*DETAIL*>




    [TYPE]   EQUIP    GUN                    >
```

```
SETUP Servogun
 TIP WEAR DETECT / EQ:1 Gun:1         1/23

  1  Common setup:              <*DETAIL*>

  2  Detection type:                  LOAD
  3    Margin of load(nwt):            294
  4  Tip speed(mm/sec):                 20
  5  Mastering pressure(kgf):          980
  6  Mis-detect toler.(mm):           5.00

     Maximum wear check(Gun)
  7    Max wear value(mm):            0.00
  8      Inform signal:            DO[  0]
  9    Increased error(mm):           0.00
     Maximum wear check(Robot)
 10    Max wear value(mm):            0.00
 11      Inform signal:            DO[  0]
 12    Increased error(mm):           0.00
     Auto update wear down ratio
 13    Update Enb/Dsb:             DISABLE
        Update status:           INACTIVE
 14    Max Wear ratio limit:          0.70
 15    Min Wear ratio limit:          0.30
 16    Severity for limit over:       WARN
     Auto-detect of meas method
 17    Increment for 2 step:        2.00mm
 18    Forced 1 step signal:       DI[  0]
 19    Forced 2 step signal:       DI[  0]
 20    1 step notification:        DO[  0]
 21    2 step notification:        DO[  0]
 22    Pressure diag function:     DISABLE
 23    Cap diag function:           ENABLE

    [TYPE]   EQUIP    GUN    END           >
```

6.7.1.1   Setup for tip wear down measurement

These are items that are used in measurement. Basically, it is not necessary to change it. It is necessary to re-execute SETUP, if these items are change.

	Setup Items	Description
Common setup	**Pressure Schedule** (Default = 98)	The number of the pressure schedule to use for tip wear measurement. Do not use this schedule in other programs or for welding.
	Start distance Schedule (Default = 98)	The number of the start position tip distance schedule to use for tip wear measurement. Do not use this schedule for other programs or for welding.
	Open Gun at Restart (Default = ENABLE)	ENABLE/DISABLE; specifies whether the gun is opened to the start position after pause/restart.
	Retry times	The no. of times the re-master step is retried when a mis-detection is observed.
Detection Type (Default : LOAD)		LOAD: Measures the wear of the movable tip with fixture-touch. DO: Measures the wear of the movable tip using a phototube or other sensors. The sensors must be provided by a user.

Setup Items	Description
Margin of Load (Default = 30 kgf)	The total of this amount and the value obtained by automatic margin measurement is used to detect the fixture touch. The total value is displayed as a "load threshold" of the reference tip wear value.
Tip Speed(mm/sec) (Default = 20 mm/sec)	This is a travel speed of the movable tip during the fixture-touch step.
Mis-detect toler(mm) (Default = 5 mm)	If a mastering position detected at the reference position is located in the direction of tip growth and the detected amount exceeds this value, measurement will be retried by the specified number of times. The error message occurs when failed to retry. SVGN-097 Tip wear down misdetection

6.7.1.2   Setup for tip wear measurement alarm process

These are items that are used to set up the alarm process during tip wear measurement. The measurement can be performed even without changing them.

Setup Items	Description
Maximum Wear Down Value	The maximum wear that can be measured. Typical values are between 4–7 mm. The error messages that occur when max wear down value is exceeded are: SVGN-118 Max wear exceeded (Gun). SVGN-119 Max wear exceeded (Robot). When this alarm outputs, replace the tip immediately before measuring tip wear.
Inform Signal	this is the digital output that is turned on when the measured wear exceeds the specified Maximum Wear Down Value.
Increased error	If a wear amount that is smaller than the previous tip wear measurement is observed (it generally increases gradually), it indicates that the tip has grown, and "tip increased error" fault is asserted. Specify the allowable value for this increased error. The typical settings for this item are 1–2 mm. If it is exceeded, the following alarms are posted: SVGN-032 tip wear increased error (Gun) SVGN-033 tip wear increased error (FRobot) Setting the new tips flag in the measurement macros prevents the Increased Error alarm from being posted when tips are changed.

> **NOTE:**
> When tip increased error happens, consider the following possible causes:
> - A piece of metal from tip dressing operation remained on the tip and increased the detected tip length. Remove the excess metal.
> - New tips were placed, but the new tips flag was not set before tip wear measurement.
> - The fixture-touch tip speed was slower than it was during the previous wear measurement. Keep the fixture-touch tip speed consistent.
> - The fixture-touch or re-master position was mis-detected. This can happen if the fixture position has shifted or the Margin of Load is set too small. In such a case, re-execute the Initialization Procedure for tip wear measurement.

> **⚠ CAUTION**
> When tip increase error occurs, measured wear down amount that shows increase error is reset automatically, then recover last wear amount temporary. As soon as eliminate cause of tip increase error, update wear down again.

> **NOTE**
> In some software versions, when tip increase error occurs, the following alarm is also posted:
> **SVGN-186 Wdn: Old: xx.x mm- > New: yy.y mm**
> "Old: xx.x mm" indicates the last wear down amount before updating. "New: yy.y mm" indicates updated wear down amount that shows increase error. Difference of both (= Old – New) means increase error amount.

> **NOTE**
> Inform signal(DO) can be output when tip increase error occurs. Specify index of the inform signal to the following variable.
> **$SGGUN#.SETUP.$TIPINCIOIDX** (# is gun number): This variable is the DO number to be outputted when tip increase error occurs for the movable tip.
> **$SGGUN#.SETUP.$RBTINCIOIDX** (# is gun number): This variable is the DO number to be outputted when tip increase error occurs for the fixed tip.

6.7.1.3   Setting of automatic calculation and updating wear ratio

These are the items for the basic setup for automatically calculating and updating the wear ratio in the tip wear detection screen.

Setup Items	Description
Update Enb/Dsb Default: DISABLE	Enable: Wear ratio is calculated and updated automatically. Disable: Wear ratio is not calculated and updated automatically.
Update status Default: INACTIVE	ACTIVE: Wear ratio can be updated automatically with the 2 step method. INACTIVE: Wear ratio cannot be updated automatically. This item is changed automatically depending on Update Enb/Dsb and initial setup status. Operator cannot change this directly.
Max Wear ratio limit Default: 0.7	This specifies the maximum limit value of the wear ratio to be updated automatically. If calculated wear ratio is larger than this value, wear ratio is not updated.
Min Wear ratio limit Default: 0.3	This specifies the minimum limit value of the wear ratio to be updated automatically. If calculated wear ratio is smaller than this value, wear ratio is not updated.
Severity for limit over Default: WARN	This specifies severity of alarm that occurs if calculated wear ratio is out of tolerance. WARN: Severity is WARNING. Program does not pause if alarm occurs. FAULT: Severity is STOP. Program pauses if alarm occurs.

6.7.1.4   Setting of diagnosis data

It set up item about acquisition of diagnosis data in tip wear detection screen.
Setup items of diagnosis data is displayed only when Zero Down Time software option (R854) has been ordered.

Setup Items	Description
Pressure diag enable Default: DISABLE	When this function is enabled, additional pressuring motion is executed after tip wear detection motion on new tip installation, and diagnosis data is acquired. The obtained data is used in Zero Down Time function.
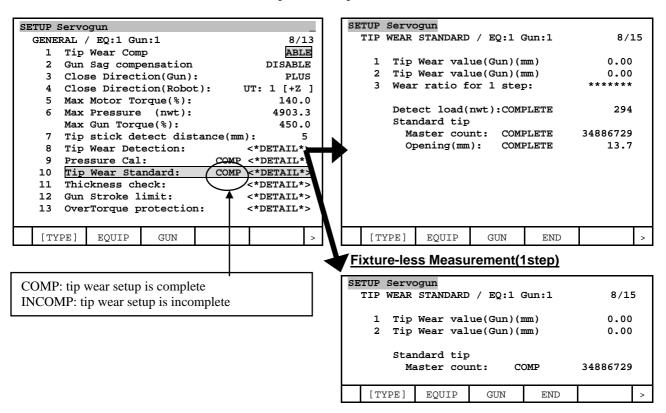
Setup Items	Description
Tip wear diagnosis function Default: ENABLE	When this function is enabled, diagnosis data is acquired during the execution of tip wear detection motion on new tip installation. The obtained data is used in Zero Down Time function.

6.7.1.5   Confirmation of wear ratio

It confirms wear ratio in tip wear standard screen.
See section 6.7.2.

6.7.2   Tip Wear Standard Screen

User can see and check some data about tip wear compensation in this screen.

```
SETUP Servogun
  GENERAL / EQ:1 Gun:1                    8/13
   1  Tip Wear Comp              ABLE
   2  Gun Sag compensation            DISABLE
   3  Close Direction(Gun):             PLUS
   4  Close Direction(Robot):    UT: 1 [+Z ]
   5  Max Motor Torque(%):             140.0
   6  Max Pressure  (nwt):            4903.3
      Max Gun Torque(%):              450.0
   7  Tip stick detect distance(mm):       5
   8  Tip Wear Detection:        <*DETAIL*>
   9  Pressure Cal:          COMP <*DETAIL*>
  10  Tip Wear Standard:     COMP <*DETAIL*>
  11  Thickness check:           <*DETAIL*>
  12  Gun Stroke limit:          <*DETAIL*>
  13  OverTorque protection:     <*DETAIL*>

  [TYPE]   EQUIP    GUN                     >
```

```
SETUP  Servogun
  TIP WEAR STANDARD / EQ:1 Gun:1          8/15

   1  Tip Wear value(Gun)(mm)          0.00
   2  Tip Wear value(Gun)(mm)          0.00
   3  Wear ratio for 1 step:        *******

      Detect load(nwt):COMPLETE        294
      Standard tip
       Master count:   COMPLETE    34886729
       Opening(mm):    COMPLETE        13.7

  [TYPE]   EQUIP    GUN    END              >
```

Fixture-less Measurement(1step)

```
SETUP Servogun
  TIP WEAR STANDARD / EQ:1 Gun:1          8/15

   1  Tip Wear value(Gun)(mm)          0.00
   2  Tip Wear value(Gun)(mm)          0.00

      Standard tip
       Master count:    COMP      34886729

  [TYPE]   EQUIP    GUN    END              >
```

COMP: tip wear setup is complete
INCOMP: tip wear setup is incomplete

Setup Items	Description
Tip Wear Value (mm)	Displays the present wear amount of each tip.
Wear Ratio	This indicates current wear ratio. This value is updated when wear ratio is calculated correctly. If you want to specify the initial wear ratio, change this value before the initial setup. Also, if auto updating wear ratio is disabled, *** will be displayed.
Detect threshold (kgf)	Displays the load threshold used to detect fixture-touch
Master Count	Displays the Pulsecoder count of the reference position when a reference zero position has been measured.
Opening (mm)	Displays the opening that was recorded when the reference open position is measured. This is not required when initialization is performed with the 1 step method.

⚠ **CAUTION**
If an incorrect wear ratio is specified, the wear measurement amount will be
incorrect, then wear measurement compensation will not work correctly.
When manually changing wear ratio, specify it carefully.

6.8 AUTO UPDATING WEAR RATIO

6.8.1 Overall

This function can automatically calculate the wear ratio for the 1 step method with the actual dress amount. The wear amount can be calculated during production. With the calculated wear ratio, the wear amount can be measured with the 1 step method. By automatically calculating the wear ratio on a periodical basis, the wear amount can be updated according to the dress trend in the time whenever needed.

6.8.2 Initial Procedures

Initial Procedures
1. Enable automatic updating wear down via tip wear detection screen.
    See section 6.7.1.3.

> **NOTE**
> This setting can be change in any time after initial setup of 2 step method complete.

2. Specify initial wear ratio via tip wear standard screen.
    See section 6.7.2.
3. Perform initial setup with 2 step method. **Execute TW_SETUP macro program.**
    The procedure and notice of execution are the same as normal 2 step method.

> **NOTE**
> It is unnecessary to perform the initial setup of the 1 step method (execute the WR_SETUP macro program) if automatic wear ratio update is enabled.

4. After tip dress, it is allowed to update wear down amount with 1 step method. Execute WR_UPDAT macro program. The procedure and notice of execution are the same as normal 1 step method.
5. When tip has been dressed with several times (wear down amount is increased), perform 2 step method to update wear ratio. **In the case to update wear ratio, execute TW_UPDAT macro program without new tip flag. Measurement of wear down** and calculation of wear down are complete successfully, **and then wear ratio is updated automatically.**

> **NOTE**
> If tip hardly is worn, wear ratio cannot be calculated accuracy.
> Performing the 2 step method to update the wear ratio every time the total wear down amount of both tips change by 2 to 3 mm is recommended.

> **NOTE**
> When wear ratio is updated correctly, the following warning massage is posted.
> (Value are example)
> **SVGN-282 Wear ratio updated: 0.5- > 0.65**
> The above massage example shows wear ratio is changed from 0.5 to 0.65.

> **NOTE**
> When wear ratio is calculated, if the ratio is larger than 1.0 or smaller than 0.0, the following warning massage is posted. (Value are example)
> **SVGN-283 Wear ratio (-0.5) Not updated**
> Together SVGN-285, either following massage is posted as cause code.
> **SVGN-284 Gun: 6.0 = > 3.0,Rbt: 3.0 = > 4.0**
> SVGN-284 shows the wear down that is measured by the last 2 step method and wear down that is measured by current 2 step method. The above massage example shows, wear down amount of gun tip changes from 6.0 mm to 3.0 mm. Even if these warning are posted, measured wear down amount is updated and applied to compensation. However only wear ratio is NOT updated.

> **NOTE**
> When wear ratio is calculated, if the ratio is larger than maximum limit or smaller than minimum limit, the following warning massage is posted. (Value are example)
> **SVGN-285 Wear ratio Out of Tolerance**
> Together SVGN-285, either following massage is posted as cause code.
> **SVGN-286 Wear ratio :0.81 > Max: 0.7**
> **SVGN-287 Wear ratio: 0.25 < Min:0.3**
> Even if these warning are posted, measured wear down amount is updated and applied to compensation. However only wear ratio is NOT updated.

> **NOTE**
> SVGN-283 or SVGN-285 occurs when the wear amount decreases from that measured by the last 2 step method.
> The main cause;
> - When the tip is replaced the wear measurement is performed without new tip flag.
> - The 2 step method is performed continually when tip dressing is hardly performed.

6. **It necessary to perform 2 step method when cap tip is replaced.** Perform TW_UPDATE macro program with new tip flag.

> ⚠**CAUTION**
> If 2 step method is performed without new tip flag when the tip is replaced, incorrect wear ratio is updated. After that, wear down cannot be measured correctly.

> **NOTE**
> Tip wear measurement with the 2 step method (with a new tip flag) right after the tip is replaced does not automatically calculate the wear ratio.

> **NOTE**
> When automatic update of wear ratio is enabled, each tip is allowed to be replaced.

NOTE
When performing tip wear measurement with the 1 step method (with new tip flag) right after tip is replaced, the following warning occurs:
SVGN-374 Wear ratio update Locked.
SVGN-288 New tip! Use 2 step TWD
If this warning occurs, next 2 step method does not update wear ratio. Until the next two-setup method is performed, the wear amount of the fixed tip measured by the 1 step method is assigned with wear ratio of all wear amounts. (This value is the same as original wear amount measured by the 1 step method.) As immediately as possible, perform the 2 step method to measure tip wear.

NOTE
If the wear amount is measured with the 2 step method after the 1 step method when the tip has changed, the following warning occurs:
SVGN-374 Wear ratio update Locked.
SVGN-375 Next 2 step TWD updates wear ratio
This warning indicates that the currently executed 2 step method does not update wear ratio. The next 2 step method will update the wear ratio. This warning does not need any remedy.
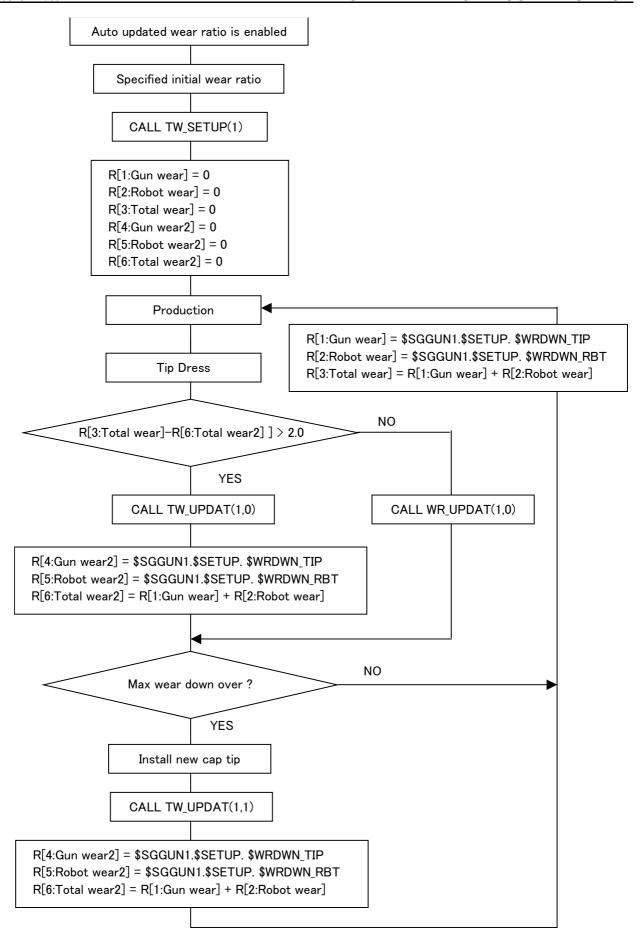
6.8.3 Sample for Introduction

The following flowchart shows a sample to introduce and manage this function for reference.
Apply management according to actual user's production system with this sample specification.

This sample flowchart is created by the following specification.
- R[1]–R[3] store the last wear down amount.
- R[4]–R[6] store wear down amount of the last 2 step method.
- After tip dress, compare the last wear down amount to wear down amount of the last 2 step method.
- If the difference is larger than 2.0 mm, the wear down amount seems to have increased to a certain degree since the last 2 step method (wear trend may have changed). Then, the 2 step method is performed to measure the wear amount and at the same time to update the wear ratio. The new wear ratio is used by the next 1 step. In this time, R[4]–R[6] is updated, these values is reference to check the next updating wear ratio.
- If the difference is smaller than 2.0 mm, the wear down amount does not seem to have increased much (wear trend may not have changed). In this case, the 1 step method is performed with the current wear ratio.
- Therefore, in this specification, every time wear ratio is updated by 2.0 mm of wear down increasing, the 2 step method is performed to measure the wear amount and update the wear ratio. During the time between the updates, the 1 step method is performed to measure wear amount.
- If measured wear down amount is larger than maximum wear down amount, new cap tip is installed. Then, it performs 2 step method. In this time, R[4]–R[6] is updated. These values is reference to check the next updating wear ratio. However, wear ratio is not updated when new cap tip is installed.
- After measurement wear down amount, R[1]–R[3] are always updated. These values are reference to check the next updating wear ratio.

```
┌─────────────────────────────────────┐
│   Auto updated wear ratio is enabled │
└─────────────────────────────────────┘
                  │
┌─────────────────────────────────────┐
│      Specified initial wear ratio    │
└─────────────────────────────────────┘
                  │
┌─────────────────────────────────────┐
│         CALL TW_SETUP(1)             │
└─────────────────────────────────────┘
                  │
┌─────────────────────────────────────┐
│  R[1:Gun wear] = 0                   │
│  R[2:Robot wear] = 0                 │
│  R[3:Total wear] = 0                 │
│  R[4:Gun wear2] = 0                  │
│  R[5:Robot wear2] = 0                │
│  R[6:Total wear2] = 0                │
└─────────────────────────────────────┘
                  │
┌──────────────────┐
│    Production     │◄──────────────────────────────────┐
└──────────────────┘                                    │
                  │    ┌────────────────────────────────────────────────┐
                  │    │ R[1:Gun wear] = $SGGUN1.$SETUP. $WRDWN_TIP       │
┌──────────────────┐   │ R[2:Robot wear] = $SGGUN1.$SETUP. $WRDWN_RBT     │
│    Tip Dress      │   │ R[3:Total wear] = R[1:Gun wear] + R[2:Robot wear]│
└──────────────────┘   └────────────────────────────────────────────────┘
                  │
```

R[3:Total wear]−R[6:Total wear2]] > 2.0   NO

YES

CALL TW_UPDAT(1,0)   CALL WR_UPDAT(1,0)

R[4:Gun wear2] = $SGGUN1.$SETUP. $WRDWN_TIP
R[5:Robot wear2] = $SGGUN1.$SETUP. $WRDWN_RBT
R[6:Total wear2] = R[1:Gun wear] + R[2:Robot wear]

Max wear down over ?   NO

YES

Install new cap tip

CALL TW_UPDAT(1,1)

R[4:Gun wear2] = $SGGUN1.$SETUP. $WRDWN_TIP
R[5:Robot wear2] = $SGGUN1.$SETUP. $WRDWN_RBT
R[6:Total wear2] = R[1:Gun wear] + R[2:Robot wear]

6.9   DATA RECOVERY

6.9.1   Recovery Mastering Data
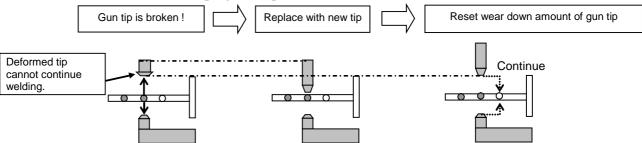
When mastering data is lost for the gun axis, it must be recovered. The mastering data is recovered in the Gun Zero Master screen.

Re-mastering in Gun Zero Master Utility
1.   Perform mastering of the servo gun in the Gun Zero Master Utility. Please refer to Appendix C for using the Gun Zero Master Utility.
2.   Re-run the tip wear Update program.(TW_UPD01 if the 2 step method is used.)
3.   Confirm the spot teaching point. Correct it if required

6.9.2   Recovery from Damage of Tip

When the tip is damaged during welding a series of points, the tip will have to be changed on the spot and the remaining points must be welded without measuring the actual wear amount. In this case, to reset the wear amount of the replaced tip, the user has to create the following macro program for each gun. The created macro program should be assigned so that it can be started with DI. This assignment can reset tip wear down amount when the weld program is paused.

NOTE
   Please be sure to update wear down amount after the welding cycle.

NOTE
   Please execute wear amount reset macro program when the robot and servo gun are not moving. If the macro program is called in TP program, specify a positioning format for the last robot operation and execute with its position set, or execute WAIT instruction.

The wear down amount reset macro requests one register. It is no problem that the register is the same as one used by the tip wear measurement macro program.

Ex)
Tip wear amount measurement target: Gun 1
•   Register number : R[10]

Wear down amount reset macro program for movable tip of gun 1: TWRSMV1.TP   （Group mask[*,*,*,*,*]）

`CALL TWKRSMOV(1,10)`	Reset wear down amount of movable tip of gun 1
`!arg1: Always 0.`	
`CALL TWKSTROK(0)`	Change stroke limit. **Set 0 as argument**
`CALL TWKRSCLB(10)`	Recovery mastering

Reset macro program for fixed tip of gun 1: TWRSFX1.TP（Group mask[*,*,*,*,*]）

`CALL TWKRSFIX(1,10)`	Reset wear down amount of fixed tip of gun 1
`!arg1: Always 0.`	
`CALL TWKSTROK(0)`	Change stroke limit. **Set 0 as argument**
`CALL TWKRSCLB(10)`	Recovery mastering

> **NOTE**
> In case of using the 1 step method, always replace both tips at the same time.
> Then run both of reset macro program for movable /fixed tip.
> It is no problem about the order of running.
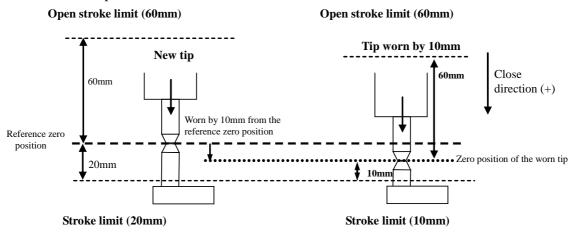
6.10 GUN STROKE LIMIT COMPENSATION BY TIP WEAR DOWN COMPENSATION

The gun stroke limits are compensated according to the tip wear down amount. Please note the following five items about the stroke limit compensation:

1. The close stroke limit after tip wear measurement is obtained by compensating the reference stroke limit that was specified during the initial setup for tip wear measurement with the reference mastering position. It is not compensated if it will change the absolute position of the original stroke limit.
2. Even if either the robot tip or gun tip is worn, the stroke limit is not updated if a tip opening distance will be larger than the original limit.
3. When mastering data is lost, the gun stroke limits are invalided. Refer to the data recovery procedures in Section 6.9 to recover the mastering data.
4. Standard stroke limit is set to the stroke limit that was set when the initial setup program of tip wear measurement was executed. At this time, it is indicated by the warning message "SVGN-178 Open/CloseLim = XXmm/YYmm."
5. When the setup program is performed again with worn tip, compensated stroke limit is applied to standard stroke limit. Perform gun zero mastering with new tip before performing the setup program.

See the visual example below:

> ⚠ **CAUTION**
> The gun axis position indication is displayed based on the current zero position:
> - Close Stroke Limit = New Master Tips:20 mm, Worn Tips: 10 mm
> - Open Stroke Limit = New Master Tips:-60 mm, Worn Tips: -60 mm

Tip wear compensation function changes the stroke limit. If tip wear compensation function is no more needed or to completely initialize tip wear, perform the following procedures to clear the stroke limits.

Sroke limit compensation:

Wear value	Stroke Limit value	
	Close Stroke Limit	Open Stroke limit
Total Wear > 0	Original stroke limit MINUS total tip wear	Original stroke limit does not change
Total Wear < 0 (growth < = detection error tolerance)	Original stroke limit does not change	Original stroke limit does not change
Total Wear < 0 (growth > detection error tolerance)		Original open stroke limit MINUS the detection error tolerance.

Procedures to disable gun stroke limit compensation (how to completely disable tip wear compensation)

1. Set the Tip Wear Comp to DISABLE on the Servo Gun General Setup Page.
2. Set the sysvar $SGGUN#.$SGTWD.$PHASE = 0 (where # is the target gun number)
3. Repower the controller.
4. Attach a new tip to the gun and perform mastering again.
5. Set the gun stroke limits to a proper value.

NOTE
   Perform the setup program again if you want to enable tip wear compensation.
   Stroke limit is compensated after performing the setup program.

⚠ CAUTION
   Do not change $SGGUN#.$SGTWD.$PHASE (where # is the target gun number)
   except in the above case, because this is the status variable.

6.11 COMPATIBILITY OF TIP WEAR MEASUREMENT PROGRAMS WITH OLD CONTROLLER

The following describes the compatibility of tip wear measurement programs before R-30*i*A.

Tip wear measurement programs that are used on R-J3*i*B
These programs cannot be supported on R-30*i*B. According to later description, modify user programs.

Tip wear measurement programs that are used on R-30*i*A

i.   Case of using KAREL programs that are provided since R-30*i*A
     These programs can be supported on R-30*i*B without user program's modification.
     Also, TW_SETUP,TW_UPDAT,WR_SETUP,WR_UPDAT macro programs can be supported, too.

ii. Case of using TP programs that have been provided at R-J3*i*B
     These programs cannot be supported on R-30*i*B. According to later description, modify user programs.

NOTE
   When tip wear measurement programs provided at R-J3*i*B is executed,
   SVGN-392.
   "This TW**.TP is not supported" occurs. According to later explanation, modify
   user Programs.

Modification user programs

Please rename the standard program executed with CALL instruction to KAREL program of R-30*i*B to use the tip wear measurement program that calls the TP program of R-J3*i*B in R-30*i*B controller. Please refer to the following table for renaming.

No	CALLING R-J3*i*B TP PROGRAM		CALLING R-30*i*B KAREL PROGRAM
1	CALL TW0THOLD(#1, #2, #3)	⇨	CALL TWKTHOLD(#1, #2, #3)
2	CALL TW1MTCLB(#1, #2, #3)	⇨	CALL TWKZRCLB(#1, #2, #3)
3	CALL TW1MTFIX(#1, #2, #3)	⇨	CALL TWKFXTCH(#1, #2, #3)
4	CALL TW2WDCLB(#1, #2, #3)	⇨	CALL TWKZRCLB(#1, #2, #3)
5	CALL TW2WDFIX(#1, #2, #3)	⇨	CALL TWKFXTCH(#1,#2,#3,#4)
6	CALL TW3RSCLB(#2)	⇨	CALL TWKRSCLB(#2)

#1:Gun number
#2:Register number
#3:Position register number
#4:New tip flag
 New tip: 1
 Worn tip: 0
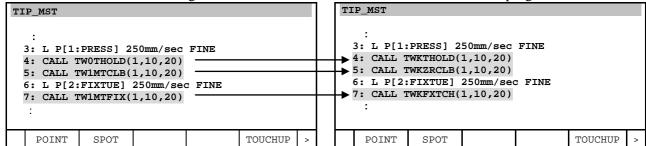
> **NOTE**
> - The order of argument is same as R-J3*i*B.except No. 5.Please set the same number.
> - About No. 2,No. 4 and No. 3,No. 5, use common KAREL program.
> - About No. 3, user not have to add new argument.
> - R-J3*i*B TP programs which support auto retry function (TW1MTCLB, TW1MTFIX, TW2WDCLB, TW2WDFIX) may have six parameters. For this case, please set only first three parameters.

SAMPLE

R-J3*i*B User Program

```
TIP_MST

  :
 3: L P[1:PRESS] 250mm/sec FINE
 4: CALL TW0THOLD(1,10,20)
 5: CALL TW1MTCLB(1,10,20)
 6: L P[2:FIXTUE] 250mm/sec FINE
 7: CALL TW1MTFIX(1,10,20)
  :

  POINT  │ SPOT  │      │      │ TOUCHUP │ >
```

R-30*i*B User program

```
TIP_MST

  :
 3: L P[1:PRESS] 250mm/sec FINE
 4: CALL TWKTHOLD(1,10,20)
 5: CALL TWKZRCLB(1,10,20)
 6: L P[2:FIXTUE] 250mm/sec FINE
 7: CALL TWKFXTCH(1,10,20)
  :

  POINT  │ SPOT  │      │      │ TOUCHUP │ >
```

About New tip flag
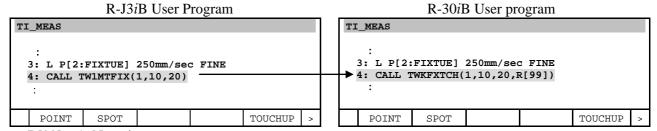
Please add argument at renaming of No. 5.
Added argument judges either new tips measurement or worn tip measurement.

New tip measurement : CALL TWKFXTCH(1,10,20,**1**)
Worn tip measurement :CALL TWKFXTCH(1,10,20,**0**)
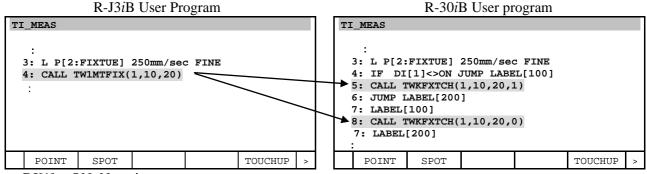
Please refer to the following examples

Ex1: Using register for new tip flag

R-J3*i*B User Program

```
TI_MEAS

   :
 3: L P[2:FIXTUE] 250mm/sec FINE
 4: CALL TW1MTFIX(1,10,20)
   :


   POINT    SPOT                       TOUCHUP    >
```

R-30*i*B User program

```
TI_MEAS

   :
 3: L P[2:FIXTUE] 250mm/sec FINE
 4: CALL TWKFXTCH(1,10,20,R[99])
   :


   POINT    SPOT                       TOUCHUP    >
```

R[99] = 1: New tip measurement
R[99] = 0: Worn tip measurement

Ex2: Using DI signal for new tip flag

R-J3*i*B User Program

```
TI_MEAS

   :
 3: L P[2:FIXTUE] 250mm/sec FINE
 4: CALL TW1MTFIX(1,10,20)
   :


   POINT    SPOT                       TOUCHUP    >
```

R-30*i*B User program

```
TI_MEAS

   :
 3: L P[2:FIXTUE] 250mm/sec FINE
 4: IF  DI[1]<>ON JUMP LABEL[100]
 5: CALL TWKFXTCH(1,10,20,1)
 6: JUMP LABEL[200]
 7: LABEL[100]
 8: CALL TWKFXTCH(1,10,20,0)
 7: LABEL[200]
   :
   POINT    SPOT                       TOUCHUP    >
```

DI[1] = ON: New tip measurement
DI[1] = OFF: Worn tip measurement

6.12 TIP WEAR DOWN COMPENSATION FOR MULTI-EQUIPMENT

6.12.1 Standard Tip Wear Programs for Multiple Equipment

The following TP programs are included when the Servo Gun option is installed to use tip wear compensation function in multiple equipment at the same time. Use these TP programs to perform the tip wear initial setup and update tasks from eq 2 to eq 5.

TP program are not prepared at each equipment. Copy and use these TP programs.

> **NOTE**
> Tip wear compensation for multi-equipment has been supported since software version 7DC2P02.
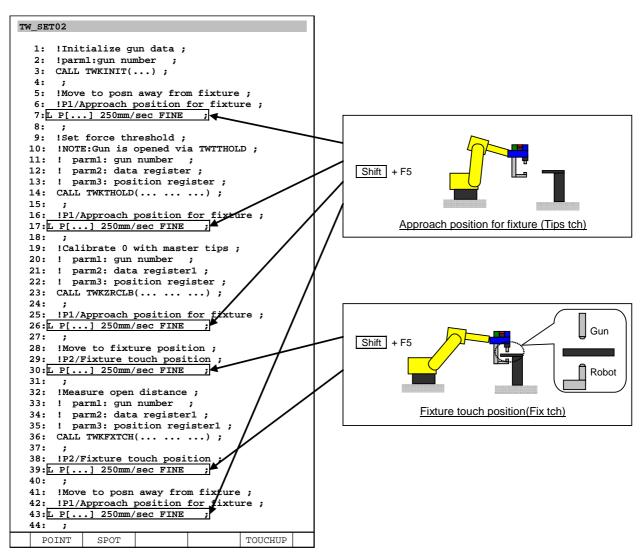
Program name	Function
To use the following programs, set $SGSYSCFG. $LOAD_TWD = 15 and cycle the power.	
TW_SET0X	This initializes tip wear data for the 2 step method. This program cannot be executed at the same time with two or more equipments. Copy and use this TP program. Ex.) Eq 2: TW_SET0X → COPY → TW_SET02
TW_UPD0X	This measures the tip wear using the 2 step method. This program can be executed at the same time with two or more equipments. Copy and use this TP program. Ex.) Eq2: TW_UPD0X → COPY → TW_UPD02

Program name	Function
WR_SET0X	This initializes tip wear data for the 1 step method. This program cannot be executed at the same time with two or more equipments. Copy and use this TP program. Ex.) Eq2: WR_SET0X → COPY → WR_SET02
WR_UPD0X	This measures the tip wear using the 1 step method. This program can be executed at the same time with two or more equipments. Copy and use this TP program. Ex.) Eq2: WR_UPD0X → COPY → WR_UPD02
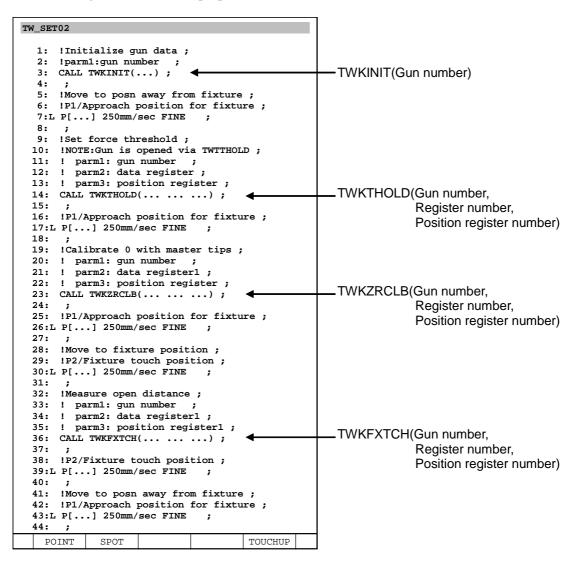
6.12.2   Initial Setup of 2-step method for Multi-Equipment

1. Set $SGSYSCFG.$LOAD_TWD = 15, and then repower controller. TW_SET0X will be loaded.
2. Copy TW_SET0X to another name. (After this, TW_SET02 is used to explain as an example.)
    Ex.) Eq 2: TW_SET0X → COPY → TW_SET02
3. Confirm the robot group and gun group match with the group mask of TW_SET02.
4. Teach the two positions shown in the right figure in TW_SET02.

```
TW_SET02

 1: !Initialize gun data ;
 2: !parm1:gun number   ;
 3: CALL TWKINIT(...) ;
 4:    ;
 5: !Move to posn away from fixture ;
 6: !P1/Approach position for fixture ;
 7:L P[...] 250mm/sec FINE    ;
 8:    ;
 9: !Set force threshold ;
10: !NOTE:Gun is opened via TWTTHOLD ;
11: ! parm1: gun number    ;
12: ! parm2: data register ;
13: ! parm3: position register ;
14: CALL TWKTHOLD(... ... ...) ;
15:    ;
16: !P1/Approach position for fixture ;
17:L P[...] 250mm/sec FINE    ;
18:    ;
19: !Calibrate 0 with master tips ;
20: ! parm1: gun number    ;
21: ! parm2: data register1 ;
22: ! parm3: position register ;
23: CALL TWKZRCLB(... ... ...) ;
24:    ;
25: !P1/Approach position for fixture ;
26:L P[...] 250mm/sec FINE    ;
27:    ;
28: !Move to fixture position ;
29: !P2/Fixture touch position ;
30:L P[...] 250mm/sec FINE    ;
31:    ;
32: !Measure open distance ;
33: ! parm1: gun number    ;
34: ! parm2: data register1 ;
35: ! parm3: position register1 ;
36: CALL TWKFXTCH(... ... ...) ;
37:    ;
38: !P2/Fixture touch position ;
39:L P[...] 250mm/sec FINE    ;
40:    ;
41: !Move to posn away from fixture ;
42: !P1/Approach position for fixture ;
43:L P[...] 250mm/sec FINE    ;
44:    ;
```

| POINT | SPOT | | | TOUCHUP | |

Shift + F5

Approach position for fixture (Tips tch)

Shift + F5

Gun

Robot

Fixture touch position(Fix tch)

> ⚠ **CAUTION**
> Notice the following for teaching positions.
> - Confirm/set the robot group and gun group match with the group mask of TW_SET02.
> - Specify the same position ID for all approach positions.
> - Specify same position ID to all fixture touch position.
> - Place the robot tip away from the fixture by about 5–10 mm. Do not make the gun tip touch the fixture at this timing.
> - The 2 step method uses the abovementioned teaching position. Be careful not to cause interference between the tip wear measurement start position and the abovementioned teaching position when teaching.
> - The positions should be taught such that the robot and gun will not interfere with the fixture when moving between teaching points.

5. Specify the gun number, register number, and position register number for TW_SET02. Don't use these registers for another purpose.

```
TW_SET02

 1:  !Initialize gun data ;
 2:  !parm1:gun number   ;
 3:  CALL TWKINIT(...) ;          ◄───── TWKINIT(Gun number)
 4:  ;
 5:  !Move to posn away from fixture ;
 6:  !P1/Approach position for fixture ;
 7:L P[...] 250mm/sec FINE   ;
 8:  ;
 9:  !Set force threshold ;
10:  !NOTE:Gun is opened via TWTTHOLD ;
11:  !  parm1: gun number   ;
12:  !  parm2: data register ;
13:  !  parm3: position register ;
14:  CALL TWKTHOLD(... ... ...) ;  ◄───── TWKTHOLD(Gun number,
15:  ;                                            Register number,
16:  !P1/Approach position for fixture ;         Position register number)
17:L P[...] 250mm/sec FINE   ;
18:  ;
19:  !Calibrate 0 with master tips ;
20:  !  parm1: gun number   ;
21:  !  parm2: data register1 ;
22:  !  parm3: position register ;
23:  CALL TWKZRCLB(... ... ...) ;  ◄───── TWKZRCLB(Gun number,
24:  ;                                            Register number,
25:  !P1/Approach position for fixture ;         Position register number)
26:L P[...] 250mm/sec FINE   ;
27:  ;
28:  !Move to fixture position ;
29:  !P2/Fixture touch position ;
30:L P[...] 250mm/sec FINE   ;
31:  ;
32:  !Measure open distance ;
33:  !  parm1: gun number   ;
34:  !  parm2: data register1 ;
35:  !  parm3: position register1 ;
36:  CALL TWKFXTCH(... ... ...) ;  ◄───── TWKFXTCH(Gun number,
37:  ;                                            Register number,
38:  !P2/Fixture touch position ;                Position register number)
39:L P[...] 250mm/sec FINE   ;
40:  ;
41:  !Move to posn away from fixture ;
42:  !P1/Approach position for fixture ;
43:L P[...] 250mm/sec FINE   ;
44:  ;

 POINT | SPOT |      |      | TOUCHUP |
```

> ⚠**CAUTION**
> - Specify the same number to all gun number in TW_SET02.
> - Specify the same number to all register number in TW_SET02.
> - Specify the same number to all position register number in TW_SET02.
>   Ex.)
>   CALL TWKINIT(2) ;
>   CALL TWKTHOLD(2, 30, 31) ;
>   CALL TWKZRCLB(2, 30, 31) ;
>   CALL TWKFXTCH(2, 30, 31) ;
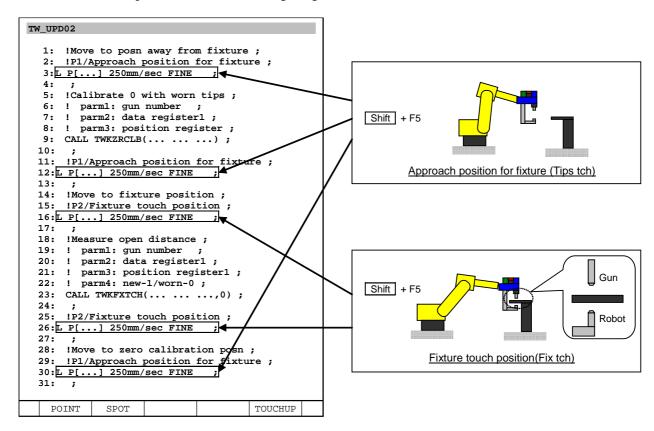
6. Execute TW_SET02. Check teaching positions and gun axis speed, then execute it finally with override 100% (AUTO mode or T2 mode). This completes the initial setup.

> ⚠**CAUTION**
> TW_SET02 cannot be executed at the same time with two or more equipments.
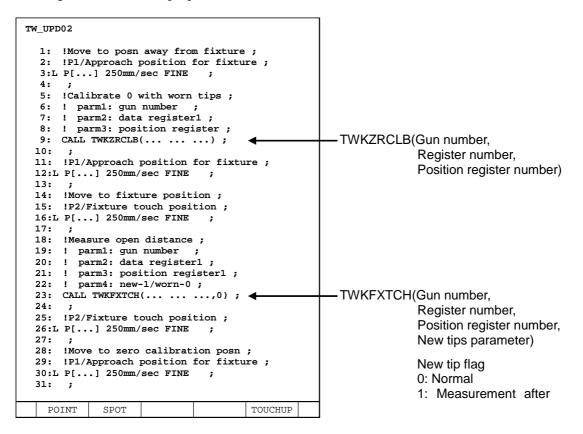
6.12.3 Update Tip Wear Amount of 2 step method for Multi-Equipment

1. Set $SGSYSCFG.$LOAD_TWD = 15, and then repower controller. TW_UPD0X will be loaded.
2. Copy TW_UPD0X to another name. (After this, TW_UPD02 is used to explain as an example.)
    Ex.) Eq 2: TW_UPD0X → COPY → TW_UPD02
3. Confirm the robot group and gun group match with the group mask of TW_UPD02.
4. Teach the two positions shown in the right figure in TW_UPD02.

```
TW_UPD02

 1:  !Move to posn away from fixture ;
 2:  !P1/Approach position for fixture ;
 3: L P[...] 250mm/sec FINE    ;
 4:  ;
 5:  !Calibrate 0 with worn tips ;
 6:  !  parm1: gun number   ;
 7:  !  parm2: data register1 ;
 8:  !  parm3: position register ;
 9:  CALL TWKZRCLB(... ... ...) ;
10:  ;
11:  !P1/Approach position for fixture ;
12: L P[...] 250mm/sec FINE    ;
13:  ;
14:  !Move to fixture position ;
15:  !P2/Fixture touch position ;
16: L P[...] 250mm/sec FINE    ;
17:  ;
18:  !Measure open distance ;
19:  !  parm1: gun number   ;
20:  !  parm2: data register1 ;
21:  !  parm3: position register1 ;
22:  !  parm4: new-1/worn-0 ;
23:  CALL TWKFXTCH(... ... ...,0) ;
24:  ;
25:  !P2/Fixture touch position ;
26: L P[...] 250mm/sec FINE    ;
27:  ;
28:  !Move to zero calibration posn ;
29:  !P1/Approach position for fixture ;
30: L P[...] 250mm/sec FINE    ;
31:  ;

   POINT    SPOT              TOUCHUP
```

Shift + F5

Approach position for fixture (Tips tch)

Shift + F5

Gun

Robot

Fixture touch position(Fix tch)

> ⚠ **CAUTION**
> Notice the following for teaching positions.
> - Confirm the robot group and gun group match with the group mask of TW_SET02 or set it.
> - Specify the same position ID for all approach positions.
> - Specify same position ID to all fixture touch position.
> - The fixture approach position of TW_UPD02 should be the same as that of TW_SET02.
> - Fixture touch position of TW_UPD02 should be the same as fixture touch position of TW_SET02.

5. Specify gun number, register number, and position register number for TW_UPD02. Don't use these registers for another purpose.

```
TW_UPD02

  1:  !Move to posn away from fixture ;
  2:  !P1/Approach position for fixture ;
  3:L P[...] 250mm/sec FINE    ;
  4:   ;
  5:  !Calibrate 0 with worn tips ;
  6:  ! parm1: gun number   ;
  7:  ! parm2: data register1 ;
  8:  ! parm3: position register ;
  9:  CALL TWKZRCLB(... ... ...) ;          ◄────── TWKZRCLB(Gun number,
 10:   ;                                                      Register number,
 11:  !P1/Approach position for fixture ;                     Position register number)
 12:L P[...] 250mm/sec FINE    ;
 13:   ;
 14:  !Move to fixture position ;
 15:  !P2/Fixture touch position ;
 16:L P[...] 250mm/sec FINE    ;
 17:   ;
 18:  !Measure open distance ;
 19:  ! parm1: gun number   ;
 20:  ! parm2: data register1 ;
 21:  ! parm3: position register1 ;
 22:  ! parm4: new-1/worn-0 ;
 23:  CALL TWKFXTCH(... ... ...,0) ;        ◄────── TWKFXTCH(Gun number,
 24:   ;                                                      Register number,
 25:  !P2/Fixture touch position ;                            Position register number,
 26:L P[...] 250mm/sec FINE    ;                              New tips parameter)
 27:   ;
 28:  !Move to zero calibration posn ;                        New tip flag
 29:  !P1/Approach position for fixture ;                     0: Normal
 30:L P[...] 250mm/sec FINE    ;                              1: Measurement after
 31:   ;

  POINT    SPOT              TOUCHUP
```

> ⚠ **CAUTION**
> - Gun number in TW_UPD02 should be the same as gun number in TW_SET02.
> - Register number in TW_UPD02 should be the same as register number in TW_SET02.
> - Position register number in TW_UPD02 should be the same as position register number in TW_SET02.

⚠**CAUTION**
- Specify the same number to all gun number in TW_UPD02.
- Specify the same number to all register number in TW_UPD02.
- Specify the same number to all position register number in TW_UPD02.
  Ex.)
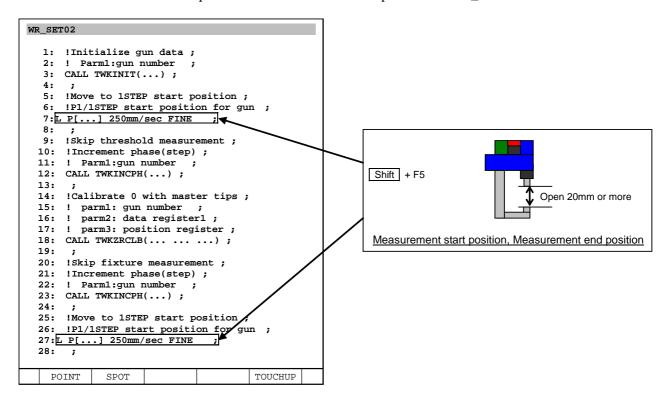   CALL TWKZRCLB(2, 30, 31) ;
      CALL TWKFXTCH(2, 30, 31, 0) ;

6.   Execute TW_UPD02.

⚠**CAUTION**
TWTHOLD2.TP, TWZRCLB*.TP, and TWFXTCH*.TP, which are used during measurement and for the initial setup, are displayed(* = 1 to 5). These are internal programs for tip wear measurement that are in a temporary visible status. **Do not edit or delete these**.

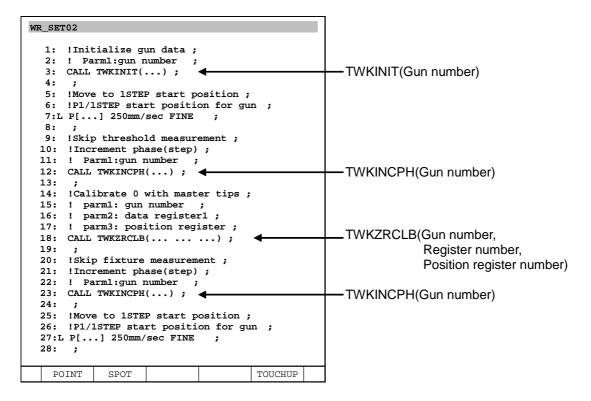## 6.12.4   Initial Setup of 1 step method for Multi-Equipment

1.   Set $SGSYSCFG.$LOAD_TWD = 15, and then repower controller. WR_SET0X will be loaded.
2.   Copy WR_SET0X to another name. (After this, WR_SET02 is used to explain as an example.)
     Ex.) Eq 2: WR_SET0X → COPY → WR_SET02
3.   Confirm the gun group matches with the group mask of WR_SET02.
4.   Teach measurement start position and measurement end position in WR_SET02.

```
WR_SET02

 1:  !Initialize gun data ;
 2:  ! Parm1:gun number   ;
 3:  CALL TWKINIT(...) ;
 4:   ;
 5:  !Move to 1STEP start position ;
 6:  !P1/1STEP start position for gun ;
 7: L P[...] 250mm/sec FINE    ;
 8:   ;
 9:  !Skip threshold measurement ;
10:  !Increment phase(step) ;
11:  ! Parm1:gun number   ;
12:  CALL TWKINCPH(...) ;
13:   ;
14:  !Calibrate 0 with master tips ;
15:  ! parm1: gun number   ;
16:  ! parm2: data register1 ;
17:  ! parm3: position register ;
18:  CALL TWKZRCLB(... ... ...) ;
19:   ;
20:  !Skip fixture measurement ;
21:  !Increment phase(step) ;
22:  ! Parm1:gun number   ;
23:  CALL TWKINCPH(...) ;
24:   ;
25:  !Move to 1STEP start position ;
26:  !P1/1STEP start position for gun ;
27: L P[...] 250mm/sec FINE    ;
28:   ;

   POINT    SPOT                   TOUCHUP
```

Shift + F5

Open 20mm or more

Measurement start position, Measurement end position

⚠**CAUTION**
Confirm the gun group matches with the group mask of WR_SET02 before teaching or set it.

5. Specify gun number, register number, and position register number for WR_SET02. Don't use these registers for another purpose.

```
WR_SET02

  1:  !Initialize gun data ;
  2:  ! Parm1:gun number   ;
  3:  CALL TWKINIT(...) ;           ◄──────────── TWKINIT(Gun number)
  4:   ;
  5:  !Move to 1STEP start position ;
  6:  !P1/1STEP start position for gun  ;
  7:L P[...] 250mm/sec FINE    ;
  8:   ;
  9:  !Skip threshold measurement ;
 10:  !Increment phase(step) ;
 11:  ! Parm1:gun number   ;
 12:  CALL TWKINCPH(...) ;          ◄──────────── TWKINCPH(Gun number)
 13:   ;
 14:  !Calibrate 0 with master tips ;
 15:  ! parm1: gun number ;
 16:  ! parm2: data register1 ;
 17:  ! parm3: position register ;
 18:  CALL TWKZRCLB(... ... ...) ;  ◄──────────── TWKZRCLB(Gun number,
 19:   ;                                                    Register number,
 20:  !Skip fixture measurement ;                          Position register number)
 21:  !Increment phase(step) ;
 22:  ! Parm1:gun number   ;
 23:  CALL TWKINCPH(...) ;          ◄──────────── TWKINCPH(Gun number)
 24:   ;
 25:  !Move to 1STEP start position ;
 26:  !P1/1STEP start position for gun  ;
 27:L P[...] 250mm/sec FINE    ;
 28:   ;

 POINT  |  SPOT  |       |        | TOUCHUP |
```

⚠**CAUTION**
- Specify the same number to all gun number in WR_SET02.
- Specify the same number to all register number in WR_SET02.
- Specify the same number to all position register number in WR_SET02.
  Ex.)
       CALL TWKINIT(2) ;
       CALL TWKINCPH(2) ;
       CALL TWKZRCLB(2, 30, 31) ;

6. Execute WR_SET02. **The gun close operation is performed immediately (the robot does not move).** Check the gun axis speed, and then perform initial setup **finally with override 100%** (AUTO mode or T2 mode).
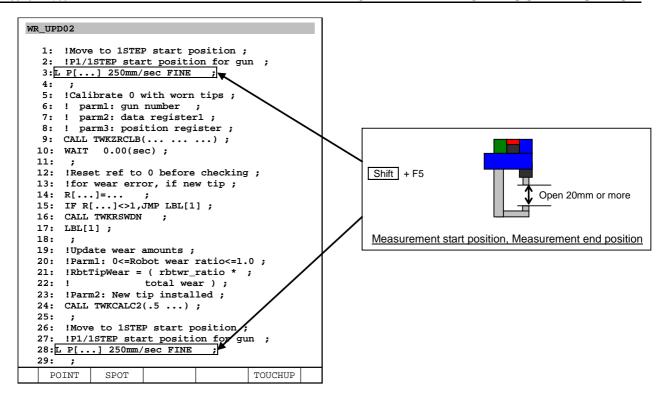   This completes the initial setup.

⚠**CAUTION**
    WR_SET02 cannot be executed at the same time with two or more equipments.
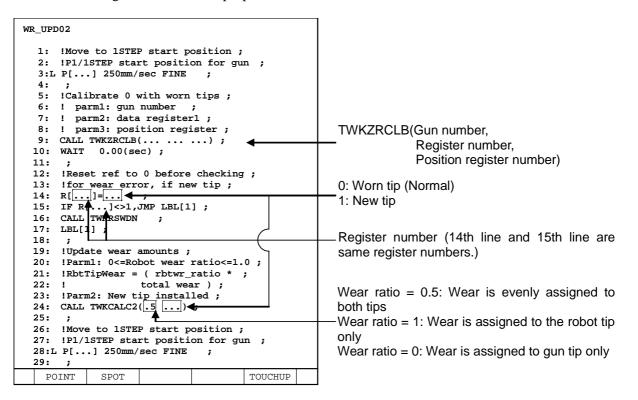
6.12.5   Update Tip Wear Amount of 1 step method for Multi-Equipment

1. Set $SGSYSCFG.$LOAD_TWD = 15, and then repower controller. WR_UPD0X will be loaded.
2. Copy WR_UPD0X to another name. (After this, WR_UPD02 is used to explain as an example.)
    Ex.) Eq 2: WR_UPD0X → COPY → WR_UPD02
3. Confirm the gun group matches with the group mask of WR_UPD02.
4. Teach measurement start position and measurement end position in WR_UPD02.

```
WR_UPD02

  1:  !Move to 1STEP start position ;
  2:  !P1/1STEP start position for gun ;
  3:L P[...] 250mm/sec FINE    ;
  4:   ;
  5:  !Calibrate 0 with worn tips ;
  6:  ! parm1: gun number   ;
  7:  ! parm2: data register1 ;
  8:  ! parm3: position register ;
  9:  CALL TWKZRCLB(... ... ...) ;
 10:  WAIT  0.00(sec) ;
 11:   ;
 12:  !Reset ref to 0 before checking ;
 13:  !for wear error, if new tip ;
 14:  R[...]=...   ;
 15:  IF R[...]<>1,JMP LBL[1] ;
 16:  CALL TWKRSWDN   ;
 17:  LBL[1] ;
 18:   ;
 19:  !Update wear amounts ;
 20:  !Parm1: 0<=Robot wear ratio<=1.0 ;
 21:  !RbtTipWear = ( rbtwr_ratio * ;
 22:  !           total wear ) ;
 23:  !Parm2: New tip installed ;
 24:  CALL TWKCALC2(.5 ...) ;
 25:   ;
 26:  !Move to 1STEP start position ;
 27:  !P1/1STEP start position for gun ;
 28:L P[...] 250mm/sec FINE    ;
 29:   ;

  POINT    SPOT              TOUCHUP
```

Shift + F5

Open 20mm or more

Measurement start position, Measurement end position

⚠ **CAUTION**
  Confirm the gun group matches with the group mask of WR_UPD02 before
  teaching or set it.

---

5.   Specify gun number, register number, position register number, and wear ratio for WR_UPD02. Don't
     use these registers for another purpose.

```
WR_UPD02

  1:  !Move to 1STEP start position ;
  2:  !P1/1STEP start position for gun ;
  3:L P[...] 250mm/sec FINE    ;
  4:   ;
  5:  !Calibrate 0 with worn tips ;
  6:  ! parm1: gun number   ;
  7:  ! parm2: data register1 ;
  8:  ! parm3: position register ;
  9:  CALL TWKZRCLB(... ... ...) ;
 10:  WAIT  0.00(sec) ;
 11:   ;
 12:  !Reset ref to 0 before checking ;
 13:  !for wear error, if new tip ;
 14:  R[...]=...   ;
 15:  IF R[...]<>1,JMP LBL[1] ;
 16:  CALL TWKRSWDN   ;
 17:  LBL[1] ;
 18:   ;
 19:  !Update wear amounts ;
 20:  !Parm1: 0<=Robot wear ratio<=1.0 ;
 21:  !RbtTipWear = ( rbtwr_ratio * ;
 22:  !           total wear ) ;
 23:  !Parm2: New tip installed ;
 24:  CALL TWKCALC2(.5 ...) ;
 25:   ;
 26:  !Move to 1STEP start position ;
 27:  !P1/1STEP start position for gun ;
 28:L P[...] 250mm/sec FINE    ;
 29:   ;

  POINT    SPOT              TOUCHUP
```

TWKZRCLB(Gun number,
          Register number,
          Position register number)

0: Worn tip (Normal)
1: New tip

Register number (14th line and 15th line are
same register numbers.)

Wear ratio = 0.5: Wear is evenly assigned to
both tips
Wear ratio = 1: Wear is assigned to the robot tip
only
Wear ratio = 0: Wear is assigned to gun tip only

> ⚠ **CAUTION**
> - Gun number in WR_UPD02 should be the same as gun number in WR_SET02.
> - Register number in WR_UPD02 should be the same as register number in WR_SET02.
> - Position register number in WR_UPD02 should be the same as position register number in WR_SET02.

6.   Execute WR_UPD02. The gun close operation is performed immediately (the robot does not move).

> ⚠ **CAUTION**
> During performing measurement/initial setup, TWZRCLB*.TP is displayed (where
> *= 1 to 5). These are internal programs for tip wear measurement that are in a
> temporary visible status. **Do not edit or delete these**.

6.13   AUTO COMBINATION OF 2 STEP AND 1 STEP METHOD

6.13.1   Overview

This function provides a function that determines whether the 1 stepor 2 step method should be used based on the current tip wear and performs the tip wear measurement using the determined method.

> **NOTE**
> This function is supported by 7DC2 series version 07 and later.

> **NOTE**
> Auto updating wear ratio function (6.8) can be used with this function.

6.13.2   Standard Tip Wear Programs for Auto Combination

The following TP programs are provided for auto combination of 2 step method and 1 step method when the Servo Gun option is installed.

Program name	Main Macro That is Run	Function
To use the following programs, set $SGSYSCFG. $LOAD_TWD = 11 and cycle the power.		
XW_UPD01	XW_UPDAT	Determines whether the 1 step or 2 step method should be used based on the current tip wear and measures the tip wear using the determined method.
To use the following program, set $SGSYSCFG. $LOAD_TWD = 15 and cycle the power.		
XW_UPD0X		Determines whether the 1 step or 2 step method should be used based on the current tip wear and measure the tip wear using the determined method. This program is for tip wear compensation with multiple equipment. Please refer to Section 6.12 about tip wear compensation with multiple equipment. Copy and use this TP program for each equipment.

XW_UPDAT macro program use R[10] as the default register. Do not use this register for any other purpose. If you want to change the register number, edit the following numbers in macro program, directly.

```
XW_UPDAT                                                _
                                               1/26
   1:  !Program description
   2:  !  Update combination wear meas
   3:
   4:  !Input parameter(s)
   5:  !  AR[1]: Gun number
   6:  !  AR[2]: New tip
   7:
   8:  !Data register(s) used
   9:  !  R[10]
  10:
  11:  !Judge measurement method
  12:  !  parm1: gun number
  13:  !  parm2: data register1
  14:  !  parm3: new-1/worn-0
  15:  CALL TWKSTCHK(AR[1],10,AR[2])
  16:  IF R[10]>0,JMP LBL[1]
  17:
  18:  !Call 1 step measurement
  19:  CALL WR_UPDAT(AR[1],AR[2])
  20:  END
  21:
  22:  LBL[1]
  23:  !Call 2 step measurement
  24:  CALL TW_UPDAT(AR[1],AR[2])
  25:  END
[End]
```
| | POINT | SPOT | | | TOUCHUP | |

Please refer to subsection 6.14.5 about XW_UPD0X (for multi-equipment).

6.13.3   Initial Procedures

1   Set $SGSYSCFG.$LOAD_TWD = 11 and cycle power. The following programs are loaded:
    -XW_UPD01 (TP program)
    -XW_UPDAT (macro program)
2   Perform initial setup with 2 step method. Please refer to 6.6.2 and 6.8.2 for more details.
3   Once the initial setup is complete, perform XW_UPD01 without the new tip flag after tip dressing.
    Tip wear measurement is performed automatically with the one- or 2 step method based on the current tip wear.
4   If new tip is installed, perform XW_UPD01 with new tip flag.
    2 step measurement is performed automatically.

NOTE
   Please make sure to perform the program with new tip flag if new tip is installed.

```
XW_UPD01                                              _
                                          1/21
   1:  !Program description
   2:  !  Update wear measmt for
   3:  !  specified gun number.
   4:
   5:  ! Note: Parm2 is used only for
   6:  !   measurement error checking
   7:  !   ( increased error function).
   8:  !   Parm2 should be <>0 at cap
   9:  !   change only.
  10:  !   If measurement error checkng
  11:  !   is NOT used, then Parm2
  12:  !   should always be 0.
  13:
  14:
  15:  !Use the following call for
  16:  !fixture-based wear measuremt
  17:  !Parm1: gun number
  18:  !Parm2: new tips:1,used tips:0
  19:  !CALL XW_UPDAT( 1, 0 )
  20:  CALL XW_UPDAT(1,0) ◄───────────── AR1: gun number,  AR2: new tip flag
[End]
```
```
 |     | POINT | SPOT |     |     | TOUCHUP |     |
```

6.13.4 Setup Screen

The threshold level for determination of measurement method, forced method selection by DI, and notification of the selected method by DO can be configured in this screen.

```
SETUP Servogun                                     _
  TIP WEAR DETECT / EQ:1 Gun:1          16/20
       Auto update wear down ratio
  12     Update Enb/Dsb:             ENABLE
         Update status:             INACTIVE
  13     Max Wear ratio limit:        0.70
  14     Min Wear ratio limit:        0.30
  15     Severity for limit over:     WARN
       Auto-detect of meas method
  16     Increment for 2 step:        2.0mm
  17     Forced 1 step signal:     DI[  0]
  18     Forced 2 step signal:     DI[  0]
  19     1 step notification:      DO[  0]
  20     2 step notification:      DO[  0]
```
```
 |  [TYPE] | EQUIP | GUN | END |   |   |
```

Setup Items	Description
Increment for 2 step	When difference between current total tip wear and total tip wear at last 2 step method is larger than this value, measurement method is 2 step. When the difference is smaller than this value, measurement method is 1 step.
Forced 1 step signal	When the specified DI is ON, the measurement method is performed with the 1 step method.
Forced 2 step signal	When the specified DI is ON, the measurement method is performed with the 2 step method.
1 step notification	DO specified for the 1 step method is set to ON.
2 step notification	DO specified for the 2 step method is set to ON.

NOTE
"Increment for the two-step" affects the calculation accuracy of wear ratio if auto updating wear ratio is used. Hence, 2 to 3 mm is recommended for "Increment for the 2 step."
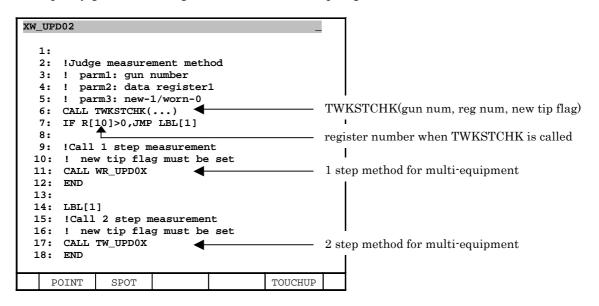
> **NOTE**
> For example, if total wear down of both tips is 4.8 mm at last 2 step method and
> "Increment for 2 step" is 2.0 mm, measurement method is 1 step until total wear
> down of both tips exceeds 6.8 mm. Measurement method is 2 step when total
> wear down of both tips exceeds 6.8 mm.

6.13.5   Auto Combination for Multi-Equipment

1   Perform initial setup with the 2 step method for multiple equipment. Please refer to 6.12.2 for more
    details.
2   Create the 1 step method program and 2 step method program for multiple equipment. Please refer to
    6.12.3 and 6.12.5 for more details.
3   Set $SGSYSCFG.$LOAD_TWD = 15 and cycle power. XW_UPD0X is loaded.
4   Copy and rename XW_UPD0X. (After this, XW_UPD02 is used to explain as an example)
    Ex) EQ2 : XW_UPD0X → COPY → XW_UPD02
5   Specify gun number, register number and new tip flag in XW_UPD02.

```
XW_UPD02                                             _

  1:
  2:  !Judge measurement method
  3:  !  parm1: gun number
  4:  !  parm2: data register1
  5:  !  parm3: new-1/worn-0
  6:  CALL TWKSTCHK(...)      ◄──────────── TWKSTCHK(gun num, reg num, new tip flag)
  7:  IF R[10]>0,JMP LBL[1]
  8:                          ──────────── register number when TWKSTCHK is called
  9:  !Call 1 step measurement
 10:  ! new tip flag must be set
 11:  CALL WR_UPD0X          ◄──────────── 1 step method for multi-equipment
 12:  END
 13:
 14:  LBL[1]
 15:  !Call 2 step measurement
 16:  ! new tip flag must be set
 17:  CALL TW_UPD0X          ◄──────────── 2 step method for multi-equipment
 18:  END

        POINT      SPOT                        TOUCHUP
```

> **NOTE**
> When executing the program, correctly set the new tip flag for the called program.
> It is recommended to set the new tip flag for TW_UPD0X and WR_UPD0X using
> arguments.

6   Perform XW_UPD02.

6.14 **FALSE DETECTION PREVENTION FOR TIP WEAR MEASUREMENT**

6.14.1 Overview

Reference zero position calibration is carried out with 0 kgf. However, 0 kgf might not be able to correctly recognize the zero position due to mechanical resistance (internal friction of the power transmission part) that exists in the spot welding gun, and might cause the false detection. This function uses the mastering pressure (arbitrary pressure) for reference zero position calibration and prevents false detection.

NOTE
   This function is supported by 7DC3 series version 13 and later.

Initial Procedures

1. Set the mastering pressure on the tip wear detect setup screen.

```
SETUP Servogun                                             _
  TIP WEAR DETECT / EQ:1 Gun:1                    1/20


    1      Common setup:            <*DETAIL*>

    2      Detection type:              LOAD
    3        Margin of load(nwt):        250
    4      Tip speed(mm/sec):             30
    5      Mastering pressure(nwt):        0
    6      Mis-detect toler.(mm):       5.00


      [TYPE]    EQUIP     GUN      END
```

Setup Items	Description
Mastering pressure (kgf) (Default = 0 kgf)	0 kgf : This function is invalid. Reference zero position calibration is carried out with 0 kgf. 0 kgf< : This function is valid. Reference zero position calibration is carried out by the value specified here.

2. Execute TW_SETUP macro program or WR_SETUP macro program. Mastering pressure is used for initial setup. Procedure and notice of execution are the same as normal use of each step measurement method.

NOTE
   During reference zero position calibration in the initial setup, the pressure motion is performed twice.
---

3. Execute TW_UPDAT macro program or WR_UPDAT macro program after tip dress. Mastering pressure is used to update the tip wear down amount. Procedure and notice of execution are the same as normal use of each step measurement method.

6.15   TIP WEAR DOWN COMPENSATION FOR AIR-CUT MOTION

6.15.1   Overview

The tip wear compensation function masters the gun axes each time tip wear measurement is performed. Therefore, the end of worn gun tip is different from end of new gun tip and surrounding objects if positioning is performed with a motion instruction without SPOT instruction (called air-cut motion).

For example, consider the case robot approaches to the fixture as shown in the following figures. In a new tip case (left figure), the distance between end of gun tip and fixture is Da.

If the tip is worn (center figure), the distance between end of gun tip and the fixture is Db = Da − wear value of robot tip because the end of robot tip has changed. If the wear advances and the wear value of robot tip > Da, the end of the gun tip bumps into the fixture.
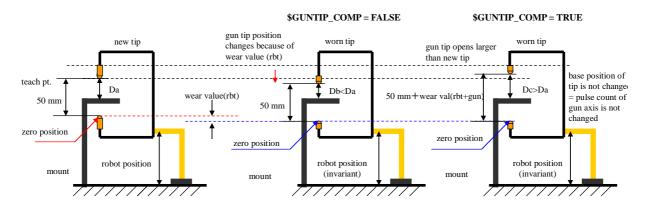
★By enabling this function, the gun axis moves to teach point + tip wear value, as shown in the right figure, when it is in a motion without SPOT instruction. That is, the base position of the gun tip (pulse count value) always moves to the same position regardless of the wear down amount.

NOTE
     Set $SGSYSTWD.$GUNTIP_COMP = TRUE (Default: FALSE) to enable this function.

NOTE
     This function is supported by 7DC2 series version 05 and later.

6.15.2   Precaution

The followings are different from the default when this function is enabled.
- Program execution behavior
- Touchup behavior
- Open stroke limit auto update

Program execution behavior

The gun tip opens additionally by a total wear of both tips when moving to a position without SPOT instruction.

For example, if taught position = 50 mm and total tip wear down = 5 mm, gun axis moves to 55 mm at program execution. Note that actual moved position is different from taught position.

> **NOTE**
> TP programs used in system are not compensated. That is, other servo gun functions are not affected by this function.

Touchup behavior

Touchup point for motion without SPOT instruction becomes gun axis position that new tip is installed. For example, if current position = 55 mm and total tip wear down = 5 mm, taught position becomes 50 mm. Note that taught position is different from current position.

> **NOTE**
> If touchup is performed with worn tip and small gun open, gun tip may bumps into peripheral when new tip is installed. Perform touchup on the assumption that new tip is installed if this function is enabled.
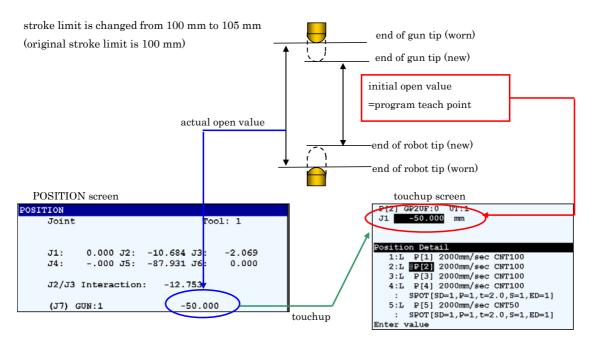
Open stroke limit auto update

Open stroke limit increases with tip wear value.

For example, if open stroke limit at setup = 100 mm and total tip wear down = 5 mm, open stroke limit is auto-updated to 105 mm. Base position of gun tip (pulse count of gun axis) at stroke limit is same even if open stroke limit becomes large.

e.g. open value = 50 mm, wear value (gun) = 2.5 mm, wear value (rbt) = 2.5 mm
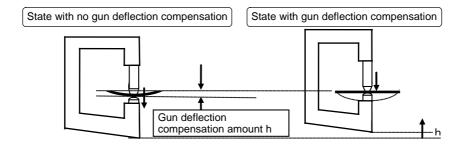
7   GUN SAG COMPENSATION

Compensating for gun sag (deflection) that may occur at pressurization will enable a spot welding sequence to always be performed at an optimum position.

7.1   COMPENSATION METHOD

Compensation method

Gun deflection is compensated for by setting up the gun sag comp value in the Pressure Schedule and pushing up the robot tip by the gun sag comp amount as pressure is applied. The gun sag comp amount can be applied by setting it up in each pressure schedule.

Gun Sag Compensation amount setting method:

Set the gun sag value by following the following steps:
1   Press the [DATA] key to display the DATA screen
2   Press F1"[TYPE]" to display the pull-up menu.
3   Select "Pressure". The servo gun Pressure Schedule list screen will be displayed.
4   Press F4"DETAIL". The servo gun Pressure Schedule detail setting screen will be displayed.
5   Input the gun deflection amount to the item " Gun Sag Comp Value (mm)" in the screen.
6   Enable " Gun Sag Compensation" on the "Servo Gun General Setup" screen.
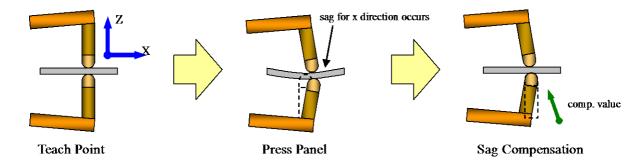
```
SERVO GUN DATA
PRESSURE / EQ:1 GUN:1                    1/99
No.   Press(Nwt)      Manual      Comment
1       3500.0        TRUE      [         ]
2       1800.0        TRUE      [         ]
3          0.0        FALSE     [         ]
4          0.0        FALSE     [         ]

   [ TYPE ]   EQUIP     GUN    DETAIL    COPY    >
```

```
SERVO GUN DATA
PRESSURE / EQ:1 GUN:1                    1/4
 1   Comment:               [         ]
 2   Standard Pressure(nwt):       3500.0
 3   Gun Sag Comp Value(mm):          1.2
 4   Weight compensation type:    DISABLE

   [ TYPE ]   EQUIP     GUN     LIST
```

7.2   3-D COMPENSATION

Gun arm sags along not only gun axis but also the axes normal to gun axis.
Sag along the axes normal to gun axis can be compensated by specifying X, Y, Z sag values.

Teach Point   Press Panel   Sag Compensation

NOTE
    This function has been supported since 7DC2/05.

NOTE
    Set $SGGUN#.$SETUP.$GUNSAGTYP = 3 to use this function (#: gun number).

Sag value for each pressure schedule can be configured or confirmed on pressure schedule screen.

```
SERVO GUN DATA
PRESSURE / EQ:1 Gun:1 No:1                    3/5
  1   Comment:                    [           ]
  2   Weld Pressure(nwt):              1500.0
  3   Gun Sag Comp for X (mm):           -0.2
  4   Gun Sag Comp for Y (mm):            0.0
  5   Gun Sag Comp for Z (mm):            2.0


   [ TYPE ]   EQUIP     GUN      LIST
```

Gun sag compensation is performed based on the specified coordinate system in servogun setup screen.
- Specify 2.0 as "gun sag comp for Z" when you want to compensate 2.0mm along +Z coordinate axis
- Specify –0.2 as "gun sag comp for X" when you want to compensate 0.2mm along –X coordinate axis

Please refer to the section 7.3 "GUN SAG COMPENSATION SETUP SCREEN" for more details on gun sag compensation setup.

7.3　GUN SAG COMPENSATION SETUP SCREEN

Compensation method can be selected/configured on gun sag compensation setup screen.

> **NOTE**
>   This screen has been supported since 7DC2/05.

> **NOTE**
>   Set $SGGUN#.$SETUP.$GUNSAGTYP = 3 to display this screen. (#: gun
>   number)
>   Compensation values for X, Y, Z direction are required to be input when
> $SGGUN#.$SETUP.$GUNSAGTYP = 3.

Procedure to display gun sag compensation setup screen
1   Press the [MENU] key, then select "6 SETUP".
2   Press F1 [TYPE], then select "Servo Gun".
3   "General Setup" -> "Gun Sag Setup". The following will be displayed.

```
Setup Servo gun
Gun Sag Compensation Setup              1/1
    Compensation Method:        SEPARATE

  Setup sag value from press data screen


   [ TYPE ]   EQUIP     GUN    [CHOICE]
```

Please select compensation method from the following methods.

METHOD	DESCRIPTION
SEPARATE	Sag compensation values are specified on pressure schedule screen.
TABLE	In this method, sag compensation value is automatically calculated based on pressure-sag relation. Input two and above pressure-sag relations.
RATE	In this method, sag compensation value is automatically calculated from a product of sag rate and specified pressure. Input sag rates on this screen.

7.3.1　Separate Setting For Each Pressure Schedule

Gun sag compensation values have to be specified on pressure schedule screen when "SEPARATE" is selected as compensation method.

```
Setup Servo gun
Gun Sag Compensation Setup              1/1
    Compensation Method:        SEPARATE

  Setup sag value from press data screen


   [ TYPE ]   EQUIP     GUN    [CHOICE]
```

Gun sag compensation values have to be input for X, Y, Z directions.
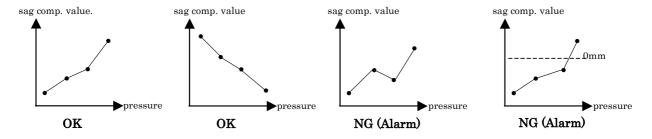
```
SERVO GUN DATA
PRESSURE / EQ:1 Gun:1 No:1                    3/5
  1  Comment:                      [           ]
  2  Weld Pressure(nwt):                 1500.0
  3  Gun Sag Comp for X (mm):              -0.2
  4  Gun Sag Comp for Y (mm):               0.0
  5  Gun Sag Comp for Z (mm):               2.0


     [ TYPE ]    EQUIP     GUN      LIST
```

7.3.2   Auto Setting By Sag Table

Gun sag compensation values are automatically calculated based on pressure-sag relations when "TABLE" is selected as compensation method. Input two and above pressure-sag relations.

```
Setup Servo gun
Gun Sag Compensation Setup                 1/12
       Compensation Method:             TABLE

       Calibration Status:             INCOMP
       Close Direction(Robot):   UT: 1 [+Z ]

   Pressure          X         Y         Z
 1 1000.0nwt       -0.1mm    0.0mm    1.0mm
 2 2000.0nwt       -0.3mm    0.0mm    2.0mm
 3 3000.0nwt       -0.5mm    0.0mm    3.0mm
 4 4000.0nwt       -0.6mm    0.0mm    4.0mm
 5    0.0nwt        0.0mm    0.0mm    0.0mm

     [ TYPE ]    EQUIP     GUN    [CHOICE]
```

Sag compensation values have to increase/decrease with pressure and cannot cross 0mm.

After sag compensation values are input, move cursor on calibration status line then press F4 "COMP". Pressure-sag values are sorted based on pressure and checked whether setting is correct or not. If setting is correct, message "Sag compensation has completed" is displayed and calibration status becomes COMP. Pressure and sag compensation values cannot be changed when calibration status is COMP. Please press F5 "INCOMP" if you want to configure it again.

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```
Setup Servo gun
Gun Sag Compensation Setup              3/12
     Calibration Status:               COMP
     Close Direction(Robot):   UT: 1 [+Z ]


   Pressure           X         Y         Z
 1 1000.0nwt       -0.1mm    0.0mm     1.0mm
 2 2000.0nwt       -0.3mm    0.0mm     2.0mm
 3 3000.0nwt       -0.5mm    0.0mm     3.0mm
 4 4000.0nwt       -0.6mm    0.0mm     4.0mm
 5    0.0nwt        0.0mm    0.0mm     0.0mm
 6    0.0nwt        0.0mm    0.0mm     0.0mm
 7    0.0nwt        0.0mm    0.0mm     0.0mm

 [ TYPE ]   EQUIP     GUN     COMP    INCOMP
```

Gun sag compensation values are automatically calculated and displayed on pressure schedule screen when calibration status is COMP. These values cannot be changed.

```
SERVO GUN DATA
PRESSURE / EQ:1 Gun:1 No:1               2/2
  1  Comment:                 [          ]
  2  Weld Pressure(nwt):            3000.0
     Gun Sag Comp for X (mm):         -0.5
     Gun Sag Comp for Y (mm):          0.0
     Gun Sag Comp for Z (mm):          3.0

 [ TYPE ]   EQUIP     GUN     LIST
```

7.3.3   Auto Setting By Sag Rate

Gun sag compensation values are automatically calculated from a product of sag rates and specified pressure when "RATE" is selected as compensation method. Input sag rates according to displayed physical unit.

```
Setup Servo gun
Gun Sag Compensation Setup              1/4
     Compensation Method:              RATE


     Close Direction(Robot):   UT: 1 [+Z ]


     Sag rate for X [mm/1000N ]:       -0.1
     Sag rate for Y [mm/1000N ]:        0.0
     Sag rate for Z [mm/1000N ]:        1.0

 [ TYPE ]   EQUIP     GUN     COMP    INCOMP
```

Gun sag compensation values are automatically calculated and displayed on pressure schedule screen. These values cannot be changed.

```
SERVO GUN DATA
PRESSURE / EQ:1 Gun:1 No:1               2/2
  1  Comment:                 [          ]
  2  Weld Pressure(nwt):            3000.0
     Gun Sag Comp for X (mm):         -0.3
     Gun Sag Comp for Y (mm):          0.0
     Gun Sag Comp for Z (mm):          3.0

 [ TYPE ]   EQUIP     GUN     LIST
```

8   EXT. TIP STICK SIGNAL DETECTION

The Tip Stick Detect Input from the external device allows tip stick signal detection. The state of this input will be checked after the weld complete signal is received and the gun actuator reaches the position specified by the <u>tip stick detect distance</u>. The robot will stop if the tips stick detect signal is still on at this specified opening.

```
┌─────────────────────────────────────────────────────────────────────┐
│ NOTE                                                                  │
│     The user is required to prepare the equipment for detecting stuck │
│     tips and the tip stick detection input signal.                    │
└─────────────────────────────────────────────────────────────────────┘
```

<u>Tip Stick Detect Input</u> is the input from the external device that indicates the tips are stuck. This input must be OFF when the gun opens past the tip stick detect distance, otherwise the robot will stop and issue the following alarm:

"SVGN-030 SVAL1 Tip Stick Detection"

Tip Stick Detect signal setting method
Display the I/O screen by executing the following procedure

```
┌─────────────────────────────────────────────────┐
│ I/O Weld In                                       │
│                                        10/10      │
│    NAME                 OUT PT   SIM STATUS       │
│  1 Weld in process:     DI[  0] U  ***            │
│  2 Weld complete:       DI[  0] U  ***            │
│  3 WELD/NOWELD status: DI[  0] U  ***             │
│  4 Major alarm:         DI[  0] U  ***            │
│  5 Minor Alarm:         DI[  0] U  ***            │
│  6 Iso contactor on:    DI[  0] U  ***            │
│  7 Cap change request: DI[  0] U  ***             │
│  8 Appr Cap change:     DI[  0] U  ***            │
│  9 Tip dress request:   DI[  0] U  ***            │
│ 10 Tip stick detect:    DI[  0] U  ***            │
│                                                   │
│    [ TYPE ]         IN/OUT              │    >    │
└─────────────────────────────────────────────────┘
```

1   Press the [MENU] key to bring up the screen menu.
2   Select "I/O".
3   Press F1"[TYPE]" to display the pull-up menu.
4   Select "Spot Equip". The Spot I/O screen will be displayed. Press F3 "IN/OUT" to display the input signal screen. The displayed screen may differ, depending on the weld interface.
5   Specify the index of the "Tip stick detect" input on Spot Input screen.

<u>Tip Stick Detect Distance</u> is the tip opening at which the tip stick detect input will be checked to determine if the tips are stuck. 1-5mm are typical values for this item.

Tip Stick Detect Distance setting method

Display the General Setup screen by executing the following procedure

```
SETUP Servogun
GENERAL / EQ:1 GUN:1                          7/13
 1 Tip Wear Comp:                        DISABLE
 2 Gun Sag Compensation:                 DISABLE
 3 Close Direction(Gun):                    PLUS
 4 Close Direction(Robot):        UT: 1 [+Z]
 5 Max Motor Torque(%):                    100.0
 6 Max Pressure(nwt):                     4900.0
   Max Gun Torque(%):                       10.5
 7 Tip stick detect distance(mm):            5
 8 Tip Wear Detection:              <*DETAIL*>
 9 Pressure Cal:           COMP    <*DETAIL*>
10 Tip Wear Standrd:       INCOMP  <*DETAIL*>
11 Thickness check:                <*DETAIL*>
12 Gun Stroke limit:               <*DETAIL*>
13 OverTorque protection           <*DETAIL*>


   [ TYPE ]   EQUIP    GUN
```

1   Press the [MENU] key to bring up the screen menu.
2   Select "SETUP".
3   Press F1"[TYPE]" to display the pull-up menu.
4   Select "Servo Gun".
5   Select "General Setup". (Move the cursor on <*DETAIL*> and press the [ENTER] key.) General Setup screen for Servo Gun setup will be displayed.
6   Specify "Tip stick detect distance(mm)"

NOTE
   Tip stick detect distance should be set to a value smaller than the SD of the tip distance schedule specified by the spot instruction.

Tip Stick Timing Output can be used to inform the PLC when the tip stick check was performed. Each time the gun opens from the weld spot, the tip stick timing output is turned on when the gun reaches the opening specified by the Tip Stick Detect Distance. This output turns on regardless of whether the tips are stuck or not.

Tip Stick Timing Output setting method

Display the I/O screen by executing the following procedure

```
I/O Weld Out
                                12/12
   NAME              OUT PT  SIM STATUS
 1 Weld schedule:    GO[  0] U **********
   Extended schedule:                  0
 2 Weld ID:          GO[  0] U **********
 3 Weld parity:      DO[  0] U  ***
 4 Schedule strobe:  DO[  0] U  ***
 5 Weld Initiate:    DO[  0] U  ***
 6 Enable weld:      DO[  0] U  ***
 7 Reset stepper:    DO[  0] U  ***
 8 Reset welder:     DO[  0] U  ***
 9 Iso contactor:    DO[  0] U  ***
10 Cap change comp:  DO[  0] U  ***
11 Enbl cont. savr:  DO[  0] U  ***
12 Tip stck timing:  DO[  0] U  ***


   [ TYPE ]           IN/OUT                    >
```
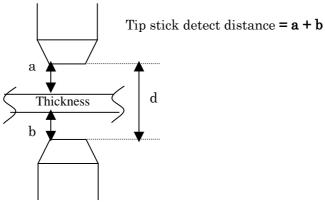
1   Press [MENU] key to bring up the screen menu.
2   Select "I/O".
3   Press F1"[TYPE]" to display the pull-up menu.
4   Select "Spot Equip". The I/O Spot Input/Output screen will be displayed. Press F3 "IN/OUT" to display the input signal screen.
5   Specify the index of the "Tip stick Timing" output on Spot Output screen.
The duration of the Tip Stick Timing output pulse is specified by the following system variable (the time is specified in ms):

$Spotweldio[eq#].$stkdo_dwltm = 500 (default)

TIP STICK DETECTION DETAIL
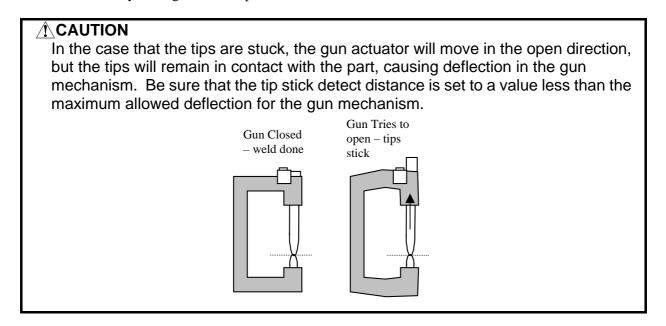
Tip Stick Detect Distance is defined as the separation between the tips and the part when the tip stick detect input shall be checked, see the flow chart:

So, the servo gun position (d) at the time of tip stick check equals:
d = Tip Stick Detect Distance + Part Thickness
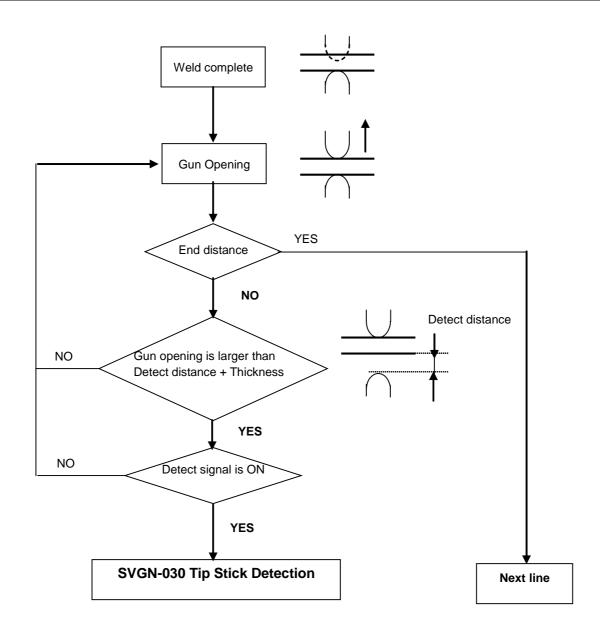
Since the gun is moving when the tip stick check is initiated, the position when the servo gun stops with a tip stick detection may be larger than the position at which the check is initiated.

⚠CAUTION
In the case that the tips are stuck, the gun actuator will move in the open direction, but the tips will remain in contact with the part, causing deflection in the gun mechanism. Be sure that the tip stick detect distance is set to a value less than the maximum allowed deflection for the gun mechanism.

Opening the Gun after a Tip Stick
When a tip stick occurs the gun can be opened by pressing the Shift+RESET key together. Alternatively, while holding down the [SHIFT] key, jog the gun open with the +/- jog key (X for gun 1, Y for gun 2) or use the BACKUP (BU 1/2) key.

> **⚠ CAUTION**
> Take great caution when using this jog method to release the tip stick. The
> Shift+RESET key sequence will override the Overtorque Protection limit and
> jogging the gun may place a large mechanical load on the servo gun and a large
> thermal load on the servo motor. The Collision Guard function of the robot will also
> be temporarily disabled. Release the [SHIFT] key to exit the Shift+RESET mode.

```
        ┌──────────────┐
        │ Weld complete │
        └──────┬───────┘
               │
               ▼
        ┌──────────────┐
───────▶│  Gun Opening  │
│       └──────┬───────┘
│              │
│              ▼
│          ◇ End distance ◇────── YES ──────────────────┐
│              │                                          │
│              NO                                         │
│              ▼                                          │
│    ◇ Gun opening is larger than ◇                       │
│ NO ◇  Detect distance + Thickness ◇  Detect distance    │
│◀─────                                                   │
│              YES                                        │
│              ▼                                          │
│ NO                                                      │
│◀──── ◇ Detect signal is ON ◇                            │
│              │                                          │
│              YES                                        │
│              ▼                                          ▼
│  ┌──────────────────────────────┐        ┌──────────────┐
│  │ SVGN-030 Tip Stick Detection │        │  Next line    │
│  └──────────────────────────────┘        └──────────────┘
```

9   SERVO GUN MONITORING

The state of the spot welding instruction being executed is displayed on the servo gun monitoring screen at real-time.

Procedure

Display the servo gun monitoring screen by executing the following procedure:

1   Press the [MENU] key to bring up the screen menu.
2   Select "0 -- NEXT --" and "4 STATUS".
3   Press F1"[TYPE]" to display the pull-up menu.
4   Select "Servo Gun". The SERVO GUN Monitoring screen will be displayed.

```
STATUS Servogun
SERVO GUN / EQ:1 Gun:1                    1/13
 1 Pressure schedule:                      0
 2 Start distance schedule:                0
 3 End distance schedule:                  0
 4 Tip Wear value(Gun)(mm):             0.00
 5 Tip Wear value(Robot)(mm):           0.00
 6 Pressure value(nwt):                 0.00
 7 Current position(Gun)(mm):           0.00
 8 Thickness check:
 9    Program name:
   ***************************************
10    Program line:              *****
11    Specified thickness(mm):       ******
12    Observed thickness(mm):        ******
13 Weight compen status:       <*DETAIL*>


    [ TYPE ]   EQUIP    GUN
```

Display items and Descriptions

Pressure schedule	Indicates the pressure schedule number specified for the spot welding instruction being executed or used last.
Start distance schedule	Indicates the start distance schedule number for the spot welding instruction being executed or used last.
End distance schedule	Indicates the end distance schedule number for the spot welding instruction being executed or used last.
Tip Wear value (Gun) (mm)	Indicates the wear amount of the movable tip.
Tip Wear value (Robot) (mm)	Indicates the wear amount of the stationary tip.
Pressure value (kgf)	Indicates the pressure applied during the execution of a spot welding instruction. The indicated pressure is obtained by subtracting a dynamic friction portion from the specified torque (corresponding to a disturbance torque) and multiplying the difference by a pressure conversion coefficient. The indicated value is therefore, a rough estimate of the pressure actually applied between the tips.
Current position (Gun) (mm)	Indicates the current gun position on the gun axis.
Thickness check:	The following parameters are used to check the thickness. Thickness status data is cleared at: Gun close Task end ****** is displayed after thickness check data is cleared.
Prog, line:	Program name and line number of spot/pressuring motion where thickness check is being performed.
Specified thickness(mm)	The expected (target) part thickness specified via pressure schedule or local condition.
Observed thickness(mm)	The measured (estimated) part thickness.
Weight compensation status	Compensation status by gun axis weight compensation function. Please refer to Section 18

NOTE
> The above items are standard display items.
> The above displayed items are dependent on software version and/or software option configuration.
> For details, see the descriptions of the corresponding option functions.

10 TEST CYCLE

This chapter describes the settings for the test cycle to confirm the correct operation of robot or gun before automatic operation executed in the conditions of production. In particular, this chapter focuses on how to set the servo gun specific application items related to running a test cycle. Please refer to Spot Welding OPERATOR'S MANUAL (B-83284EN-4) for more details on how to use the Test Cycle.

Spot Weld Test Cycle screen

1   Press the [MENU] key to bring up the screen menu.
2   Select "TEST CYCLE" to display the Test Cycle screen.
3   Press F1 "Screen" then select "SPOT Weld."

```
SPOT WELD
                                    1/10
      1 Gun operation:              STROKE
      2 Weld controller mode:          WELD
      3 Tryout mode:               DISABLED
      4 Weld IO sim:                ENABLED
      5    Weld Duration (ms):     500   ms
      6    Inform output to plc     DO[  0]
      7 Force process complete:    DISABLED

        Servo Gun Motion in Single Step
      8    Pressure Motion:          ENABLED
      9    Stop @ Taught Pos:        ENABLED

        Servo Gun Motion in Backward
     10    Stop @ Taught Pos:        ENABLED


    [TYPE]                  ENABLED   DISABLED
```

Set-Up Items for Test Cycle

Set the test operation conditions of the program on the Test Cycle screen.

Pressure Enabled/Disabled (cannot be changed if a program is running)	➤ **ENABLED**: Pressure motion is performed. ➤ **DISABLED**: No pressure motion or weld are performed. Weld is disabled.
Weld controller mode: (cannot be changed if a program is running)	➤ **ENABLED:** When the gun closes, the weld controller passes current through the gun according to the weld schedule. ➤ **DISABLED**: No current is passed through the gun when the weld controller executes the weld sequence.
Tryout Mode:	➤ **ENABLED:** Even when there is no panel, the weld operation is performed so that the desired pressure is reached without changing the thickness setting in the SPOT instruction. When the tryout state signal is assigned in the cell-interface output signals, the Tryout mode can be switched on this screen when TP is enabled. **DISABLED:** Weld operation is performed as usual, with the presence of a panel assumed. Always disabled when no Tryout state signal is assigned.
Weld IO sim	➤ **ENABLED:** Even if no weld schedule has been set, SPOT instruction and manual weld can be performed. To enable sim weld, weld must be disabled. ➤ **DISABLED** – sim weld is disabled.
Sim Weld Duration	Sim weld is executed for the specified duration. NOTE: Waiting time for sim weld may not be as specified. Default: 500 ms Maximum: 32767 ms Minimum: 0 ms
Sim Weld Notification	This signal provides external notification that sim weld is ENABLED.

Force Process Complete: (This is not related to the servo gun function.)	➤ **ENABLED** - Process Complete is turned on immediately. Process Complete will be cleared at the start of the next style. The Process Alert signal is turned on whenever Force Process Complete is enabled, and a WARNING error is displayed on the ALARMS screen to indicate that this abnormal operation was performed. ➤ **DISABLED** - Process Complete is turned off.
Servo gun motion in single step	
Pressure motion	➤ **ENABLED(DEFAULT) :** When SPOT instruction in program is executed with a single step, pressure motion is performed. ➤ **DISABLED:** When SPOT instruction in program is executed with a single step, pressure motion is not performed. However, manual pressure and pressure by utility functions such as manual weld are performed. For details, refer to subsection 5.1.6 Single Step.
Stop @ Taught Pos	➤ **ENABLED (DEFAULT):** When SPOT instruction is executed with a single step, robot and gun stop at taught position. ➤ **DISABLED:** When SPOT instruction is executed with a single step, robot and gun do not stop at taught position. For details, refer to subsection 5.1.6 Single Step.
Servo Gun Motion in Backward	
Stop @ Taught Pos	➤ **ENABLED:** When SPOT instruction is executed backward, robot and gun pause at taught position. ➤ **DISABLED (DEFAULT):** When SPOT instruction is executed backward, robot and gun do not stop at taught position. Refer to subsection 5.1.7 Backward.

NOTE
 If weld duration is specified extremely short or override is low, pressuring time might become longer than specified weld duration.

NOTE
 Even in tryout mode, the gun's open distance, trajectory of tips, and timing of deceleration are the same as those when there is a panel. Even if there is no panel, gun motion is decelerated before the panel position. As such, the cycle time in tryout mode differs from that when there is work.

NOTE
 Turn off rightmost bits of system variable $SGCFG[equipment number].$TRYOUT_MSK if you would like to use "PRESSURE ENABLE SIGNAL", "NEXT STEP ENABLE" or "NEXT STEP ENABLE FROM WELD CONTROLLER" with tryout mode enabled. To turn off rightmost bits, set value obtained by subtracting 1 from $TRYOUT_MSK if $TRYOUT_MSK is an odd number. For example, change to $TRYOUT_MSK = 6 in case of $TRYOUT_MSK = 7 (ODD). "PRESSURE ENABLE SIGNAL", "NEXT STEP ENABLE" or "NEXT STEP ENABLE FROM WELD CONTROLLER" can already be used if $TRYOUT_MSK is an even number.

11   PRESSURE RELATED I/O SIGNALS

The following are special signals related to the pressuring operation of the servo gun that can be used. The use and setup of these signals are optional.

Equalize Signal (output)
When a pneumatic equalizer is used, the timing for activation and the value of the Group Output associated with the equalizer can be controlled.

Pressure Enable Signal (input)
Set to enable the closing of the servo gun to pressure

Next Step Enable Signal (input)
Set to enable execution of the next step in the teach pendant program following the completion of a spot welding instruction

Pressure Notification Signal (output)
Set to inform that pressuring is active on the servo gun

11.1   EQUALIZE SIGNAL

Initial Setup
To enable the function with servo gun, do the following:
1   Set the following items on the Spot Config screen
   • Equalization Pressure : ENABLE
   • Number of Pressures: 4 or higher
Example: If 5 I/O points will be used with the group output, the number of pressure should be set to 31. If there is only 1 I/O point, then set to 4

```
SPOT CONFIG
                                  8/34
 1 F Number:                    F00000>
 2 Load Spottool Macros:        DISABLED
 3 Number of equipments:              2
 4 Number of weld controllers:        1
 5 Current equipment, gun:          1, 1
 6   Weld interface:            INTEGRAL
 7   Number of guns:              SINGLE
 8   Equalization Pressure:      ENABLED
 9     number of pressures:            4
10   Rst water saver time-out:    500 ms
11     pulse length:              500 ms

    [ TYPE ]              ENABLED DISABLED
```

2   Select the Group Output to assign to the Pneumatic Equalizer on the Spot Equipment I/O Screen (Select Screen →I/O→Spot Equipment).

```
I/O Equip Out
                                  3/3
     NAME            OUT PT SIM STATUS
 1 Reset water saver:   DO[ 0] U    ***
 2 Gun pressure:        DO[ 0] U    ***
 3 Eqlztn pressure:     GO[ 1] U    ***

    [ TYPE ]        IN/OUT              >
```

3   Configure the Group output in the Group Output Config Screen (Select Screen→I/O→Group).

```
I/O Group Out
                                    1/100
GO #     RACK      SLOT   START PT  NUM PTS
 1        0         1        21        1
 2        0         0         0        0
 3        0         0         0        0
 4        0         0         0        0
 5        0         0         0        0


      [ TYPE ]  MONITOR   IN/OUT           HELP    >
```

4   Cycle Power for the I/O changes to take effect.

Equalization Trigger Control

The settings to control the equalizing function are available on the Spot Equipment Setup Screen (Select Screen→Setup→Spot Equipment).

```
SETUP Spot Equip
                                    5/10
 Equalizer: before pressure state
 5 Trigger type:              EVENT
 6 Trigger event:            NEAR_SD
 7 Control type:            Param***
 Equalizer: after pressure state
 8 Trigger type:            DISTANCE
 9 Trigger event:               5.0
10 Control type:            Param***


      [ TYPE ]                  [CHOICE]
```

You must set 3 items to specify the operation of the equalizer for before and after the weld. Refer to following table for descriptions for each item.
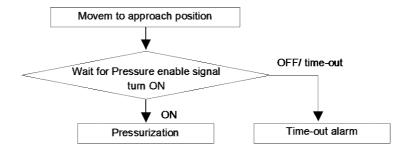
Equalizer function setup

ITEM	DESCRIPTION	
Equalizer: before pressure state - These items specify the operation for the equalizing cylinder control as the gun is closing to the spot weld.		
Trigger Type	You can specify trigger type before pressure.	
	EVENT:	when this is selected, you will have a list of "events" which will trigger the equalizing cylinder group output to change to the before pressure value as the gun is closing to the spot weld.
	TIME:	when this is selected, you will be able to specify the time (ms) before the tips arrive at the spot weld for the equalizing cylinder to be triggered.
Trigger Event	EVENT Choices:	
	START_SD:	trigger occurs as soon as the gun tips begin moving to the start distance. The timing will vary with start distance value and with term type used on the spot instruction, typically this event will occur early in the robot transfer to the spot.
	NEAR_SD:	trigger occurs near the programmed start distance. The timing will vary with start distance value and with term type used on the spot instruction, typically this event will occur near the actual start distance position, after the robot transfer is nearly done
	NEAR_PS:	trigger occurs as the gun tips are closing to the spot, typically after the robot transfer is complete.
Trigger time	If you select TIME as trigger type, you can specify the time (ms) before the tips arrive at the spot weld for the equalizing cylinder to be triggered.	

ITEM	DESCRIPTION	
Control type	You can specify the output type of the equalize signal.	
	PARAM:	you will set the group output value via the EP parameter of each spot instruction. The group output will change to this value when the before pressure state trigger occurs. ex) SPOT[SD=1, EQ=#, P=1, t=1.0, S=1, ED=1]
	CONST #:	This type always specifies a constant equalize signal before pressure. The value specified by # is output in the GO signal before pressure. There will be no parameter in the spot instruction.
Equalizer: after pressure state - These items specify the operation for the equalizing cylinder control as the gun is opening from the spot weld		
Trigger Type	You can specify trigger type after pressure.	
	DISTANCE:	when this is selected, the user will specify the tip clearance – with respect to the part surface - when the equalizer should change to the after pressure value.
	TIME:	when this is selected, you will be able to specify the time after motion start when the equalizer should change to the after pressure value.
Trigger Distance	If you select DISTACE as the trigger type, then you can specify trigger distance. When a tip is at the specified distance from the work, the equalize signal is output. This clearance is 5mm by default.	
Triger time	If you select TIME as trigger type, then you can specify trigger time. When a specified time has passed, the equalize signal is output. This time is 0 ms by default.	
Control type	You can specify the output type of the equalize signal.	
	PARAM:	By specifying an equalize signal to be output after pressure in a spot instruction, different equalize signals can be output for respective spot instructions. ex) SPOT[SD=1, P=1, t=1.0, S=1, EQ=#, ED=1] A value specified for the EQ condition is output in the GO signal before pressure.
	CONST #:	This type always specifies a constant equalize signal after pressure. The value specified by # is output in the GO signal before pressure. There will be no parameter in the spot instruction.

11.2   PRESSURE ENABLE SIGNAL

When a spot welding instruction is issued, the robot checks the state of the Pressure enable signal before starting pressurization. If the signal is on, pressurization is started

SETTING
- The Digital Input index is specified by setting the following system variable:

    $SPOTEQIO[#].$DI_PEN_T=1(DI),
    $SPOTEQIO[#].$DI_PEN_I= Signal number
        # : Equipment number
        Example) To set DI[62], write $SPOTEQIO[#].$DI_PEN_I=62.

- The time-out value is defaulted to 5 seconds. To change the value, update the following system variable (ms).

    $SPOTEQSETUP[#].$PEN_TMOUT = 5000

Others
This function does not work with:
- Pressurization instruction
- Manual pressurization
- Manual welding

    If a time-out condition occurs, the following alarm message will be displayed, causing the program to pause.

    "SVGN-035 Pressure enable time out"
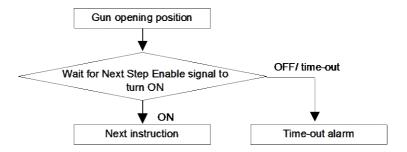
NOTE
Turn off rightmost bits of system variable $SGCFG[equipment number].$TRYOUT_MSK if you would like to use "PRESSURE ENABLE SIGNAL" with tryout mode enabled. To turn off rightmost bits, set value obtained by subtracting 1 from $TRYOUT_MSK if $TRYOUT_MSK is an odd number. For example, change to $TRYOUT_MSK = 6 in case of $TRYOUT_MSK = 7 (ODD). "PRESSURE ENABLE SIGNAL" can already be used if $TRYOUT_MSK is an even number.

11.3   NEXT STEP ENABLE

When a spot welding instruction is issued, the robot checks the state of the Weld completion signal between gun opening and the execution of the next instruction. If the signal is on, the next instruction is started.

SETTING

- Set the signal with the following system variable:

  $SPOTEQIO[#].$DI_NSE_T=1(DI)
  $SPOTEQIO[#].$DI_NSE_I= Signal number
  # : Equipment number
  Example) To set DI[63], write $SPOTEQIO[#].$DI_PEN_I=63.

- The time-out value is defaulted to 5 seconds. To change the value, update the following system variable (msec).

  $SPOTEQSETUP[1].$NSE_TMOUT = 5000

Others
This function does not work with:
- Pressurization instruction
- Manual pressurization
- Manual welding
  If a time-out condition occurs, the following alarm message will be displayed, causing the program to pause.
  "SVGN-036 Comp confirmation time out"
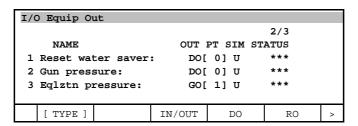
> **NOTE**
> Turn off rightmost bits of system variable $SGCFG[equipment number].$TRYOUT_MSK if you would like to use "NEXT STEP ENABLE" with tryout mode enabled. To turn off rightmost bits, set value obtained by subtracting 1 from $TRYOUT_MSK if $TRYOUT_MSK is an odd number. For example, change to $TRYOUT_MSK = 6 in case of $TRYOUT_MSK = 7 (ODD). "NEXT STEP ENABLE" can already be used if $TRYOUT_MSK is an even number.

11.4   PRESSURIZATION NOTIFICATION SIGNAL

This signal indicates that the servo gun is in a pressurization operation while a spot instruction is being executed.
With the Spot Equipment on the I/O screen, set the "Gun pressurization notification" signal.

```
I/O Equip Out
                                      2/3
       NAME                 OUT PT SIM STATUS
 1 Reset water saver:       DO[ 0] U    ***
 2 Gun pressure:            DO[ 0] U    ***
 3 Eqlztn pressure:         GO[ 1] U    ***


     [ TYPE ]          IN/OUT    DO      RO    >
```

The pressurization signal is turned on or off as follows:
On: When the machine starts moving to the pressurization start position (just before the synchronized contacting position)
Off: When welding is complete or after the machine reaches the pressurization completion position (this position actually varies depending on the setting of the positioning mode for the pressurization completion position.)
When the program starts, restarts, pauses, or is forcibly terminated, this signal is forcibly turned off.
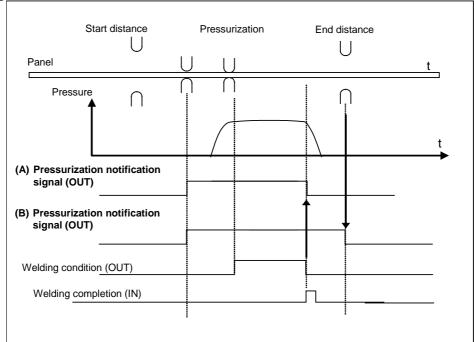
$SGSYSCFG.$PRES_SIGNAL
= 0 (default setting): Turns the signal off when welding is complete. (A) in the following figure.
= 1: Turns the signal off after the machine reaches the pressurization completion position. (B) in the following figure.
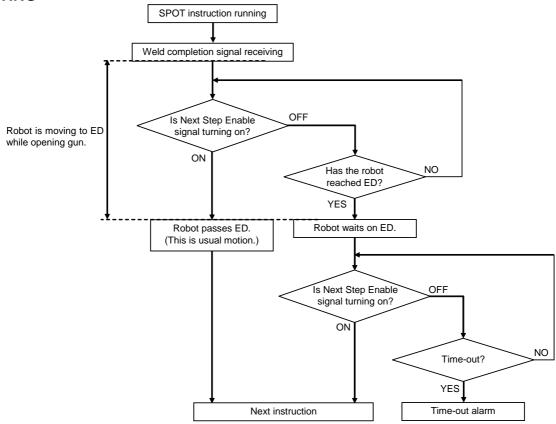
For the pressurization instructions (Press_motion), the pressurization signal is not output.

11.5   NEXT STEP ENABLE FROM WELD CONTROLLER

When a spot welding instruction is issued, the robot checks the state of the "next step enable signal from weld controller" between weld completion signal receiving and the execution of the next instruction. If the signal is on, the next instruction is started.

SETTING

```
                        ┌─────────────────────────┐
                        │ SPOT instruction running │
                        └────────────┬────────────┘
                                     ↓
                        ┌─────────────────────────────┐
                        │ Weld completion signal receiving │
                        └────────────┬────────────┘
                                     ↓
                          ╱ Is Next Step Enable ╲    OFF
                         ⟨  signal turning on?    ⟩────────┐
                          ╲                       ╱         ↓
                                   │ ON              ╱ Has the robot ╲  NO
                                   │                ⟨ reached ED?     ⟩──┐
                                   │                 ╲               ╱   │
Robot is moving to ED              │                      │ YES          │
while opening gun.                 ↓                      ↓              │
                        ┌──────────────────────┐  ┌──────────────────┐   │
                        │ Robot passes ED.      │  │ Robot waits on ED.│←─┘
                        │ (This is usual motion.)│  └────────┬─────────┘
                        └──────────┬───────────┘           ↓
                                   │              ╱ Is Next Step Enable ╲  OFF
                                   │             ⟨  signal turning on?    ⟩──┐
                                   │              ╲                       ╱   │
                                   │                      │ ON                │
                                   │                      │          ╱ Time-out? ╲ NO
                                   │                      │         ⟨            ⟩─┘
                                   │                      │          ╲          ╱
                                   │                      │             │ YES
                                   ↓                      ↓             ↓
                        ┌──────────────────┐    ┌──────────────────┐
                        │ Next instruction  │    │ Time-out alarm    │
                        └──────────────────┘    └──────────────────┘
```

- Make "next step enable signal from weld controller" effective via the following system variables.

  $SGSYSCFG.$NSE_MODE = 1   ENABLED
  $SGSYSCFG.$NSE_MODE = 0   DISABLED (Default)

NOTE
   When this function is made effective, section 11.3 NEXT STEP ENABLE cannot be used.

- The digital input index is specified by setting the following system variable:

  $SPOTWELDIO[#].$DI_WCS_T= 1(DI)
  $SPOTWELDIO[#].$DI_WCS_I = Port number
   # : Weld controller number

  Specify 63 to $SPOTWELDIO[#].$DI_WCS_I if you want to use DI[63] for this signal.

- The time-out value is defaulted to 5 seconds. To change the value, change the following system variable (msec).

  $SPOTWELDIO[#].$WCS_TMOUT = 5000
   # : Weld controller number

> **NOTE**
> Ensure the timeout period is the same when you connect a separate weld controller with gun A and gun B in a dual gun system. When different timeout periods are set, the larger one is used.

- When the robot pauses while being waiting to turn on "next step enable signal from weld controller", after robot moves to SD by next start, the robot executes spot instruction again.

- If a time-out condition occurs, the following alarm message will be displayed, causing the program to pause.

  "SVGN-036 Comp confirmation time out"

Others
This function does not work with:
- When weld IO sim is enabled
- Pressurization instruction
- Tip dress instruction
- Manual pressurization

> **NOTE**
> Turn off rightmost bits of system variable $SGCFG[equipment number].$TRYOUT_MSK if you would like to use "NEXT STEP ENABLE FROM WELD CONTROLLER" with tryout mode enabled. To turn off rightmost bits, set value obtained by subtracting 1 from $TRYOUT_MSK if $TRYOUT_MSK is an odd number. For example, change to $TRYOUT_MSK = 6 in case of $TRYOUT_MSK = 7 (ODD). "NEXT STEP ENABLE FROM WELD CONTROLLER" can already be used if $TRYOUT_MSK is an even number.
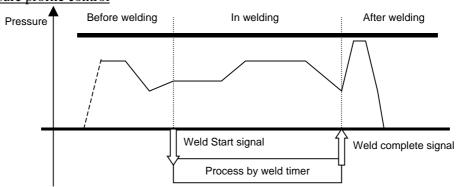
12 PRESSURE PROFILE CONTROL FUNCTION

12.1 OVERVIEW
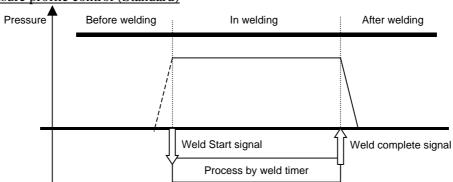
It is possible to control pressure value with multi-step in servo gun spot welding. This function is an option.
- Maximum 4 steps pressure can be specified for each step (Before welding, In welding, After welding).
- Profile (pressure and pressurization time) can be specified for each pressure condition.

Enable pressure profile control

Disable pressure profile control (Standard)
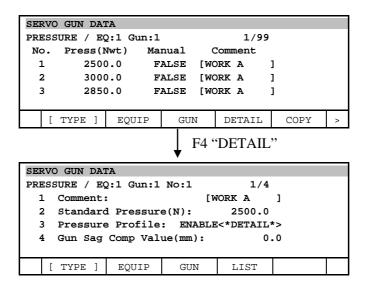
NOTE
If this option is added after completing auto tune, additional tuning is required. Please perform "Auto Tune" or "Profile Auto Tune" in servo gun autotuning utility.

12.2   PROFILE DATA

12.2.1   Operation

1.   Select Pressure on the Data screen to enter the screen for setting detailed pressure conditions.

```
SERVO GUN DATA
PRESSURE / EQ:1 Gun:1                1/99
 No.   Press(Nwt)   Manual     Comment
  1      2500.0      FALSE    [WORK A    ]
  2      3000.0      FALSE    [WORK A    ]
  3      2850.0      FALSE    [WORK A    ]


 [ TYPE ] │ EQUIP │  GUN  │ DETAIL │ COPY │ >
```

F4 "DETAIL"

```
SERVO GUN DATA
PRESSURE / EQ:1 Gun:1 No:1           1/4
  1  Comment:              [WORK A    ]
  2  Standard Pressure(N):     2500.0
  3  Pressure Profile:  ENABLE<*DETAIL*>
  4  Gun Sag Comp Value(mm):        0.0

 [ TYPE ] │ EQUIP │  GUN  │ LIST │    │
```

2.   Move cursor to "Pressure Profile," and press the [ENTER] key.
      Please refer to the next page for the meaning of each items.

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1            1/7
  1  Pressure Profile Control:  ENABLE
  2  Manual Compensation:       DISABLE
  3  Standard Pressure(nwt):     2500.0
  4  Init Press:  2500.0[N] (100.0[%])
     (Pressure Control Start)
  5     100[msec]  2000.0[N] ( 80.0[%])
     (Weld Start)
  6      50[msec]  2500.0[N] (100.0[%])
     (Weld Complete)
  7     100[msec]  2000.0[N] ( 80.0[%])

 [ TYPE ] │ EQUIP │  GUN  │ ENABLE │ DISABLE │
```

12.2.2 Meaning of Each Items

You can change a pressure value one time by one stage at each stage (Pressure control start, weld start and weld complete) in standard.

Select ENABLE/DISABLE of profile control by each pressure condition. Standard setting is DISABLE.

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1           1/7
 1  Pressure Profile Control:    ENABLE
 2  Manual Compensation:         DISABLE
 3  Standard Pressure(N):        2500.0
 4  Init Press:   2500.0[N] (100.0[%])
    (Pressure Control Start)
 5     100[msec]  2000.0[N] ( 80.0[%])
    (Weld Start)
 6      50[msec]  2500.0[N] (100.0[%])
    (Weld Complete)
 7     100[msec]  2000.0[N] ( 80.0[%])

   [ TYPE ]   EQUIP    GUN    ENABLE  DISABLE
```
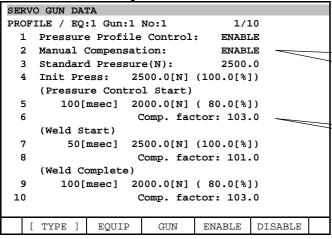
Select ENABLE/DISABLE of manual compensation. Please refer to the following figure for more information. This configuration item is displayed when bit3 (0x8) of $SGPPDCFG.$PPDCUSTOM is ON.

Standard pressure value
This is standard value is for the following pressure ratio(%).

Specify target pressure value(P) and time(T). There are two input types that specify the target pressure value(P) directly or specify the pressure ratio(%) to the above standard pressure value. And when the standard pressure is changed, each pressure is automatically updated depending on the respective ratio (%).

If "Manual Compensation" is enabled:

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1          1/10
 1  Pressure Profile Control:    ENABLE
 2  Manual Compensation:         ENABLE
 3  Standard Pressure(N):        2500.0
 4  Init Press:   2500.0[N] (100.0[%])
    (Pressure Control Start)
 5     100[msec]  2000.0[N] ( 80.0[%])
 6                 Comp. factor: 103.0
    (Weld Start)
 7      50[msec]  2500.0[N] (100.0[%])
 8                 Comp. factor: 101.0
    (Weld Complete)
 9     100[msec]  2000.0[N] ( 80.0[%])
10                 Comp. factor: 103.0

   [ TYPE ]   EQUIP    GUN    ENABLE  DISABLE
```
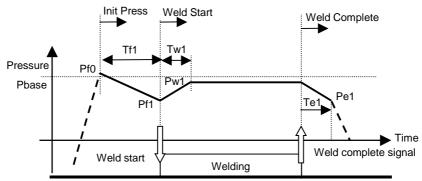
ENABLE : "Comp. factor" is displayed
Convergence pressure can be adjust in each step.

If there is a gap between specified target pressure and convergence pressure, please adjust this value. If the value is larger than 100, convergence pressure is larger. If the value is smaller than 100, convergence pressure is smaller.

Relationship between target pressure value (P) and time (T):
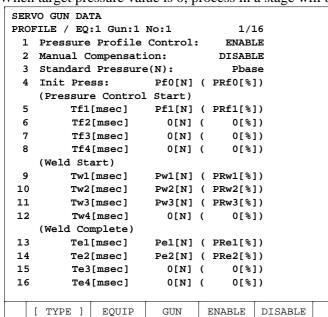
To change the target pressure value more than two times in each stage, a following system variable should be changed.
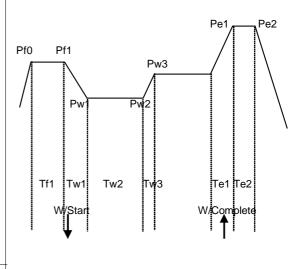
$SGPPDCFG.$NUM_STEPS: Number of pressure change (Standard:1, Maximum:4)

Example: $SGPPDCFG.$NUM_STEPS=4

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1              1/16
  1  Pressure Profile Control:   ENABLE
  2  Manual Compensation:        DISABLE
  3  Standard Pressure(N):        Pbase
  4  Init Press:       Pf0[N] ( PRf0[%])
     (Pressure Control Start)
  5      Tf1[msec]     Pf1[N] ( PRf1[%])
  6      Tf2[msec]     Pf2[N] ( PRf2[%])
  7      Tf3[msec]     Pf3[N] ( PRf3[%])
  8      Tf4[msec]     Pf4[N] ( PRf4[%])
     (Weld Start)
  9      Tw1[msec]     Pw1[N] ( PRw1[%])
 10      Tw2[msec]     Pw2[N] ( PRw2[%])
 11      Tw3[msec]     Pw3[N] ( PRw3[%])
 12      Tw4[msec]     Pw4[N] ( PRw4[%])
     (Weld Complete)
 13      Te1[msec]     Pe1[N] ( PRe1[%])
 14      Te2[msec]     Pe2[N] ( PRe2[%])
 15      Te3[msec]     Pe3[N] ( PRe3[%])
 16      Te4[msec]     Pe4[N] ( PRe4[%])

   [ TYPE ]   EQUIP    GUN    ENABLE  DISABLE
```

When target pressure value is 0, process in a stage will be completed.

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1              1/16
  1  Pressure Profile Control:     ENABLE
  2  Manual Compensation:          DISABLE
  3  Standard Pressure(N):          Pbase
  4  Init Press:       Pf0[N] ( PRf0[%])
     (Pressure Control Start)
  5      Tf1[msec]     Pf1[N] ( PRf1[%])
  6      Tf2[msec]        0[N] (    0[%])
  7      Tf3[msec]        0[N] (    0[%])
  8      Tf4[msec]        0[N] (    0[%])
     (Weld Start)
  9      Tw1[msec]     Pw1[N] ( PRw1[%])
 10      Tw2[msec]     Pw2[N] ( PRw2[%])
 11      Tw3[msec]     Pw3[N] ( PRw3[%])
 12      Tw4[msec]        0[N] (    0[%])
     (Weld Complete)
 13      Te1[msec]     Pe1[N] ( PRe1[%])
 14      Te2[msec]     Pe2[N] ( PRe2[%])
 15      Te3[msec]        0[N] (    0[%])
 16      Te4[msec]        0[N] (    0[%])

   [ TYPE ]   EQUIP    GUN    ENABLE  DISABLE
```


When weld completion signal is received in welding (Twi), welding stage will move to processing of the weld completion.
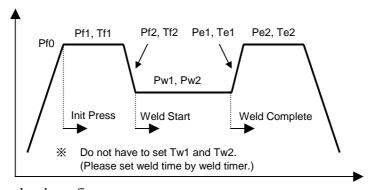
12.2.3   Example

Example1: Two-Stage Pressurization Method

The following shows a setting example for increasing the pressure before and after welding.

In this example, set $SGPPDCFG.$NUM_STEPS=2 for changing the target value two times in "Init Press" and "Weld Complete" stages like the following figure.
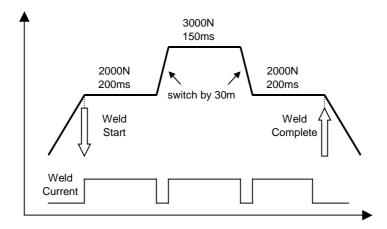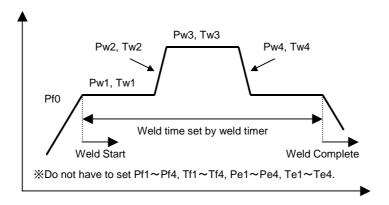
Set the values based on the above figure.

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1              1/10
  1  Pressure Profile Control:    ENABLE
  2  Manual Compensation:         DISABLE
  3  Standard Pressure(N):        2000.0
  4  Init Press:    3000.0[N] (150.0[%])
     (Pressure Control Start)
  5      100[msec]  3000.0[N] (150.0[%])
  6       30[msec]  2000.0[N] (100.0[%])
     (Weld Start)
  7        0[msec]  2000.0[N] (100.0[%])
  8        0[msec]  2000.0[N] (100.0[%])
     (Weld Complete)
  9       30[msec]  3000.0[N] (150.0[%])
 10      100[msec]  3000.0[N] (150.0[%])


  [ TYPE ]   EQUIP    GUN    ENABLE   DISABLE
```

Example2: Multiple-Stage Welding

The following shows a setting example of 3 stage's welding. (Please set weld current by weld timer.)

In this example, set $SGPPDCFG.$NUM_STEPS=4 for changing the target value four times in "Weld Start" stages like the following figure.

Set the values based on the above figure.

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1            1/16
  1  Pressure Profile Control:    ENABLE
  2  Manual Compensation:         DISABLE
  3  Standard Pressure(N):         2000.0
  4  Init Press:   2000.0[N] (100.0[%])
     (Pressure Control Start)
  5       0[msec]  2000.0[N] (100.0[%])
  6       0[msec]  2000.0[N] (100.0[%])
  7       0[msec]  2000.0[N] (100.0[%])
  8       0[msec]  2000.0[N] (100.0[%])
     (Weld Start)
  9     200[msec]  2000.0[N] (100.0[%])
 10      30[msec]  3000.0[N] (150.0[%])
 11     150[msec]  3000.0[N] (150.0[%])
 12      30[msec]  2000.0[N] (100.0[%])
     (Weld Complete)
 13       0[msec]  2000.0[N] (100.0[%])
 14       0[msec]  2000.0[N] (100.0[%])
 15       0[msec]  2000.0[N] (100.0[%])
 16       0[msec]  2000.0[N] (100.0[%])


  [ TYPE ]   EQUIP    GUN    ENABLE   DISABLE
```

12.2.4   Limitations

Profile time
Please do not shorten a specified time in a profile data too much. (10 Kgf/msec is a standard.)
A specified profile may not be implemented due to the gun's response characteristics.
When an overshoot is observed, prolong the specified time to prevent overshooting from happening.

Behavior at HOLD
When press motion paused during profile pressure with HOLD, pressure specification is decided according to the following system variable.

$SYSCFG.$REL_PRESS
    =0: Pressure is maintained at HOLD.
    =1: Pressure is released at HOLD.

> ⚠ **CAUTION**
> Only when pressure release is set, the delay time from holding by HOLD to
> pressure release can be specified by a system variable
> $SGSYSCFG.$REL_PRS_DLY, but when a pressure profile is enabled, the delay
> time is always 0 and the pressure is released immediately.

12.3   PROFILE SETUP SCREEN

12.3.1   Display Profile Setup Screen

The profile setup screen supports GI/AI port number for pressure command and pressure control gain.
Please set $SGPPDCFG.$SHO_PPDSET = TRUE to display the profile setup screen.

12.3.2 Profile Setup Screen

```
SETUP Servogun
GENERAL / EQ:1 GUN:1                    15/15
 1 Tip Wear Comp:                    DISABLE
 2 Gun Sag Compensation:             DISABLE
 3 Close Direction(Gun):                PLUS
 4 Close Direction(Robot):      UT: 1 [+Z]
 5 Max Motor Torque(%):              100.0
 6 Max Pressure(N):                 4000.0
   Max Gun Torque(%):                 17.9
 7 Tip stick detect distance(mm):       5
 8 Tip Wear Detection:          <*DETAIL*>
 9 Pressure Cal:         COMP   <*DETAIL*>
10 Tip Wear Standrd:     INCOMP <*DETAIL*>
11 Thickness check:             <*DETAIL*>
12 Gun Stroke limit:            <*DETAIL*>
13 OverTorque protection:       <*DETAIL*>
14 Gun Teach Setup:             <*DETAIL*>
15 Pressure Profile Setup:      <*DETAIL*>

   [ TYPE ]   EQUIP    GUN
```

```
SETUP Servogun
PRESSURE PROFILE SETUP / EQ:1 GUN:1    1/4
 1 Step Number (COMMON):                 4
 2 External Switching(COMMON):      ENABLE
 3 Pressure Value:                   GI[ 1]
 4 Pressure Scale (nwt):1.0 * GI +      0.0
 5 Pressure Gain Adjustment:        ENABLE
 6 Pressure Gain:                     50.0

   [ TYPE ]   EQUIP    GUN
```

```
SETUP Servogun
PRESSURE PROFILE SETUP / EQ:1 GUN:1    1/4
 1 Step Number (COMMON):                 4
 2 External Switching(COMMON):      ENABLE
 3 Pressure Value:                   AI[ 1]
 4 Pressure Scale (nwt):1.0 * AI +      0.0
 5 Pressure Gain Adjustment:        ENABLE
 6 Pressure Gain:                     50.0

   [ TYPE ]   EQUIP    GUN
```

Item	Description
Step Number (Common)	This item corresponds to $SGPPDCFG.$NUM_STEPS. The number of times the pressure is changed in the profile. (This item does not depend on gun number.)
External Switching (Common)	This item corresponds to $SGPPDCFG.$EXSWTCH_ENB. Enables/disables profiles to switch by DI/DO signals. ENABLE: Display DI/DO switching on pressure profile data screen. DISABLE: Not display DI/DO switching on pressure profile data screen.
Pressure Value	Specify GI or AI, and specify port number. For example, "GI[1]" means that port number 1 of GI is used to specify pressure value.
Pressure Scale (unit)	Specify scaling of GI/AI to command appropriate pressure. You can specify slope and intercept. The default slope is 1.0 and the default intercept is 0.0.
Pressure Gain Adjustment	Specify if pressure gain adjustment is used or not. ENABLE: Use "Pressure Gain" for pressure force control DISABLE: Use default gain (determined by autotune) for pressure force control
Pressure Gain	Specify pressure gain for pressure control. Maximum value is 100.0 and cannot be larger than 100.0. Larger gain will achieve faster response time but may cause overshoot. The specified value is used when pressure gain adjustment is enabled and pressure profile control is enabled.

12.4   PROFILE SWITCHING BY DI/DO

This section describes profile switching method by DI/DO.

12.4.1   Enable/Disable Profile Switching by DI/DO

This function is disabled by default.
Please set $SGPPDCFG.$EXSWTCH_ENB = TRUE to use this function.

12.4.2   Profile Data Screen

When this function is enabled, the following DI/DO items are added to profile data screen as the follow.

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1              1/16
  1  Pressure Profile Control:    ENABLE
  2  Standard Pressure(N):        2000
  3  Init Press:  2000[nwt] ( 100.0[%])
     (Pressure Control Start)
  4  DI:0       0[msec]    2000.0[nwt]    DO:0
  5  DI:0       0[msec]    2000.0[nwt]    DO:0
  6  DI:0       0[msec]    2000.0[nwt]  DO:0
  7  DI:0       0[msec]    2000.0[nwt]  DO:0
     (Weld Start)
  8  DI:0       0[msec]    2000.0[nwt]  DO:0
  9  DI:0       0[msec]    2000.0[nwt]  DO:0
 10  DI:0       0[msec]    2000.0[nwt]  DO:0
 11  DI:0       0[msec]    2000.0[nwt]  DO:0
     (Weld Complete)
 12  DI:0       0[msec]    2000.0[nwt]  DO:0
 13  DI:0       0[msec]    2000.0[nwt]  DO:0
 14  DI:0       0[msec]    2000.0[nwt]  DO:0
 15  DI:0       0[msec]    2000.0[nwt]  DO:0


 [ TYPE ]   EQUIP    GUN    ENABLE   DISABLE
```

The signals for profile switching can be specified on DI/DO items.
Profile switching by DI/DO is not performed when 0 is specified.

12.4.3   Profile Switching by DI
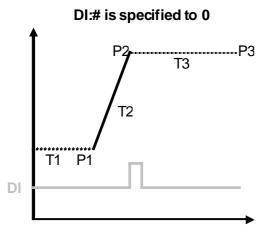
On the profile data screen, specify DI:# as 1 or a larger value to switch profile by DI.
If DI:# is assigned to 0, profile switching by DI is not performed. In this case, this profile segment starts after the previous profile segment is completed as shown in the left figure below.
If "DI:#" is assigned as 1 or larger, the profile is switched by the specified signal. In this case, this profile segment does not start before the inputting of the signal specified after the completion of previous instruction, as shown in the right figure below.
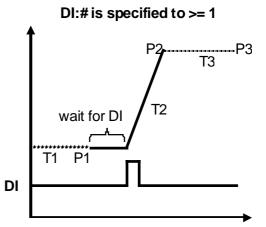
DI:0	T1[ms]	P1[nwt]	DO:0
DI:0	T2[ms]	P2[nwt]	DO:0
DI:0	T3[ms]	P3[nwt]	DO:0

DI:0	T1[ms]	P1[nwt]	DO:0
DI:1	T2[ms]	P2[nwt]	DO:0
DI:0	T3[ms]	P3[nwt]	DO:0

DI:# is specified to 0   **DI:# is specified to >= 1**
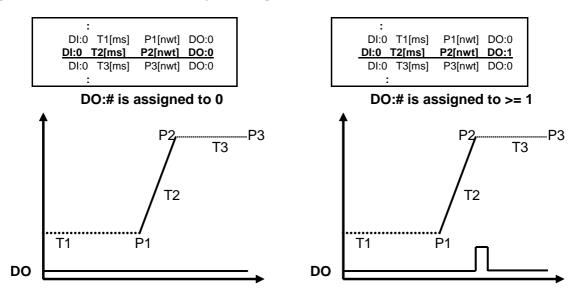
12.4.4   Profile Switching Notification by DO

On the profile data screen, specify DO:# to a value greater than 1 to notify profile switching by DO.
If DO:# is assigned to 0, profile switching notification by DO is not performed.
If DO:# is assigned to a signal, the profile segment does not complete until pressure becomes stable. When the pressure becomes stable, the DO signal is outputted.

:			
DI:0	T1[ms]	P1[nwt]	DO:0
DI:0	**T2[ms]**	**P2[nwt]**	**DO:0**
DI:0	T3[ms]	P3[nwt]	DO:0
:			

:			
DI:0	T1[ms]	P1[nwt]	DO:0
DI:0	**T2[ms]**	**P2[nwt]**	**DO:1**
DI:0	T3[ms]	P3[nwt]	DO:0
:			

DO:# is assigned to 0   **DO:# is assigned to >= 1**

DO signal pulse width [ms] can be configured by $SGPPDCFG.$DO_PLSWIDTH.
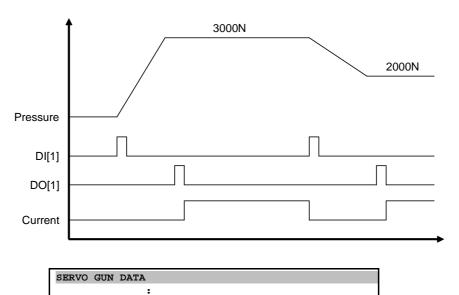
NOTE
   If the previous DO and current DO are same DO number, and the specified signal width for profile switching is large, the signal width may become larger than the specified one, and the assumed number of pulses may not be the output.

12.4.5   Example

Example3 : Combination of DI and DO

In this example, a robot controller gets a DI signal from a weld controller and switches the pressure profile; then the robot controller outputs a DO signal to the weld controller after stabilizing pressure, and the weld controller starts to weld on receiving the DO.


```
SERVO GUN DATA
                 :
      (Weld Start)
  10    DI:1  30[msec]     3000[nwt]  DO:1
  11    DI:1  30[msec]     2000[nwt]  DO:1
                 :

    [ TYPE ]   EQUIP    GUN    ENABLE  DISABLE
```
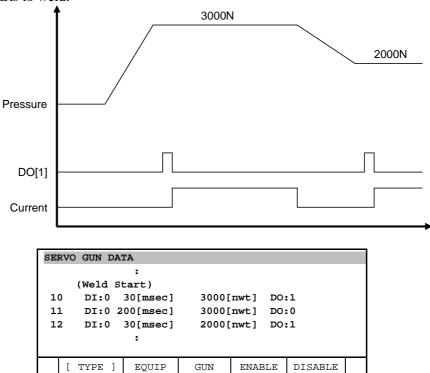
The following sequence is performed by the robot controller and weld controller in this example.
1   Robot controller gets pressure change permission information from weld controller by DI[1].
2   Change pressure to 3000N, then notify to weld controller by DO[1].
3   After receiving pressure change completion information, weld controller starts to weld. Robot controller maintains pressure at 3000N.
4   Weld controller issues pressure change permission information after welding completion, and robot controller receives it by DI[1].
5   Change pressure to 2000N, then notify to weld controller by DO[1].
6   After receiving pressure change completion information, weld controller starts welding. Robot controller maintains pressure at 2000 N.

Example4: Pressure switching notification by DO alone

In this example, robot controller notifies pressure stability by DO signal, and then weld controller gets the DO signal and starts to weld.


```
SERVO GUN DATA
              :
     (Weld Start)
  10    DI:0  30[msec]     3000[nwt]  DO:1
  11    DI:0 200[msec]     3000[nwt]  DO:0
  12    DI:0  30[msec]     2000[nwt]  DO:1
              :

   [ TYPE ]   EQUIP    GUN    ENABLE  DISABLE
```

The following sequence is performed by the robot controller and weld controller in this example.
1   Change pressure to 3000N, then notify to weld controller by DO[1].
2   Wait for 200ms with pressure = 3000N.
3   Change pressure to 2000N, then notify to weld controller by DO[1].

12.5   PROFILE COMMAND BY GI/AI

This section describes profile command by GI/AI. An external equipment such as a weld controller can specify the target pressure using this function.

12.5.1   Enable Function and Profile Setup Screen

This function is disabled by default. And you need to display profile setup screen to use this function.
Please set $SGPPDCFG.$EXPRES_ENB = TRUE and $SGPPDCFG.$SHO_PPDSET = TRUE to enable this function and display profile setup screen.

12.5.2   Profile Data Screen

You can select GI/AI as well as numerical values as pressure on the profile data screen when the function is enabled.

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1              1/16
  1  Pressure Profile Control:    ENABLE
  2  Standard Pressure (N):       2000.0
  3  Init Press: 2000.0[nwt] (100.0[%])
     (Pressure Control Start)
  4  DI:0      0[msec]        0.0[nwt]   DO:0
  5  DI:0      0[msec]        0.0[nwt]   DO:0
  6  DI:0      0[msec]        0.0[nwt]   DO:0
  7  DI:0      0[msec]        0.0[nwt]   DO:0
     (Weld Start)
  8  DI:0     20[msec]     1000.0[nwt]   DO:0
  9  DI:0     20[msec]       GI [nwt]    DO:0
 10  DI:0     20[msec]       GI [nwt]    DO:0
 11  DI:0      0[msec]       GI [nwt]    DO:0
     (Weld Complete)
 12  DI:0      0[msec]        0.0[nwt]   DO:0
 13  DI:0      0[msec]        0.0[nwt]   DO:0
 14  DI:0      0[msec]        0.0[nwt]    MODE   1
 15  DI:0      0[msec]        0.0[nwt]  1 CONSTANT
                                        2 GI
  ┌──────┬───────┬──────┬──────┬────────┬──┐
  │[ TYPE ]│ EQUIP │ GUN  │ END  │ [MODE] │  │
  └──────┴───────┴──────┴──────┴────────┴──┘
```

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1              1/16
  1  Pressure Profile Control:    ENABLE
  2  Standard Pressure (N):       2000.0
  3  Init Press: 2000.0[nwt] (100.0[%])
     (Pressure Control Start)
  4  DI:0      0[msec]        0.0[nwt]   DO:0
  5  DI:0      0[msec]        0.0[nwt]   DO:0
  6  DI:0      0[msec]        0.0[nwt]   DO:0
  7  DI:0      0[msec]        0.0[nwt]   DO:0
     (Weld Start)
  8  DI:0     20[msec]     1000.0[nwt]   DO:0
  9  DI:0     20[msec]       AI [nwt]    DO:0
 10  DI:0     20[msec]       AI [nwt]    DO:0
 11  DI:0      0[msec]       AI [nwt]    DO:0
     (Weld Complete)
 12  DI:0      0[msec]        0.0[nwt]   DO:0
 13  DI:0      0[msec]        0.0[nwt]   DO:0
 14  DI:0      0[msec]        0.0[nwt]    MODE   1
 15  DI:0      0[msec]        0.0[nwt]  1 CONSTANT
                                        2 AI
  ┌──────┬───────┬──────┬──────┬────────┬──┐
  │[ TYPE ]│ EQUIP │ GUN  │ END  │ [MODE] │  │
  └──────┴───────┴──────┴──────┴────────┴──┘
```

F5 [MODE] fkey is displayed only if cursor is on pressure item.
If you press F5 [MODE] fkey, pull-up menu is displayed and you can change the pressure mode.

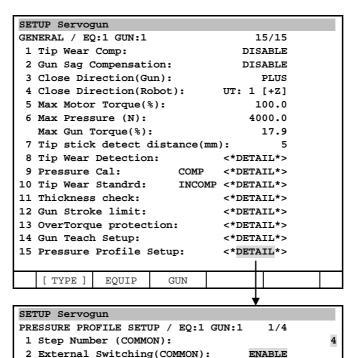| Item	Description
CONSTANT	Constant pressure value. Numerical value is displayed if this item is selected.
GI	This item is displayed when "GI" is specified on profile setup screen. Pressure of this step is defined by GI.
AI	This item is displayed when "AI" is specified on profile setup screen. Pressure of this step is defined by AI.

12.5.3   Profile Setup Screen

You can change GI/AI port number and scaling on the profile setup screen.

```
┌─────────────────────────────────────────────────┐
│ SETUP Servogun                                    │
│ GENERAL / EQ:1 GUN:1                    15/15     │
│  1 Tip Wear Comp:                    DISABLE      │
│  2 Gun Sag Compensation:             DISABLE      │
│  3 Close Direction(Gun):                PLUS      │
│  4 Close Direction(Robot):     UT: 1 [+Z]         │
│  5 Max Motor Torque(%):               100.0       │
│  6 Max Pressure (N):                 4000.0       │
│    Max Gun Torque(%):                  17.9       │
│  7 Tip stick detect distance(mm):         5       │
│  8 Tip Wear Detection:          <*DETAIL*>        │
│  9 Pressure Cal:         COMP   <*DETAIL*>        │
│ 10 Tip Wear Standrd:     INCOMP <*DETAIL*>        │
│ 11 Thickness check:             <*DETAIL*>        │
│ 12 Gun Stroke limit:            <*DETAIL*>        │
│ 13 OverTorque protection:       <*DETAIL*>        │
│ 14 Gun Teach Setup:             <*DETAIL*>        │
│ 15 Pressure Profile Setup:      <*DETAIL*>        │
│                                                   │
│ ┌──────────────────────────────────────────────┐ │
│ │ [ TYPE ]   EQUIP    GUN                       │ │
│ └──────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────┘
                        │
                        ▼
┌─────────────────────────────────────────────────┐
│ SETUP Servogun                                    │
│ PRESSURE PROFILE SETUP / EQ:1 GUN:1    1/4        │
│  1 Step Number (COMMON):                   4      │
│  2 External Switching(COMMON):    ENABLE          │
│  3 Pressure Value:                     GI[ 1]     │
│  4 Pressure Scale (nwt):1.0 * GI +    0.0         │
│                                                   │
│ ┌──────────────────────────────────────────────┐ │
│ │ [ TYPE ]   EQUIP    GUN                       │ │
│ └──────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────┘

┌─────────────────────────────────────────────────┐
│ SETUP Servogun                                    │
│ PRESSURE PROFILE SETUP / EQ:1 GUN:1    1/4        │
│  1 Step Number (COMMON):                   4      │
│  2 External Switching(COMMON):    ENABLE          │
│  3 Pressure Value:                     AI[ 1]     │
│  4 Pressure Scale (nwt):1.0 * AI +    0.0         │
│                                                   │
│ ┌──────────────────────────────────────────────┐ │
│ │ [ TYPE ]   EQUIP    GUN                       │ │
│ └──────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────┘
```

Item	Description
Pressure Value	Specify GI or AI, and specify port number. For example, "GI[1]" means that port number 1 of GI is used to specify pressure value.
Pressure Scale (unit)	Specify scaling of GI/AI to command appropriate pressure. You can specify slope and intercept. The default slope is 1.0 and the default intercept is 0.0.
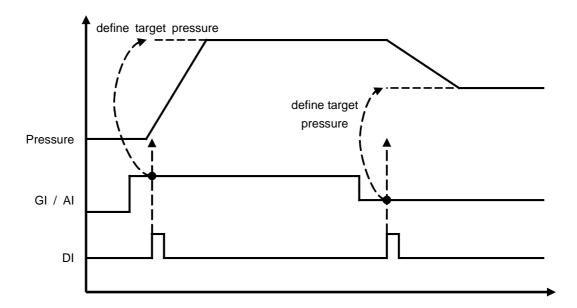
12.5.4 **Profile Sequence Example**

Example 5 : Pressure command latched by DI assertion

If the profile step uses DI switching, the profile sequence becomes the below.
When the DI signal becomes ON, pressure command by GI/AI is latched, and the pressure switches to the target.

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1            1/16
…
  8  DI:1     20[msec]        GI [nwt]   DO:1
  9  DI:1     20[msec]        GI [nwt]   DO:1
…
   [ TYPE ]   EQUIP    GUN     END    [MODE]
```
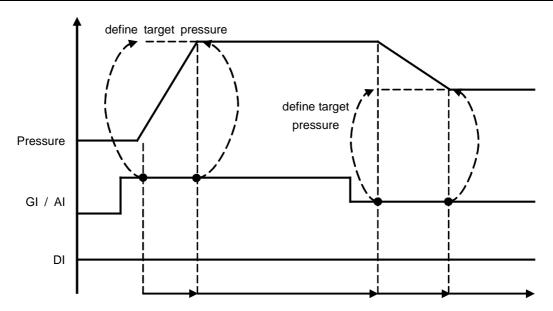

Example6 : Pressure command latched by step time

If the profile step does NOT use DI switching, the profile sequence becomes the below.
When the specified time has passed, pressure command by GI/AI is latched, and the pressure switches to the target.

```
SERVO GUN DATA
PROFILE / EQ:1 Gun:1 No:1            1/16
…
    (Weld Start)
  8  DI:0     20[msec]        AI [nwt]   DO:0
  9  DI:0    200[msec]        AI [nwt]   DO:0
 10  DI:0     20[msec]        AI [nwt]   DO:0
 11  DI:0    200[msec]        AI [nwt]   DO:0
…
   [ TYPE ]   EQUIP    GUN     END    [MODE]
```

12.6   POSITION LOCK DURING PRESSURIZING

This section describes position lock during pressurizing.
This function can switch the control mode from force control mode to position lock mode or from position lock mode to force control mode during pressurizing.

> **NOTE**
> This function does not support dual gun.

> **NOTE**
> Force on the tips will change during the position lock mode.

12.6.1   Enable Position Lock

Please set $SGCFG[#].$NOMOTN_FCSW = TRUE to use this function. Where # is equipment number.

12.6.2   Profile Data Screen

You can select POSLOCK as well as numerical values and GI/AI as pressure on the profile data screen when the function is enabled.

```
┌──────────────────────────────────────────────────┐
│ SERVO GUN DATA                                     │
│ PROFILE / EQ:1 Gun:1 No:1            1/16          │
│   1  Pressure Profile Control:    ENABLE           │
│   2  Standard Pressure (N):       2000.0           │
│   3  Init Press: 2000.0[nwt] (100.0[%])            │
│      (Pressure Control Start)                      │
│   4  DI:0       0[msec]        0.0[nwt]   DO:0      │
│   5  DI:0       0[msec]        0.0[nwt]   DO:0      │
│   6  DI:0       0[msec]        0.0[nwt]   DO:0      │
│   7  DI:0       0[msec]        0.0[nwt]   DO:0      │
│      (Weld Start)                                  │
│   8  DI:0      20[msec]     1000.0[nwt]   DO:0      │
│   9  DI:0      20[msec]        GI [nwt]   DO:0      │
│  10  DI:0      20[msec]        GI [nwt]   DO:0      │
│  11  DI:0       0[msec]        GI [nwt]   DO:0      │
│      (Weld Complete)                               │
│  12  DI:0       0[msec]        0.0[nwt]   DO:0      │
│  13  DI:0       0[msec]        0.0[nwt]  │ MODE  1 ││
│  14  DI:0       0[msec]        0.0[nwt]  │1 CONSTANT│
│  15  DI:0       0[msec]        0.0[nwt]  │2 GI      │
│                                         │3 POSLOCK │
│   ┌────────┬───────┬──────┬───────┬────────┬──────┐│
│   │[ TYPE ]│ EQUIP │ GUN  │ END   │[MODE]  │      ││
│   └────────┴───────┴──────┴───────┴────────┴──────┘│
└──────────────────────────────────────────────────┘
```

When POSLOCK is specified, the control mode is switched to the position lock mode at the step change.
If the subsequent step is force mode, the control mode is switched to the force control after the specified
time proceeds.

13 GUN CHANGE FUNCTION

13.1 OUTLINE

13.1.1 Feature of Function

It is possible to switch more than two servo guns without power off.
For pulse coders, both battery type and battery-less type are available.

The total number of changeable gun	9 guns in one equipment. 10 guns in one system. Only one gun can be controlled at the same

> **NOTE**
> For a gun change system, it is recommended that the servo gun should have battery.

13.1.2 Restrictions

Restrictions matters
・   Guns whose motors are without battery require calibration motion after attachment and hence have a longer cycle time than guns having battery.
・   The motor of the gun change must be controlled by the same amp.
・   The gun change instruction does not support multi tasks. (The gun change instruction can not be execute by plural tasks at the same time)
・   The motion group that gun change function is enabled must be used a final group in the system.

Prohibition matters
・   Do not force to detach the gun while the controller is off.
・   In a system in which the gun change is enabled, the line tracking function is disabled.

When the batteryless type is used, there are restrictions as follows:
・   When the calibration motion type 1 or 2 is selected, calibration cannot be interrupted by a hold or emergency stop. (Program execution must not be stopped during gun attach processing)
・   When the calibration motion type 1 or 2 is selected, magnetic phase detection cannot be performed.
・   When the calibration motion type 7 or 8 is selected, calibration preformed during gun attachment is disabled if the tip wear amount changed while the gun was detached. Therefore, tip replacement must be performed for the attached gun.
・   The calibration motion type 3, 4, 5 and 6 are not supported.

NOTE
When a Pulsecoder alpha*i* AR128(A860-2010-T341) shipped until May of 2006 is used, alarm SRVO-068(DTERR) occurs at turning power on and executing GUN ATTACH instruction. Implement either of following countermeasures.
Replace Pulsecoder alpha*i* AR128 with one shipped after June of 2006.
Change system valuables as follows.
$SHC_ITF[#].$WAITTM_PCHK = 270
$SHC_ITF[#].$WAITTM_PWUP = 550
$SHC_ITF[#].$SVON_DELAY = 230
$SHC_ITF[#].$WAITTM_STRT = 650
is group number of servo gun group using Gun Change Function.
When you implement 2nd countermeasure, gun attach process is extended by about two seconds.
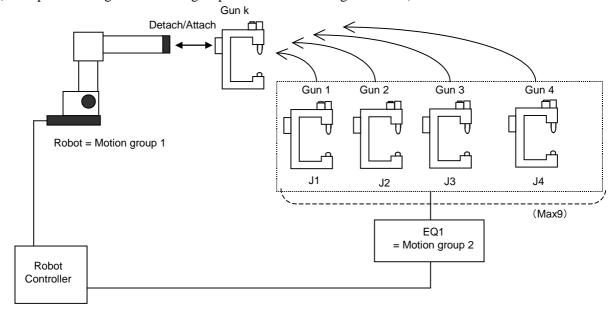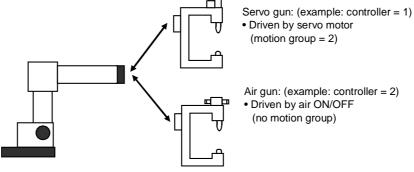
13.1.3 System Configuration

Servo gun change system is constructed as follows.
(Example : Servo gun is the 2nd group and the number of gun is four.)
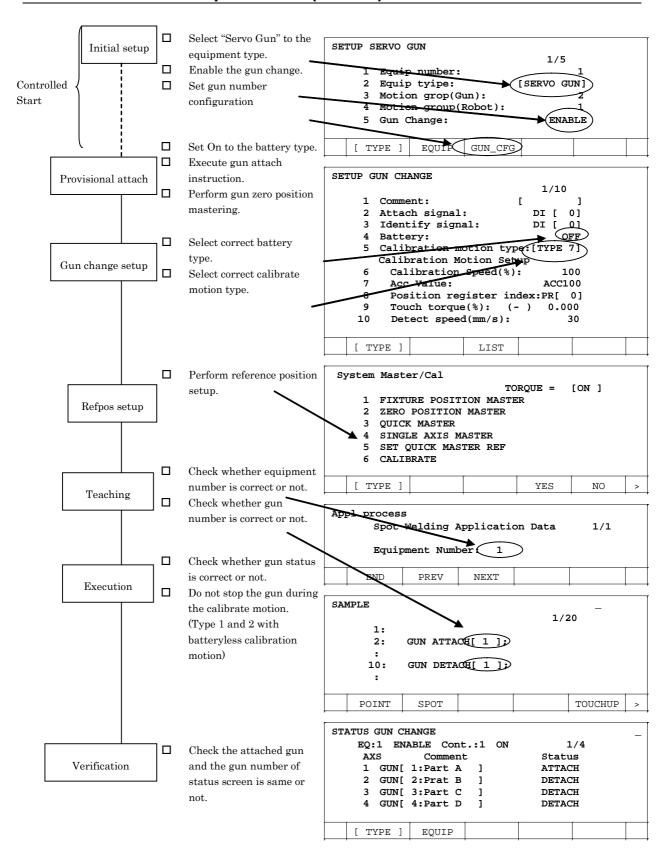
You can replace the servo gun with the air gun by switching on the controller.

13.1.3.1 Installation procedure (outline)

```
┌─────────────┐   ☐  Select "Servo Gun" to the
│Initial setup│      equipment type.
└─────────────┘   ☐  Enable the gun change.
Controlled {      ☐  Set gun number
Start                 configuration
```

```
SETUP SERVO GUN
                                          1/5
   1  Equip number:                        1
   2  Equip tyipe:            [SERVO GUN]
   3  Motion grop(Gun):                     2
   4  Motion group(Robot):                  1
   5  Gun Change:                  ENABLE

   [ TYPE ]    EQUIP    GUN_CFG
```

```
┌────────────────────┐  ☐  Set On to the battery type.
│Provisional attach  │  ☐  Execute gun attach
└────────────────────┘      instruction.
                        ☐  Perform gun zero position
                            mastering.
```

```
SETUP GUN CHANGE
                                         1/10
   1   Comment:              [        ]
   2   Attach signal:        DI [  0]
   3   Identify signal:      DI [  0]
   4   Battery:                      OFF
   5   Calibration motion type:[TYPE 7]
       Calibration Motion Setup
   6     Calibration Speed(%):        100
   7     Acc Value:               ACC100
   8     Position register index:PR[  0]
   9     Touch torque(%):  (- )   0.000
   10    Detect speed(mm/s):           30

   [ TYPE ]            LIST
```

```
┌────────────────────┐  ☐  Select correct battery
│Gun change setup    │      type.
└────────────────────┘  ☐  Select correct calibrate
                            motion type.
```

```
┌────────────┐  ☐  Perform reference position
│Refpos setup│      setup.
└────────────┘
```

```
System Master/Cal
                           TORQUE =  [ON ]
   1  FIXTURE POSITION MASTER
   2  ZERO POSITION MASTER
   3  QUICK MASTER
   4  SINGLE AXIS MASTER
   5  SET QUICK MASTER REF
   6  CALIBRATE

   [ TYPE ]                 YES    NO    >
```

```
┌────────────┐  ☐  Check whether equipment
│Teaching    │      number is correct or not.
└────────────┘  ☐  Check whether gun
                    number is correct or not.
```

```
Appl process
     Spot Welding Application Data    1/1

     Equipment Number:     1

   END    PREV    NEXT
```

```
┌────────────┐  ☐  Check whether gun status
│Execution   │      is correct or not.
└────────────┘  ☐  Do not stop the gun during
                    the calibrate motion.
                    (Type 1 and 2 with
                    batteryless calibration
                    motion)
```

```
SAMPLE                                    _
                                         1/20
     1:
     2:    GUN ATTACH[ 1 ];
     :
    10:    GUN DETACH[ 1 ];
     :

   POINT   SPOT              TOUCHUP  >
```

```
┌────────────┐  ☐  Check the attached gun
│Verification│      and the gun number of
└────────────┘      status screen is same or
                    not.
```

```
STATUS GUN CHANGE                          _
    EQ:1  ENABLE  Cont.:1  ON       1/4
    AXS        Comment           Status
    1  GUN[ 1:Part A  ]          ATTACH
    2  GUN[ 2:Prat B  ]          DETACH
    3  GUN[ 3:Part C  ]          DETACH
    4  GUN[ 4:Part D  ]          DETACH

   [ TYPE ]   EQUIP
```

13.2 INITIAL SETUP

The following initial setup is needed to install the servo gun change system.

- Motion parameter setup of servo gun axes
- The configuration setup of servo gun number
- Enable the gun change function.

```
┌─────────────────────────────────────────────────────────────────┐
│ NOTE                                                              │
│   These setup must be done at the beginning of system installation.│
│   These setup must be done only once. You do not need to change the setup in your │
│   usual operation.                                               │
└─────────────────────────────────────────────────────────────────┘
```
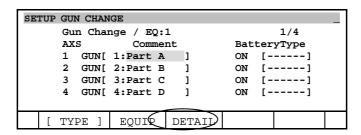
These setup is done at the controlled start.
See "Servo Gun Function Supplementary Manual".

13.3 GUN CHANGE SETUP

The gun change setup must be done for each gun.

1   Press the [MENU] key to display the screen menu.
2   Select "SETUP."
3   Press F1 Type to display the screen switching menu.
4   Select "Gun change." The gun change setup list screen will display.
5   Select gun from the list of guns, then press F3:DETAIL. The detail screen will be displayed.

```
┌─────────────────────────────────────────────┐
│ SETUP GUN CHANGE                          _ │
│      Gun Change / EQ:1              1/4     │
│      AXS        Comment       BatteryType   │
│      1  GUN[ 1:Part A    ]     ON  [------] │
│      2  GUN[ 2:Part B    ]     ON  [------] │
│      3  GUN[ 3:Part C    ]     ON  [------] │
│      4  GUN[ 4:Part D    ]     ON  [------] │
│                                             │
│   [ TYPE ]   EQUIP   DETAIL                 │
└─────────────────────────────────────────────┘
```

```
┌─────────────────────────────────────────────┐
│ SETUP GUN CHANGE                          _ │
│      Gun Change / EQ:1  GUN:1       1/5     │
│      1  Comment:             [ﾊﾟｰﾂ A ﾖｳ]    │
│      2  Attach signal:        DI [  0]      │
│      3  Identify signal:      DI [  0]      │
│      4  Battery:                  ON        │
│      5  Opposable gun:            OFF       │
│                                             │
│   [ TYPE ]          LIST                    │
└─────────────────────────────────────────────┘
```

Common setup (setup items common to all guns)

Comment	Comment for each gun.
Attach signal	This signal specifies the type and number of the input signal used for attachment confirmation. Available I/O type = DI/RI • This signal is check before gun attach/detach instruction. If this signal is OFF, the error occurs. • If the index is zero, the above checking is canceled.

Comment	Comment for each gun.
Identify signal	This signal specifies the type and number of the input signal used for gun identification. Available I/O type = DI/RI/GI • Before a gun is attached/detached, check whether the identification signal corresponding to the specified gun number by the instruction is ON or OFF, and when it is OFF, it means an error has occurred. • When the GI signal is used, its value becomes the gun number. • When the number of input signal is "0," nothing is checked.
Battery	Select battery type. ON = Battery backup type (recommended) OFF = Batteryless type

Calibration motion type setup (select the following when Battery is set to OFF in the common settings.)

Calibration Motion Type	On battery-less guns, the position (pulse value) is lost when the gun is detached. To recover the position, gun automatically performs calibration motion when attached. Calibration involves the following two operations: • Turning the motor two turns for positioning the Pulsecoder (this operation is simply referred to as "positioning" from here on) • Calibrating at a preset reference position Type 7 or 8 is recommended.

Types 7, 8 (Recommended type)

Types 7 and 8 use motor torque to detect the gun axis touching the gun close position and set the position as the reference position.
When the gun is detached (by detachment instruction), the gun is automatically closed, and the reference position is set.

Type 7: Specify this type when the gun is detected at a position (near the 0 position) where the distance to the gun close position is equivalent to less than two turns of the motor at the time of gun attachment.

Type 8: Specify this type when the gun is detected at a position (near the 0 position) where the distance to the gun close position is equivalent to more than two turns of the motor at the time of gun attachment.

RESTRICTION
•   For types 7 and 8, if the tip wear amount changes while the gun is detached, calibration when the gun is attached cannot be performed correctly. Therefore tip replacement must be performed for the attached gun.

Types 1, 2

Select these types on systems capable of holding the gun detachment position as a result of braking the servo gun axis motor up to the next servo gun attachment. The gun detachment position is automatically recorded as the reference point.

Type 1: Specify this type when the gun is detached at a position where
          the gun cannot be operated in the direction to close the gun (near the 0 position).

Type 2: Specify this type when the gun is detached at a position where
          the gun cannot be operated in the direction to open the gun (near the open limit).

RESTRICTIONS:
    With types 1 and 2, if calibration is interrupted by a hold or emergency stop, recovery to the detachment position cannot be performed automatically. In this case, manual mastering is required.
    With type 1 and 2, magnetic phase detection cannot be performed.
    The position where the gun is attached must be the same as the position where it is detached.

The allowable errors of the detach and attach positions must fall within the respective following ranges for the direct-acting axis and rotary axis:

Direct-acting axis: ±(gear ratio/2)mm or less around the detach position
Rotary axis: ±((360/gear ratio)/2)deg or less around the detach position
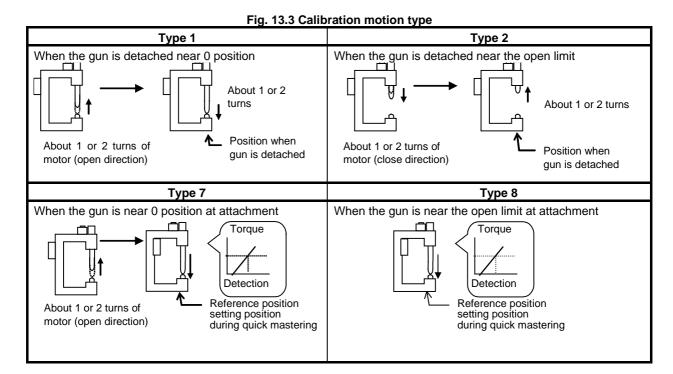
NOTE that positional misalignment occurs during gun attachment if the above ranges are exceeded.

Table 13.3. Calibration Motion Type and Reference Position Setup

Type	Calibration Motion	Set Position of Reference position
Type 1	The servo gun is opened by about two turns of the motor, and then calibrated at the position where it is closed by about two turns. NOTE 1	Position when gun is detached Reference position is not required. NOTE 2
Type 2	The servo gun is closed by about two turns of the motor, and then calibrated at the position where it is opened by about two turns.	Position when gun is detached Reference position is not required. NOTE 2
Type 7	The servo gun is opened by about two turns of the motor ,closed to its close position ,then calibrated. Arrival at the close position is detected by motor torque.	Gun close position Reference position setting is not required.NOTE3
Type 8	The servo gun is closed to its close position ,then calibrated. Arrival at the close position is detected by motor torque.	Gun close position Reference position setting is not required.NOTE3

NOTE
1   Gun master data is lost if the operation is canceled due to a hold or an emergency stop during calibration that is carried out during the gun change sequence when types 1 or 2 are selected. If this happens, manually carry out zero position mastering.
2   With types 1 and 2, the system automatically memorizes the position where the servo gun is detached as the reference position. This memorized reference position is used in calibration when the same gun is next attached. For this reason, when types 1 or 2 are selected, the detachment position and the attachment position must be the same. Do not select types 1 or 2 when a motor without a brake is used for the servo gun axis.
3   With types 7 and 8, the servo gun is closed during execution of the GUN DETACH instruction ,and the system automatically memorizes the position where the servo gun is detached. The memorized reference position is used for calibration performed when the same un is next attached. For reason, when the calibration motion type is changed to type 7 or 8, the gun must have been attached.

Fig. 13.3 Calibration motion type

Type 1	Type 2
When the gun is detached near 0 position	When the gun is detached near the open limit
About 1 or 2 turns Position when gun is detached About 1 or 2 turns of motor (open direction)	About 1 or 2 turns Position when gun is detached About 1 or 2 turns of motor (close direction)

Type 7	Type 8
When the gun is near 0 position at attachment	When the gun is near the open limit at attachment
Torque / Detection About 1 or 2 turns of motor (open direction) Reference position setting position during quick mastering	Torque / Detection Reference position setting position during quick mastering

Screen for Calibration Types 1, 2

```
SETUP GUN CHANGE                          _
                                      5/7
    1   Comment:           [         ]
    2   Attach signal:        DI [  0]
    3   Identify signal:      DI [  0]
    4   Battery:                  OFF
    5   Calibrate motion type:  [TYPE 2]
        Calibration Motion Setup
    6     Calibration Speed(%):    100
    7     Acc Value:            ACC100



 [ TYPE ]        LIST
```

Screen for Calibration Types 7, 8

```
SETUP GUN CHANGE                          _
                                     9/10
    1   Comment:           [         ]
    2   Attach signal:        DI [  0]
    3   Identify signal:      DI [  0]
    4   Battery:                  OFF
    5   Calibration motion type: [TYPE 7]
        Calibration Motion Setup
    6     Calibration Speed(%):    100
    7     Acc Value:            ACC100
    8     Position register index:PR[  0]
    9     Touch Torque(%):   (+ )  0.000
   10     Detect speed(mm/s):       30

 [ TYPE ]        LIST
```

(1)   Open limit operation setting (Set the following when the calibration motion type 1,2 or 7 is selected.)

Calibration speed	Specify the motion speed of calibration (motion for about two turns of the motor)

(2)   Acceleration rate

Accelerate rate	Specify the acceleration of calibration motion. The standard value is 100(%).

(3)   Position register No. setting (Set as follow when type 7 or 8 is selected.)

Position register No	Position register for holding the momentary position where arrival at the reference position (open limit or signal input position) was detected Set the position register specified here exclusively for calibration. (Do not use the same position register in the program, for example.)

(4)   Open limit detection torque setting (Set as follows when type 7 or 8 is selected.)

Touch torque (%)	Threshold value of the motor torque for detecting arrival at the open limit Set the value within range 0.0 to 100.0%.

(5)   Detection speed (Set the following when the calibration motion type 7 or 8 is selected)

Detection speed	Specify the speed of the motion to the reference position.

13.4   SETTING THE REFERENCE POSITION

13.4.1   Battery-less Type Guns

On battery-less guns, the position (pulse value) is lost when the gun is detached. So, calibration must be carried out when gun is attached.
The position taken as the reference for calibration is called the "reference position."
On battery-less guns, the reference point must be set before the gun is detached.
How the reference point is set differs according to the calibration motion type.
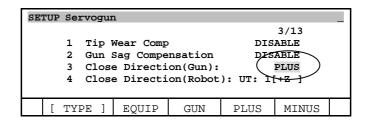
> ⚠**CAUTION**
> Before you set the following reference positions, be sure to set the correct
> direction at Close Direction (Gun) in the Servo Gun Setup screen.

```
SETUP Servogun                                        _
                                          3/13
        1  Tip Wear Comp              DISABLE
        2  Gun Sag Compensation       DISABLE
        3  Close Direction(Gun):         PLUS
        4  Close Direction(Robot): UT: 1[+Z ]

   [ TYPE ]   EQUIP    GUN    PLUS    MINUS
```
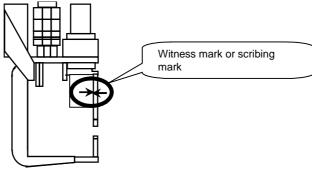
Types 1, 2
The system automatically sets the reference position when the servo gun is detached.

Types 7, 8
The system automatically sets the reference position when the servo gun is detached.

13.4.2   Battery-mounted Type Guns

On battery-mounted type guns, the position (pulse value) is not lost even if the gun is detached. Therefore, the reference position used for calibration when the gun is attached need not be set as it needs to be on a battery-less type gun. However, that we recommend setting a reference position for quick mastering by witness mark or scribing mark as shown in the figure below for extra safety in the event that the battery comes loose.

Witness mark or scribing mark

13.5   GUN CHANGE INSTRUCTION

For servo gun replacement, the following instructions are provided.

13.5.1   GUN DETACH Instruction

This instruction can detach the servo gun without power off. When the calibration motion type 7 or 8 is selected , before the servo gun is detached, the servo gun is closed automatically, and the gun close position is set the reference position.

Format : GUN DETACH[i]

i :   Gun number (1 ~ 10)
       Specify the gun number which you want to detach.
       R[ ] and AR[ ] can be used.
Ex) GUN DETACH[1]
     GUN DETACH[R[2]]
     GUN DETACH[AR[1]]

13.5.2   GUN ATTACH Instruction

This instruction can attach the servo gun without power off. In case of batteryless gun, the mastering and calibration are performed automatically.

Format : GUN ATTACH[i]

i :   Gun number (1 ~ 10)
       Specify the gun number which you want to detach.
       R[ ] and AR[ ] can be used.
Ex) GUN ATTACH[5]
     GUN ATTACH[R[3]]
     GUN ATTACH[AR[1]]
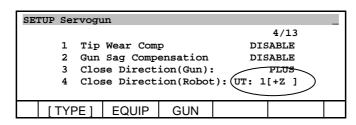
After servo gun is attached, the tool number is changed to the same number which is specified as a gun close direction of fixed side in the servo gun setup screen.

```
SETUP Servogun                                          _
                                             4/13
          1  Tip Wear Comp               DISABLE
          2  Gun Sag Compensation        DISABLE
          3  Close Direction(Gun):          PLUS
          4  Close Direction(Robot): UT: 1[+Z ]

      [ TYPE ]    EQUIP    GUN
```

13.5.3   Sample Program

Sample Program

	[Explanation]
1: J P[1:Approach] 100% FINE	1: Move to approach position
2: L P[2:GUN1 SET] 100mm/sec FINE	2: Set gun axis to 0 position
3: GUN DETACH[1]	3: Gun 1 detach sequence executed
4: L P[1:Approach] 100mm/sec FINE	4: Mechanical detachment operation
:	
11: J P[11: Approach] 100% FINE	
12: L P[12:GUN2 SET] 100mm/sec FINE	
13: GUN ATTACH[2]	13: Gun 2 attach sequence executed.
14: L P[13: Approach] 100mm/sec FINE	
:	
99: END	99: Normal end
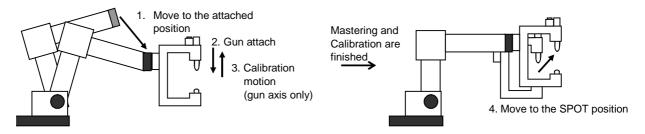
> **NOTE**
> The above is merely a sample program. Create programs to suit the requirements
> of your system.

13.5.4   Forward Execution

It is necessary to check that the gun number of instruction is same as the actual gun. And in the case of
attach instruction, the calibration motion type must be set correct type.
In the case of batteryless gun, the calibration motion (3 in the following figure) is done.

> **⚠ CAUTION**
> In the case of calibration motion type is Type 1 or Type 2, if the motion is stopped
> by e-stop or HOLD during the calibration motion, the mastering data is lost.
> If the mastering data is lost, please do the zero mastering and calibration by
> manual again.
> Otherwise,
> 1) The current position on TP is not matched to the actual position.
> 2) If the motion instruction is executed, the following alarm is occurred.
>   "MOTN-049 Attempt to move w/o calibrated"
> 3) The GUN DETACH instruction does not work until manual mastering and
>   calibration are finished.
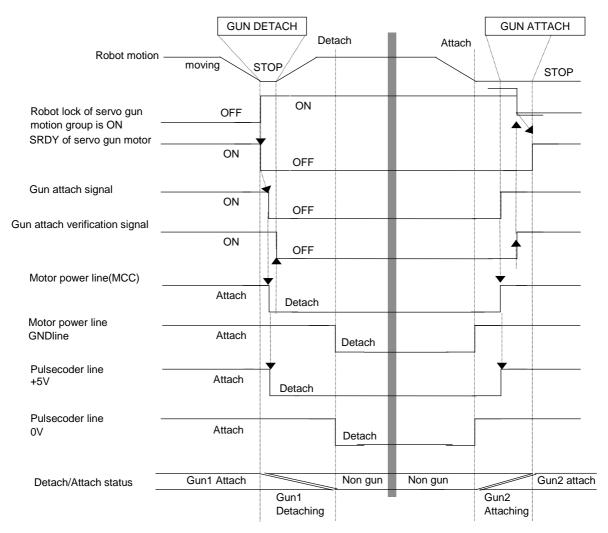
13.5.5   Backward Execution (BWD)

Both GUN ATTACH and GUN DETACH instruction cannot be executed by backward execution. Therefore, gun change cannot be performed in backward execution.

13.6   GUN CHANGE SEQUENCE

The gun change instruction executes the following sequence.

13.7 GUN CHANGE STATUS

On the gun change status screen, verify that which gun is attached or detached now.

1   Press the [MENU] key to display the screen menu.
2   Select "- - Next- -" → "STATUS."
3   Press F1 TYPE to display the screen switching menu.
4   Select "Gun change." Then, the gun change status screen will display.

```
STATUS GUN CHANGE                                  _
    EQ:1  ENABLE  Cont.:1  ON            1/4
    AXS      Comment                  Status
     1  GUN[ 1:Part A    ]            ATTACH
     2  GUN[ 2:Prat B    ]            DETACH
     3  GUN[ 3:Part C    ]            DETACH
     4  GUN[ 4:Part D    ]            DETACH

      [ TYPE ]   EQUIP
```

The following status are displayed.

AXS	The axis number of the motion group which is assigned to the current equipment.
Gun	The gun number which is assigned to the above axis.
Status	Gun status
	ATTACH : The gun is attached.
	DETACH : The gun is detached.
Comment	The comment of each gun.

13.8 SERVO GUN SETUP
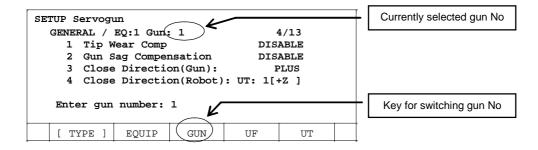
On gun change systems, the following settings must be carried out each time that the gun is changed.

· **Gun adjustment utility (motion sign, gear ratio, stroke limit, automatic adjustment)**
· **Servo gun general setup (gun close direction, maximum pressure, pressure adjustment)**
· **Pressure conditions setup**
· **Stroke conditions setup**
· **Manual operation (manual pressuring, manual stroke, manual welding) setup**
· **Tip wear down value compensation setup**

To select the gun to be set in each screen, use F3 GUN.
When setting the above items, the gun to be set need not necessarily be attached. (NOTE, however, that the gun to be set must be attached when the gun is actually operated by manual pressuring, pressure adjustment and tip wear down detection.)

Example) Servo Gun General Setup Screen

```
SETUP Servogun
    GENERAL / EQ:1 Gun: 1            4/13              Currently selected gun No
      1  Tip Wear Comp            DISABLE
      2  Gun Sag Compensation     DISABLE
      3  Close Direction(Gun):       PLUS
      4  Close Direction(Robot): UT: 1[+Z ]

    Enter gun number: 1                               Key for switching gun No

      [ TYPE ]   EQUIP    GUN     UF      UT
```

13.9   TEACHING

In the gun change system, the normal spot instructions used are the same as those used in normal systems (systems that do not perform gun change). For details on spot instructions, see Chapter 5.
However, in the gun change system, please NOTE the following points in teaching.

13.9.1   Notice for Teaching

Position data

In the gun change system, the each gun is assigned to the each axis of the servo gun motion group. For example, if three kinds of gun are assigned to gun change system, the servo gun motion group has three axes data. This means three axes data are recorded when servo gun position is taught.

(Ex. The position data of gun1 which is assigned to first axis)

```
GP1:    UF : 0, UT : 1,    Config : 'N, 0, 0, 0',
    X =   1879.25 mm,  Y = -1035.37 mm,  Z =     162.65 mm,
    W =  -178.67 deg,  P =  -13.68 deg,  R =    -37.32 deg
GP2:    UF : 0, UT : 1,
    J1 = 10.00 mm      J2 = 0.00 mm      J3 = 0.00 mm
```
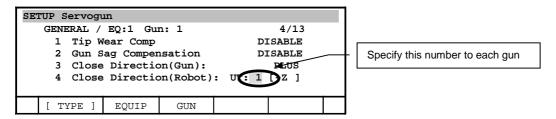
Please note that the position taught here, if not set otherwise can also be used for execution when gun 2 assigned to the second axis is attached (In this case, gun 2 operates at 0.00 mm position). This specification is to make programs versatile, but when the position is recovered by mistake while gun 2 is attached, interference may occur. To prevent such risk, please set the coordinate system number used for the "gun close direction (fixed-side tip)" for each gun.

```
SETUP Servogun
    GENERAL / EQ:1  Gun: 1                    4/13
    1  Tip Wear Comp                DISABLE
    2  Gun Sag Compensation         DISABLE
    3  Close Direction(Gun):           PLUS        <- Specify this number to each gun
    4  Close Direction(Robot):  UT: 1 [ Z ]

    [ TYPE ]    EQUIP     GUN
```

With the above setting, the position data taught at each gun contains a different coordinate number each. Therefore, even if a different gun is connected and mistakenly used for execution, the selected coordinate system number is different from the one contained in the position data, which allows you to generate an error. (Note that when a gun attach instruction is executed, as the selected coordinate system number automatically switches to the coordinate system number of the attached gun, the coordinate system number does not need to be changed manually even when the above settings are made.)

•   SPOT instruction
The gun number is not specified in SPOT instruction. This means SPOT instruction does not care which gun is attached. So, same SPOT instruction can control plural guns.
        1 : J P[1] 100% FINE SPOT[SD=1,P=1,S=1,ED=1]
                <- Gun number is not specified.
But, in other word, the SPOT instruction taught with gun1 can be executed with gun2.
Therefore, to prevent a spot instruction from being mistakenly executed when a different gun is attached, like the case with the position data, please set the "coordinate system number used for the gun close direction (fixed-side tip)" for each gun. For the same reason as the program's position data, it allows you to generate an error of inconsistent coordinate system numbers when the program is executed.

13.9.2 Sample Program

Sample program

	[Explanation]	

:
11:J P[11] 100% FINE SPOT[P=1,S=1,BU=1]
12:L P[12] 100mm/sec FINE
  : SPOT[P=1,S=1,BU=1]
13:J P[13:Approach pos] 100% FINE
14:L P[14:Gun1 set] 100mm/sec FINE
15:   GUN DETACH[1]
16:L P[13:Approach pos] 100mm/sec FINE
            :
21:J P[21:Approach pos] 100% FINE
22:L P[22:Gun2 set] 100mm/sec FINE
	11:Spot weld with gun1
	12:Spot weld with gun1
	13:Move to approach position
	14:Set gun1 to gunchanger
	15:Detach gun1
	16:Release gun1
	    :
		Move with tool number 1

23:   GUN ATTACH[2]
24:L P[23:Approach pos] 100mm/sec FINE
25:J P[24] 100% FINE SPOT[P=1,S=1,BU=1]
26:L P[25] 100mm/sec FINE
  : SPOT[P=1,S=1,BU=1]
            :
99:   END
	23:Attach gun2.
	
	25:Spot weld with gun2
	26:Spot weld with gun2
	
	99:Normal end
		Tool number is changed to 2
		
		Move with tool number 2
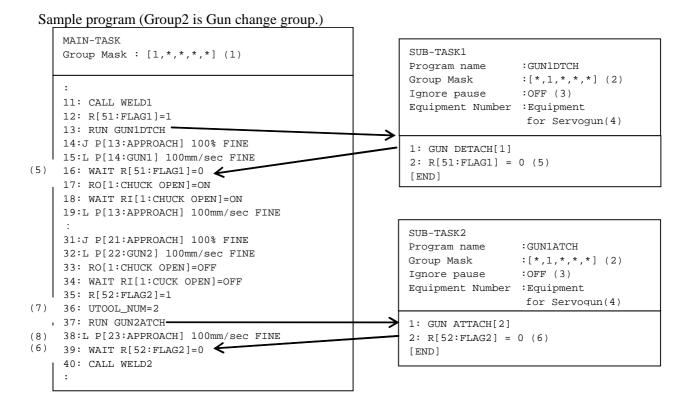
NOTE
   This is sample program. Create the program related to your system.

13.9.3 Gun Change by Multi-task

Using multi-task, the robot motion instruction and Gun change instruction can be run at same time. Cycle time can be reduced by that Gun change is done in sub-task during the robot is moved. See the following guide when teach Gun change by multi-task.

- Set the motion mask for main-task to Gun change group is disabled.(1)
- Set the motion mask for sub-task to Gun change group is enabled.(2)
- Set Ignore pause for sub-task to OFF.(3)
- Set Equipment Number in Application Data for sub-task to the equipment number of servo gun.(4)
- Synchronize main-task and sub-task by a register.
  - Detach instruction must be finished in sub-task before the gun separates off from the robot physically.(5)
  - Attach instruction must be finished in sub-task before start welding.(6)
- Teach the coordinate system instruction in the main task and switch Tool coordinate system No. to "Gun Close Direction(Robot)" of this gun just before run sub-task included Gun attach instruction.(7)
  - As preceding section, Gun attach instruction changes Tool coordinate system No. This process prevents changing coordinate No. during the motion of (8).

Sample program (Group2 is Gun change group.)

```
MAIN-TASK
Group Mask : [1,*,*,*,*] (1)

       :
11: CALL WELD1
12: R[51:FLAG1]=1
13: RUN GUN1DTCH
14:J P[13:APPROACH] 100% FINE
15:L P[14:GUN1] 100mm/sec FINE
(5)  16: WAIT R[51:FLAG1]=0
17: RO[1:CHUCK OPEN]=ON
18: WAIT RI[1:CHUCK OPEN]=ON
19:L P[13:APPROACH] 100mm/sec FINE
       :
31:J P[21:APPROACH] 100% FINE
32:L P[22:GUN2] 100mm/sec FINE
33: RO[1:CHUCK OPEN]=OFF
34: WAIT RI[1:CUCK OPEN]=OFF
35: R[52:FLAG2]=1
(7)  36: UTOOL_NUM=2
37: RUN GUN2ATCH
(8)  38:L P[23:APPROACH] 100mm/sec FINE
(6)  39: WAIT R[52:FLAG2]=0
40: CALL WELD2
       :
```

```
SUB-TASK1
Program name    :GUN1DTCH
Group Mask      :[*,1,*,*,*] (2)
Ignore pause    :OFF (3)
Equipment Number :Equipment
                  for Servogun(4)

1: GUN DETACH[1]
2: R[51:FLAG1] = 0 (5)
[END]
```

```
SUB-TASK2
Program name    :GUN1ATCH
Group Mask      :[*,1,*,*,*] (2)
Ignore pause    :OFF (3)
Equipment Number :Equipment
                  for Servogun(4)

1: GUN ATTACH[2]
2: R[52:FLAG2] = 0 (6)
[END]
```

> ⚠ **CAUTION**
> Teach the motion instructions by selected coordinate system No. at that time.
> In above sample program, LINE motion at line38 must be taught by coordinate
> system No.2 because No.2 is selected at line36 before RUN GUN2ATCH.

14 OVERTORQUE PROTECTION FEATURE

> **NOTE**
> No special hardware/software is required. This function is included in Enhanced Servo Gun option.
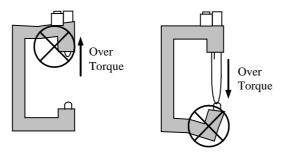
14.1 OVERVIEW

OverTorque Protection is designed to reduce the damage to servo guns and servo gun actuators caused by driving the gun open to its hard stop or closed to where tips collide at excessive force. OverTorque Protection monitors the motor current on the servo gun axis to determine if an unexpected disturbance, such as the gun being jogged to its end of stroke, has occurred. It will remove servo power from the motor and post a "Collision Detect Alarm" if a potential OverTorque condition is captured.

There are no additional setup tasks required to activate and use OverTorque Protection. It is enabled by default. However, you can change the settings on the servo gun general setting screen. This Chapter explains how to do this.

Before changing the settings of this function, correctly set the gun's maximum pressure and tip displacement ratio, and complete autotuning and pressure calibration.

Before the Servo Gun setup is complete, the OverTorque Protection is an estimate, based on theoretical data. However, as the setup is completed, the parameters are optimized to best protect the gun.

14.2 OVERTRQUE PROTECTION SETUP

Before autotuning: motor torque is limited to a torque corresponding to the max gun pressure based on the selected motor and tip displacement ratio. The gun not being able to reach the commanded position causes "Move Error Excess" or "Stop Error Excess."
After autotuning: motor torque is not limited, but actually the load torque is monitored, and the gun is protected by a "Collision Detect Alarm."

Step 1: Proper Motor and Axis Setup at a Control start
1   Add servo gun axis
2   Setup servo gun axis
3   Make sure that motor selection is correct.
4   Correctly set the proper gear ratio.
5   Go to a Cold Start

Step 2: OverTorque Protection Screen Basic Settings
1   Get to this menu through setup servogun

- MENU-SETUP-Servo Gun-General Setup –OverTorque Protection<DETAIL>

```
SETUP Servogun
GENERAL / EQ:1 GUN:1                    14/14
 1 Tip Wear Comp:                     DISABLE
 2 Gun Sag Compensation:             DISABLE
 3 Close Direction(Gun):               PLUS
 4 Close Direction(Robot):      UT: 1 [+Z]
 5 Max Motor Torque(%):              100.0
 6 Max Pressure(nwt):              4900.0
   Max Gun Torque(%):                 10.5
 7 Tip stick detect distance(mm):        5
 8 Tip Wear Detection:         <*DETAIL*>
 9 Pressure Cal:         INCOMP <*DETAIL*>
10 Tip Wear Standrd:     INCOMP <*DETAIL*>
11 Weight compensation:        <*DETAIL*>
12 Thickness check:            <*DETAIL*>
13 Gun Stroke limit:           <*DETAIL*>
14 OverTorque protection       <*DETAIL*>


    [ TYPE ]   EQUIP     GUN
```

Before auto tuning

The following message is displayed. Press F4 OK to go setting screen.

```
              Overtorque protect status: ACTIVE

              Collision thresholds are not
              available yet, autotuning status
              is not complete. But torque%
              has been reduced to protect gun.
              Please perform autotuning.


                                        OK
```

After auto tuning

When auto tuning is complete, the following message is displayed. Press F4 OK to go setting screen.
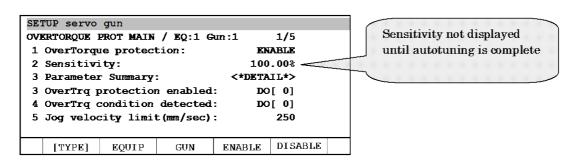
```
              Overtorque protect status: ACTIVE

              Autotuning status is complete, and
              Over torque detection thresholds
              have been set.


                                        OK
```

2   Make sure that OverTorque Protection is enabled. The software default is enabled.
3   Reduce the jog velocity limit to get more response time during jogging. This is optional.
         NOTE: OverTorque sensitivity adjustment is not available prior to completion of autotuning
4   Set a DO number to notify overtorque detection.

```
SETUP servo gun
OVERTORQUE PROT MAIN / EQ:1 Gun:1      1/5
 1 OverTorque protection:          ENABLE
 2 Sensitivity:                   100.00%
 3 Parameter Summary:          <*DETAIL*>
 3 OverTrq protection enabled:     DO[ 0]
 4 OverTrq condition detected:     DO[ 0]
 5 Jog velocity limit(mm/sec):        250


    [TYPE]    EQUIP     GUN    ENABLE  DISABLE
```

Sensitivity not displayed
until autotuning is complete

Step 3: Max Pressure Setting at Servogun setup screen

Overtorque Protection will prevent torque in excess of what generates Max Pressure as defined on the servo gun setup screen and calculated from the user provided calibration data for the servo gun.

1   Get to this menu through setup servogun.
2   Set Max Pressure to the actual maximum allowable tip force for the weld gun (NOTE: the default value is 4900.0N (500kgf).

The maximum gun torque is the value of the maximum pressure converted to the ratio of the maximum amplifier current. This value can be updated when the maximum pressure is changed. This value cannot be changed directly.

```
SETUP Servogun
GENERAL / EQ:1 Gun:1                    6/14
   :

 5 Max Motor Torque(%):              100.0
 6 Max Pressure(nwt):               4900.0
   Max Gun torque(%):                 10.5
   :


   [ TYPE ]   EQUIP    GUN
```

Step 4: Perform Autotuning

Perform servo gun autotuning. For the details, see the description on how to complete autotuning in "2, Initial Settings." It is not needed when autotuning has already been completed.

Step 5: Perform Pressure Calibration

Perform pressure calibration. For the details, see the description on how to calibrate pressure in "2. Initial Settings."

Before pressure calibration, the maximum gun torque is calculated based on a theoretical value. Generating the maximum pressure might require a torque larger than the theoretical value. In the standard settings, adjusting to a torque larger than the theoretical value is allowed.

Select F4 "OK" to move to the pressure calibration screen.

⚠️**CAUTION**

The torque limit during calibration is determined by the setting of the system variable $SGSYSCD.$CAL_TRQ_SEV as follows:

$SGSYSCD.$CAL_TRQ_SEV = 0: Adjusting to a torque larger than the theoretically largest motor torque is allowed (default).

$SGSYSCD.$CAL_TRQ_SEV = 1: Adjusting to a torque larger than the theoretically largest motor torque is prohibited.

Procedure

- Perform force calibration as usual.
  If max gun torque is exceeded, then a prompt is displayed, as shown below (when the maximum gun torque is 15%).

```
SETUP Servogun
PRESSURE CALIB PARMS / EQ:1 Gun:1      1/14
 1 Calibration Status:              INCOMP
 2 Pressuring Time(sec):               1.5
 3 Thickness of Gauge(mm):            12.7
 4 Gun Open Value(mm):               115.0
   Torque(%) Speed(mm/sec)    Press(nwt)
5    5.0 %     100 mm/sec    1000.0 nwt
6   10.0 %     100 mm/sec    2000.0 nwt
7   16.0 %     100 mm/sec    3000.0 nwt
Warning: max gun torque is  15.0%


   [ TYPE ]  CANCEL  PRESSURE   COMP   INCOMP
```

Step 6: Adjustment and Description of OverTorque Protection parameters

The parameter settings can be viewed from the OverTorque Protection line item seen on the Servo Gun General Setup Screen. By default, OverTorque Protection will be enabled and set to a sensitivity of 100%. When needed, adjust sensitivity.

- 100% is what the servo gun software perceives to be the optimal setting for the mechanical gun, now defined.
- The limit can usually be increased to 200% (twice as sensitive) or decreased to a value that varies based on the Max Pressure for the gun.
  - 50% would be ½ the collision sensitivity of 100%. The sensitivity can never be decreased to a value that would allow a collision above the gun's Max Pressure.
  - Disabling OverTorque Protection, completely disables the OverTorque Protection feature.

When "2 Parameter Summary <*DETAIL*>" in the Overtorque Protection screen is selected, the screen is displayed in the left. The values in the screen are the parameters used to detect servo gun collision. The parameters can be displayed in units of torque counts (TorqCt) or Units Force, based on the results of the Pressure Calibration for the gun.

```
SETUP servo gun
OVERTORQ PARAM SUMRY / EQ:1 Gun:1      1/1
 1 Display unit:                    TorqCt
   Max Gun torque:                    1106
   Std OverTorque value:               692
   Max Motor torque:                  7282
   OverTorque thresholds:
     Program close stroke(trq):       1106
     Program open stroke(trq):         692
     Jog close stroke(trq):            692
     Jog open stroke(trq):             692


   [ TYPE ]   EQUIP    GUN    [CHOICE]
```

Overtorque Protection Parameters

Item	Description
Display Units	The user can specify the display units for the Overtorque Parameters Torque: Shown in TorqCt initially. Torque can be calculated based on motor current by the following equation: Amps (Pk) = TorqCt/7282 × amplifier max current output Force = the TorqCt is converted to a unit of force based on the existing Pressure Calibration data
Max Gun Torque	**This is the maximum collision torque that OverTorque Protection will allow for the servo gun axis**. This value corresponds to the torque that will yield the Max Pressure, as specified on the servo gun general setup screen, plus a small margin. Max gun torque is the value at which the overtorque alarm triggers. Therefore, the margin should be specified so that Max gun torque is slightly larger than the max torque observed during close (transient torque) and hold (static torque). The magnitude of the margin is specified by the system variable $sggun#.$chk_prs.$margin_p and is in units of kgf
Std. Overtorque Threshold	**This is the standard collision detection torque**. This is a parameter obtained in autotuning. When sensitivity is set to 100%, all OverTorque thresholds except the program close stroke (used for pressuring) will be set to this value. When sensitivity is changed, the overtorque threshold is adjusted based on the new sensitivity value as shown below. Overtorque threshold = 100/sensitivity × std. overtorque threshold.
Max Motor Torque	This is NOT an OverTorque limit. This value represents the maximum motor torque available from the amplifier for standard motion, such as acceleration and deceleration.
OverTorque Threshold	The following values display the actual OverTorque parameters for the (4) different types of servo gun motion. **These represent the actual torque value at which a Collision Alarm will be issued**.
Program Close Stroke	This is the limit for program close motion, which is for performing pressuring operations. The value corresponds to the torque that yields the Max Pressure specified for the gun. This value can only be adjusted by changing the Max Pressure. Since pressuring operations require large torque, this value is always equal to the Max Gun Torque.
Program Open Stroke	This is the limit for open motion of the gun during program operation. This is based on the Std OverTorque Value and the Sensitivity
Jog Close Stroke	This is the limit for close motion of the gun during jogging operation. This is based on the Std OverTorque Value and the Sensitivity
Program Open Stroke	This is the limit for open motion of the gun during jogging operation. This is based on the Std OverTorque Value and the Sensitivity

⚠ **CAUTION**
After Sensitivity Adjustment, it is good to check the Parameter Summary screen in OverTorque Protection to confirm that the open stroke torque limits are still set below the mechanical limit of the gun's open hard stop.
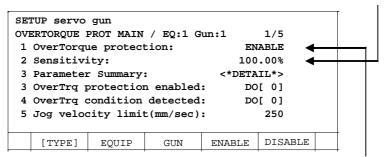
> **NOTE**
> - Largest allowed gun torque = Max Gun Torque
> - Program Close Stroke threshold does not change with Sensitivity adjustment, it is always equal to Max Gun Torque
> - Minimum sensitivity depends on the ratio between Max Pressure and Std OverTorque value
> - If the "Std OverTorque value" is higher than "Max Gun Torque", the OverTorque Protection function may return an error status message. Countermeasures to this condition include:
>   - Increase Max Pressure until the error status is eliminated
>   - NOTE: After this change, even if the Max Pressure is reduced, "Program Close Stroke" will not be updated. Overtorque Protection for jogging and program open motion will still be maximized
>   - Stroke the gun many times to reduce the friction in the drive mechanism then Autotune the gun again to re-measure the Std OverTorque value

Effect of Tip Sticking on OverTorque Protection

Since OverTorque Protection provides for detection of unexpected motor current disturbances that are relatively small, there is a possibility that heavy tip sticking following a spot weld will trigger collision alarms for the servo gun axis. If these alarms are troublesome, attempt the following countermeasures (in recommended order) to reduce the occurrence of these alarms:

1   **Reduce the tip sticking**. Only excessive tip sticking will cause a fault in most guns.
2   **Reduce the sensitivity of OverTorque Protection**. Sensitivity may be reduced to the minimum percentage, but it is best to only reduce to a level that prevents unwanted alarms from tip sticking. Reducing sensitivity will remove unwanted alarms in most cases and OverTorque Protection will still be active.

```
SETUP servo gun
OVERTORQUE PROT MAIN / EQ:1 Gun:1       1/5
 1 OverTorque protection:           ENABLE   ◄──────
 2 Sensitivity:                     100.00%  ◄──────
 3 Parameter Summary:              <*DETAIL*>
 3 OverTrq protection enabled:       DO[ 0]
 4 OverTrq condition detected:       DO[ 0]
 5 Jog velocity limit(mm/sec):          250


 ┌──────┬────────┬───────┬────────┬─────────┬──────┐
 │      │[TYPE]  │ EQUIP │  GUN   │ ENABLE  │DISABLE│     │
 └──────┴────────┴───────┴────────┴─────────┴──────┘
```

3   **Disable OverTorque Protection**. When Overtorque Protection is not specifically needed, disable the function. By doing so, collision alarms caused by tip sticking will no longer be generated.

15   PART THICKNESS CHECK FUNCTION

Part Thickness checks can be carried out with the servo gun and standalone SPOT instructions and the Press_Motion instruction.

The part thickness check will perform a measurement to determine the *Estimated Part Thickness* and compare it to the *Expected part thickness*. When the measured value is outside of the user-specified tolerance a WARNING or fault can be issued, and an output can be asserted. Thickness checks can be enabled for all spot and press_motion instructions or only when directly specified.

Target applications for Part Thickness check include detection of:
- Missing part
- Incorrect part

> **NOTE**
> Compensation for wear on the welding tips (Tip wear compensation) and bending in the gun arms (Gun Sag compensation) are required for accurate part thickness measurement. See the appropriate sections for details on each of these compensation functions.

The user must complete the "Thickness Check Calibration" item on the Servogun Autotune Utility for the part thickness function to be enabled. In addition, the user is required to:

1   Accurately set the tip displacement ratio for the gun (mm/motor revolution).
2   Keep gun tips accurately mastered so tips touch exactly at zero position. Tip wear compensation programs are typically used to achieve this.
3   Fixed tip of gun must be in gentle contact with the metal surface during thickness check. (Accurate touching and gun sag compensation are typically required.)

> **NOTE**
> For the restrictions of above 2 and 3, it is recommended to set Tip wear compensation and Gun Sag compensation to enable.

> **DEFINITIONS**:
> **Estimated (Measured) Part Thickness** = position of the gun tips minus expected gun deflection when the thickness check is performed.
>
> **Expected Part Thickness** = part thickness from the specified pressure schedule (or THK_VAL condition if used). This is compared to the Measured Part Thickness to determine if the measured thickness is out of tolerance.

15.1   THICKNESS CHECK CALIBRATION

Gun Deflection Calibration Procedure
1   Press the [MENU] key.
2   Select [1 UTILITIES].
3   Press F1, [TYPE] and select SG Auto Tune. The following screen will be displayed.

```
UTILS Gun setup                                        _
         EQ:1 Gun:1                              3/3
         1.Set gun motion sign:                 COMP
         2.Set Gun specs, master gun:           COMP
               Tip Displacement:  15.00(mm/rev)
               Open stroke limit:    -150.0(mm)
               Close stroke limit:     20.0(mm)
         3.Auto Tune:                           COMP
         4.Press Compensation Setup: <*DETAIL*>
         5.Thickness Check calibration: INCOMP

    [ TYPE ]   EQUIP    EXEC    RESTART
```

4   Complete Steps 1-3 of the Servogun Autotune utility.
5   Complete Pressure Calibration.
6   Be sure that the tips touch at the zero position exactly (+/- 0.1mm). It is best to complete Tip Wear
     Compensation Setup/Initialization since tip wear compensation is needed, and provides for accurate
     zero position mastering of the gun tips.
7   Select the appropriate equipment and gun number using the F-keys.
8   Move the cursor to select Step 4, "Thickness Check Calibration".

NOTE
Before starting the calibration the following items must be confirmed:
• The gun tips must be accurately mastered. (any error in mastering will lead to a
  direct error in part thickness measurement).
• For accurate thickness measurement, Pressure Calibration must be complete
  before Step 4.
  • Thickness check calibration is done when Pressure Calibration is incomplete.
  • In above, the result of calibration is the theoretical value. So this function
    cannot do the best performance.
• Robot may have to be placed in AUTO or T2 and all faults cleared.

---

9   Press Shift + F3 (EXEC) to initiate the calibration. The following prompt box will be displayed when
     you do this.

```
Accurate gun 0 position is
required for thickness check
calibration. Master gun via
tipwear update program or
automaster if current zero
position is not accurate.

   [ OK ]
```

10   Select OK after read this note of caution.
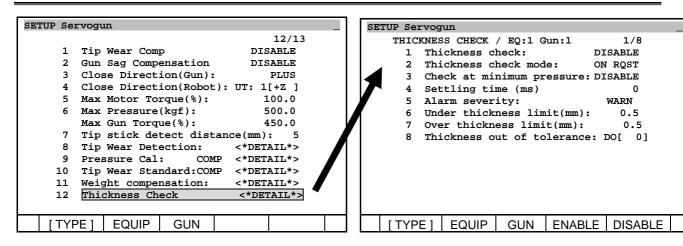
```
┌─────────────────────────────┐
│                             │
│  Thickness Check calibration │
│  exercises will begin.       │
│                             │
│                             │
│  ARE YOU SURE YOU WANT TO DO │
│  THIS?                       │
│                             │
│     [ YES ]      NO          │
│                             │
└─────────────────────────────┘
```

11   Select YES. Calibration starts and the selected gun will open and close several times. The robot will
      not move during this process.

15.2   THICKNESS CHECK GENERAL SETUP

```
┌──────────────────────────────────────────┐   ┌──────────────────────────────────────────┐
│ SETUP Servogun                         _  │   │ SETUP Servogun                          _  │
│                               12/13        │   │   THICKNESS CHECK / EQ:1 Gun:1      1/8    │
│    1  Tip Wear Comp           DISABLE      │   │    1  Thickness check:          DISABLE    │
│    2  Gun Sag Compensation    DISABLE      │   │    2  Thickness check mode:     ON RQST    │
│    3  Close Direction(Gun):      PLUS      │   │    3  Check at minimum pressure:DISABLE    │
│    4  Close Direction(Robot): UT: 1[+Z ]   │   │    4  Settling time (ms)              0     │
│    5  Max Motor Torque(%):       100.0     │   │    5  Alarm severity:             WARN      │
│    6  Max Pressure(kgf):         500.0     │   │    6  Under thickness limit(mm):    0.5     │
│       Max Gun Torque(%):         450.0     │   │    7  Over thickness limit(mm):     0.5     │
│    7  Tip stick detect distance(mm):   5   │   │    8  Thickness out of tolerance: DO[  0]   │
│    8  Tip Wear Detection:     <*DETAIL*>   │   │                                            │
│    9  Pressure Cal:    COMP   <*DETAIL*>   │   │                                            │
│   10  Tip Wear Standard:COMP  <*DETAIL*>   │   │                                            │
│   11  Weight compensation:    <*DETAIL*>   │   │                                            │
│   12  Thickness Check         <*DETAIL*>   │   │                                            │
│                                            │   │                                            │
│  [ TYPE ] │ EQUIP │ GUN │   │   │          │   │ [ TYPE ] │ EQUIP │ GUN │ ENABLE │ DISABLE │  │
└──────────────────────────────────────────┘   └──────────────────────────────────────────┘
```

Thickness Check General Setup Procedure
1   Press the [MENU] key.
2   Select [6 SETUP].
3   Press F1, [TYPE] and select Servo Gun. Then select the General Setup page.
4   Place the cursor over <*DETAIL*> in SETUP and press the [ENTER] key.

Place the cursor over THICKNESS CHECK and press the [ENTER] key to see the Thickness Check screen
     as shown below.

5   Using the table below as a guideline, setup each item on the Thickness Check page to specify the part
     thickness check operation that you desire.

Item	Description	Values
Thickness check	This setting specifies whether thickness checking is enabled.	**ENABLE** → checking is done based on thickness check mode selected below **DISABLE** → (default) checking is globally disabled and never done.
Thickness check Mode	Specify whether every spot or only specified spots should be checked.	**ALL** → if thickness check is set to ENABLE, checks are done for every spot and press motion (they can be partially disabled by the TCHK_SKP macro). **ON_RQST** ("**on request**") → (default) if thickness check is set to ENABLE, checks are done only for each spot instruction (or press_motion command) that is specified with the TCHK_RQD macro.

Item	Description	Values
Check at minimum pressure	Specify whether thickness should be checked with no pressure in the gun. An additional step is added to relax the gun in this case.	**ENABLE** → the weld pressure will be set to a minimum value (i.e. the gun is relaxed) prior to checking thickness, after the measurement is done the gun will close to weld pressure before welding. **DISABLE** → (default) check is performed when gun reaches the specified weld pressure.
Settling time delay (ms)	Delay after achieving pressure, before reading thickness value. Adding a delay <u>may</u> improve the repeatability of the measurement (which depends on the characteristics of the gun mechanism), but will increase the time required to complete the measurement	**0-9999** → (default = 0) time in msec that system will wait after pressure is achieved before checking the part thickness.
Alarm severity	Severity level of message that is posted when out of tolerance condition is detected.	**WARN** → (default) if thickness check yields an out-of-tolerance value, a WARNING message is posted but the program and weld will execute normally. **FAULT** → if thickness check yields an out of-tolerance value, a fault will be issued that will immediately stop the robot and pause the program. No welding will be done.
Under thickness limit (mm)	Maximum deviation from specified thickness in the negative direction. For example, if: Expected thickness = 2.0 under thickness limit = 0.5 Measurements < 1.5mm are out of tolerance	**Min: 0** **Max: 99.9mm** **Default: 0.5mm** A value of 0.5mm or higher is recommended for most users.
Over thickness limit (mm)	Maximum deviation from specified thickness, in the positive direction. For example, if: Expected thickness = 2.0 Over thickness limit = 0.5 Measurements > 2.5mm are out of tolerance	**Min: 0** **Max: 99.9mm** **Default: 0.5mm** A value of 0.5mm or higher is recommended for most users.
Thickness out of tolerance DO	The output number (DO index) asserted, when a thickness alarm occurs. A 500 ms-pulse signal is the output after a thickness alarm occurs with a stop instruction or press_motion instruction.	**0 -> 999** → (default = 0)

NOTE
Even if thickness check is enabled, thickness is not checked when tryout mode is enabled. And specified thickness becomes 0mm at the time.

Program-Based Thickness Check Conditions

By using a thickness check macro, thickness checking conditions can be set or changed in a program.

These special conditions are activated by placing the condition statement directly before the pressuring instruction (SPOT or Press_motion) when the thickness check is to be done. The condition is only active for the next pressuring motion.

Macro name (argument, <> can be omitted)	Comment
TCHK_RQD (<gun number>)	Measurement request Used in the previous line of the spot or pressure_motion instruction for which the thickness check function is enabled when the thickness check mode is set to On Request (ON_RQST)
TCHK_SKP (<gun number>)	Measurement skip Used in the previous line of the spot or pressure_motion instruction for which the thickness check function is skipped (disabled) when the thickness mode is set to ALL
Override Conditions (parameters)	
THK_TOL (under, over, gun index)	Upper and lower limit value change The under and over tolerance thickness values in the Thickness Check setup screen are usually used. The conditions used in the previous line of the spot or pressure_motion instruction to override the tolerance settings at a certain location. Values should be 0.0 mm or greater.
THK_SEV (severity, gun index)	Alarm severity change The alarm severity in the Thickness Check setup page is usually used. The conditions used in the previous line of the spot or pressure_motion instruction to override the severity at a certain location. Settings for the severity parameter are: 1 = WARNING (message only) 2 = Fault (pause program)

Gun number: For the cause of a dual-gun:

1 = gun A

2 = gun B

3 = both guns

Sample program demonstrating use of Thickness Check Conditions

The following setting is used;

  Under thickness limit : 0.5mm (Default)

  Over thickness limit : 0.5mm (Default)

  Alarm severity: WARN (Default)

TP Program instruction	Comments:
1: L P[1] 2000mm/sec CNT100 SPOT[SD=1,P=1,ED=1,t=1.5]	Expected thickness = 1.5mm If measurement is greater than 2.0mm or less than 1.0mm, warning is posted.
2: CALL THK_TOL(0.3,0.3)	Under/Over limit is temporarily changed to +/-0.3mm.
3: CALL THK_SEV(2)	Alarm Severity override condition for next checking is set
4: L P[1] 2000mm/sec CNT100 SPOT[SD=1,P=1,t=1.5,ED=1]	Expected thickness = 1.5mm If measurement is greater than 1.8mm or less than 1.2mm, the program will stop.
5: L P[1] 2000mm/sec CNT100 SPOT[SD=1,P=1,t=1.5,ED=1]	Expected thickness = 1.5mm If measurement is greater than 2.0mm or less than 1.0mm, warning is posted.

16   GUN OPEN FUNCTION AT WELD FAULT
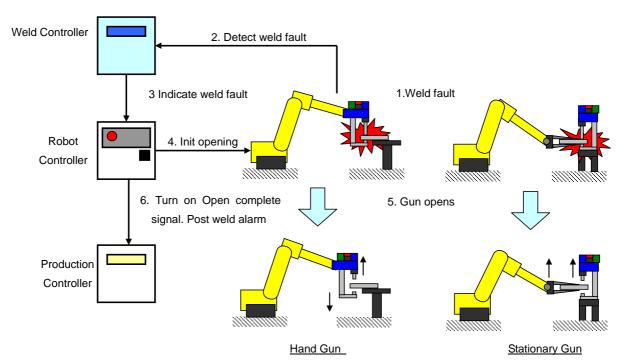
16.1   OVERALL

This function automatically opens servo gun when weld major fault or weld complete time-out is occurred, then movable tip and fixed tip is removed from panel.

Once the opening motion is complete, the program is paused when a weld fault occurs. However, the user can restart welding as soon as the alarm is released and the program is re-executed.

16.2   GUN OPEN FUNCTION FLOW

The following is function flow.

1   Welding fault occurs during welding
2   Welding controller detects.
3   Welding controller informs welding fault to robot controller. Or welding controller cannot inform weld complete to robot controller.

NOTE
If connection type of between weld controller and robot controller is general digital I/O, not integrated type, weld fault is informed by DI assigned in spot weld I/O screen(Menu>I/O>Spot Weld). Condition to inform weld fault is depended on weld controller specification. Please confirm the specification.

In other words, the opening motion is executed for the following alarm conditions.
- SPOT-007 Weld time-out
- SPOT-008 Weld complete time-out
- SPOT-010 Fault detected

4   The robot controller automatically starts the opening motion if it determines the presence of a weld
      fault or a weld incomplete and the opening motion start conditions have been fulfilled.

      The opening motion start conditions are as follows:
      • Gun opening function is enabled. (This function is disabled by default.)
      • AUTO mode and teach pendant are disabled.
      • If weld retry is enabled, it has a specified finish time.

5   Gun actually opens.

⚠ **CAUTION**
   When HOLD or any alarm occur during gun opening, gun opening motion is
   cancelled.

---

6   Robot controller turn on alarm signal. If open complete signal is assigned, the signal is turned on, too.

16.3   GUN OPEN FUNCTION SETTING

This function setting is specified by system variable

System variable	Min/Default/Max	Description
$SGGUN#.$FLTOPN.$ENABLE	FALSE/TRUE/TRUE	It specifies function is enabled/ disabled.
$SGGUN#.$FLTOPN.$OPEN_GUN	0.0/10.0/100.0	It specifies gun open distance.(*1)
$SGGUN#.$FLTOPN.$OPEN_RBT	0.0/5.0/100.0	It specifies robot open distance.(*1)
$SGGUN#.$FLTOPN.$OPEN_CMP_I	0/0/(*2)	It specifies DO number of open complete signal
$SGGUN#.$FLTOPN.$CUSTOM	0/2/65535	Specifies parameter for customized setting related to gun opening.

NOTE
1 This parameter is ignored if the customized setting enables an open distance by
   SD or ED in the SPOT instruction. Please see 16.4.1 "Gun Open Distance" for
   further details.
2 Maximum DO number is determined by the communication configuration of the
   user system.

16.4　GUN OPENING MOTION
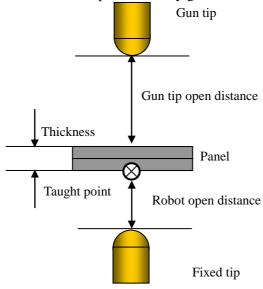
Gun opening motion is performed as follows:

Case of carried gun
Fixed tip of robot TCP removes from panel.

Case of stationary gun
Panel handled by robot removes from fixed tip of stationary gun.

⚠**WARNING**
> During opening motion, the robot moves in the open direction on the servo gun frame.
> Please confirm servo gun frame (Refer to 2.2) and robot tip close direction (Refer to 2.3) on the frame are correct.
> Also, we recommend that the open distance be shorter than the distance used in the SPOT instruction.

NOTE
> If program does not have a robot motion group, the robot does not open the fixed tip.

16.4.1　Gun Open Distance

Gun opening distance is the following.

System variable	Default	Description
$SGGUN#.$FLTOPN.$OPEN_GUN	10.0	It specifies gun open distance.
$SGGUN#.$FLTOPN.$OPEN_RBT	5.0	It specifies robot open distance.

The following customized parameter decides open distance by SD or ED that specified to the SPOT instruction.

$SGGUN#.$FLTOPN.$CUSTOM = Bit2: Open distance is decided by value of SD.
　　　　　　　　　　　　　　　Bit3: Open distance is decided by value of ED.

Example

Distance schedule setting

```
SERVO GUN DATA                                    _
DISTANCE / EQ:1 Gun:1              1/99
 No.  Gun(mm)  Robot(mm)     Comment
  1     5.0        5.0     [            ]
  2    10.0       10.0     [            ]
  3    15.0       10.0     [            ]
```
| [TYPE] | EQUIP | GUN | DETAIL | COPY | |

Program

```
  :
11:L           P[11]          2000mm/sec          CNT50
SPOT[SD=3,P=1,t=2.0,S=1,ED=1]
12:L           P[12]          2000mm/sec          CNT50
SPOT[SD=1,P=2,t=2.0,S=2,ED=2]
  :
```

If $SGGUN#.$FLTOPN.$CUSTOM is 4 or 6 (Bit2=ON),
- Weld fault occur at P[11], then open distance is 15mm and 10mm by SD=3.
- Weld fault occur at P[12], then open distance is 5mm and 15mm by SD=1.

If $SGGUN#.$FLTOPN.$CUSTOM is 8 or 10 (Bit3=ON),
- Weld fault occur at P[11], then open distance is 5mm and 5mm by ED=1.
- Weld fault occur at P[12], then open distance is 10mm and 10mm by ED=2.

16.5   GUN OPEN COMPLETE SIGNAL

Gun open complete signal turns ON when the gun opening is completed or when the gun opening motion is paused.
Gun open complete signal turns OFF when the program restarts. By the following setting, the signal turns OFF at the same time as the reset of weld alarm (*).

$SGGUN#.$FLTOPN.$CUSTOM = Bit0: OFF by weld alarm reset (disabled by default)
                               Bit1: OFF by program restart (re-press) (enabled by default)

(*) When $SGGUN#.$FLTOPN.$CUSTOM is divided by 2, if the remainder is 1, Bit1 is ON.
(*) By default setting of SpotTool, the DO assigned to weld reset signal turns ON at the same time as the alarm reset.

16.6   CUSTOM SETTING OF GUN OPEN FUNCTION

Specifications according to the value of $SGGUN#.$FLTOPN.$CUSTOM is shown below.

$SGGUN#.$FLTOPN.$CUSTOM	Open distance of Gun	Reset of gun open complete signal
0 or 1	Assigned by system variables	OFF by weld alarm reset
2(default)	Assigned by system variables	OFF by program restart
4	Assigned by SD condition	OFF by weld alarm reset
6	Assigned by SD condition	OFF by program restart
8	Assigned by ED condition	OFF by weld alarm reset
10	Assigned by ED condition	OFF by program restart

17 **DUAL-GUN CONTROL**

17.1 **OVERALL**

The Enhanced Servo Gun software supports the use of dual-servo guns (i.e., conjoined-gun, twin-gun). Typically, the guns should be physically connected twin guns that are designed to weld simultaneously. Each tip is controlled by separate servo motors.

When two servo gun axes are added to the same motion group and equipment, they are automatically specified by the software as a Dual-Gun. The only exception is when multiple guns are part of a gun change system and the Gun Change option and function is enabled.

Advantages of Dual-Gun Control:
- Simultaneously welding with both gun tips
- Pressurizing can be done on one or both guns in a single pressuring instruction
- Unique weld schedules can still be specified for each gun in the same welding instruction

Limitations:
- Each gun must have the same max tip speed and acceleration rates for proper motion control.
- The same distance and pressure schedule must be used for pressuring operations when both guns are pressuring simultaneously, although each gun will have unique pressure calibration data

---
NOTE
   Alarms SVGN-203 through SVGN-210 indicate that a motion setting related to closing motion of a Spot or Press_Motn instruction did not match for the two guns. Refer to the section on alarms for more information.

NOTE
   In Dual-Gun Control, cause codes indicating the servo gun that caused the relevant error are checked for errors, as well as alarm codes, to verify the gun in which the error has occurred. When an error occurs in the first axis of the dual gun, "SVGN-201" is generated as the cause code, and when an error occurs in the second axis of the dual gun, "SVGN-202" is generated as the cause code.

If you have multiple guns on a single robot controller, but do not want to use them as a dual gun, then place each gun on a separate motion group and define it as a separate welding equipment. In this case, each gun will have a unique tool center point or frame.

The following describes how to use and set up the dual gun.

17.2   DUAL-GUN EQUIPMENT AND AXIS SETUP

Configuring the Equipment

When adding the axis, you must first specify that the welding equipment will be a dual gun. This setting is changed on the Spot Config screen of the Controlled Start menu.

1   Place the cursor on the Number of guns.
2   Press the F4 key labeled CHOICE.
3   Select "DUAL" from the pull-down menu.

```
SPOT CONFIG

                                     7/34
  1 F Number:                    F00000>
  2 Load SpotTool Macros:        DISABLED
  3 Number of equipment:                1
  4 Number of weld controllers:         1
  5 Current equipment, gun:          1, 1
  6   Weld interface:            INTEGRAL
  7   Number of guns:                DUAL
  8   Equalization Pressure:     DISABLED
  9     Number of pressures:            0
 10   Rst water saver time-out:  500   ms
 11     Pulse length:            500   ms


      [TYPE]                 [CHOICE]
```

> **NOTE**
> If you add the two axes or select the Equip Type to AIR GUN, you can set up a dual-gun.

Adding the Axes

Both axes for a dual gun must be added to the same Motion Group.
Refer to 2.1 SERVO GUN AXIS INITIALIZATION for the details on adding each axis.
After the axes are added, change the equipment type to servo gun on the servo gun configuration screen (refer to 2.1 SERVO GUN AXIS INITIALIZATION).

17.3   DUAL-GUN OPERATIONAL SETUP
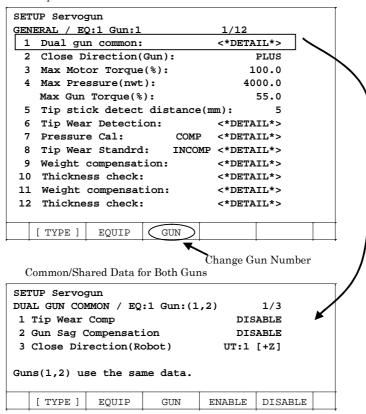
In the dual-gun system, some of the setting items can be shared between both guns.
Below is a brief summary of the items that are unique to each gun and those shared by both guns.

> **NOTE**
> Hereafter, the 1st gun of the dual-gun will be referred to as Gun A, and the 2nd as Gun B. Gun A is the gun that is controlled by the 1st axis of the aux-axis amplifier(s).

17.3.1   Servo Gun Setup

In General Setup Servo gun screen (MENU->SETUP->F1[TYPE]->Servo Gun->General Setup), items common for both guns and items set for each gun are displayed on different screens. For items common for both guns, "Dual gun common" is selected to display the common settings screen. For the setting contents, refer to 3 SERVO GUN MAIN SETUP SCREEN.

Unique Data For Each Gun

```
SETUP Servogun
GENERAL / EQ:1 Gun:1              1/12
 1  Dual gun common:             <*DETAIL*>
 2  Close Direction(Gun):             PLUS
 3  Max Motor Torque(%):             100.0
 4  Max Pressure(nwt):              4000.0
    Max Gun Torque(%):               55.0
 5  Tip stick detect distance(mm):      5
 6  Tip Wear Detection:          <*DETAIL*>
 7  Pressure Cal:        COMP    <*DETAIL*>
 8  Tip Wear Standrd:    INCOMP  <*DETAIL*>
 9  Weight compensation:         <*DETAIL*>
10  Thickness check:             <*DETAIL*>
11  Weight compensation:         <*DETAIL*>
12  Thickness check:             <*DETAIL*>


     [ TYPE ]   EQUIP     GUN
```

Change Gun Number

Common/Shared Data for Both Guns

```
SETUP Servogun
DUAL GUN COMMON / EQ:1 Gun:(1,2)      1/3
 1 Tip Wear Comp                   DISABLE
 2 Gun Sag Compensation            DISABLE
 3 Close Direction(Robot)        UT:1 [+Z]


Guns(1,2) use the same data.


     [ TYPE ]   EQUIP     GUN    ENABLE   DISABLE
```

NOTE
> With dual-guns, the same TCP is used for both Gun A and Gun B. Hence, there is
> only one setting for Tip Wear Down Compensation setup, Gun Sag Compensation
> setup and Robot Close Direction setup - items that are all related to TCP.
> Generally, it is based on TCP of Gun A.

17.3.2 Pressure Schedule, Distance Schedule, and Backup Schedule Table

Guns A and B are shared data of the pressure schedule, the distance schedule and the backup schedule table.
The way set up them is same in single gun.
Refer to 4. MANUAL OPERATIONS and 5. PROGRAMMING.

Pressure Schedule

```
SERVO GUN DATA
PRESS/EQ:1 Gun:(1,2)                  1/99
 No.   Press (Nwt)   Manual    Comment
  1         0.0      FALSE  [          ]
  2         0.0      FALSE  [          ]
  3         0.0      FALSE  [          ]
  4         0.0      FALSE  [          ]


Guns (1,2) use the same data.


     [TYPE]     EQUIP     GUN    DETAIL    COPY    >
```

Distance Schedule

```
SERVO GUN DATA
DIST/EQ:1 Gun:(1,2)                1/99
 No.  Gun (mm)  Robot (mm)    Comment
  1     10.0       10.0     [         ]
  2     10.0       10.0     [         ]
  3     10.0       10.0     [         ]
  4     10.0       10.0     [         ]


Guns (1,2) use the same data.


    [TYPE]   EQUIP    GUN   DETAIL   COPY    >
```

Backup Schedule Table

```
SERVO GUN DATA
MANUAL BKUP/EQ:1 Gun:(1,2)         1/30
 No.    Comment       Stroke (mm)   Enable
  1  [         ]        0.000      FALSE
  2  [         ]        0.000      FALSE
  3  [         ]        0.000      FALSE
  4  [         ]        0.000      FALSE


Guns (1,2) use the same data.


    [TYPE]   EQUIP    GUN   RECORD   CLEAR
```

17.3.3   Gun Setup Utility Operation

The gun setup utility should be run for both Guns A and B. By completing the gun setup utility, the settings of the stroke limit, master gun, and Auto Tune can be completed. However, both Guns A and B should have the same acceleration rates and gear ratio. If they do not, then you will be prompted for instruction to deal with this.

Refer to 2.5 SERVO GUN SETUP AND AUTOTUNING UTILITY for information on the basic operations of the Gun Setup Utility screen.

Operating Procedure for Gun Setup Utility

1   In dual gun system, [INDEX] is displayed on F5 key like the blow screen. Press the F5 key to switch between the two guns. The Gun number is shown at the top of the screen to indicate which gun is presently selected.

```
UTILS Gun Setup
EQ:  1 Gun:1                          1/1
1.Set gun motion sign:              COMP
2.Set Gun specs, master gun         COMP
     Tip Displacement:     5.000(mm/rev)
     Open stroke limit:     −999.99(mm)
     Close stroke limit:     999.99(mm)
3.Auto Tune:                      INCOMP
4.Pressure Compensation Setup: <*DETAIL*>
5.Thickness Check calibration:    INCOMP


    [TYPE]   EQUIP   SKIP   RESTART   INDEX
```

2   Finish the setup and tuning for both guns
3   Once both guns are set up and tuned, "DG_CHECK" appears in F6 (F-> key +F1). The following screen will be displayed when you press the F6 key.

```
Dual Gun check
EQ:  1
                            Gun A    Gun B
1.Tip displacement (mm/rev):14.050   14.050
2.Maximum speed (mm/s):      702.5    702.5
3.Accel time1 (ms):            200      200


Speed, acc are same, press prev to exit


              |        |        |        | SETSPD | SETACC |
```

4   If there is a discrepancy between Guns A and B, then press the appropriate key:
   •   F4 (Speed) —> to change speeds to resolve the data conflict.
   •   F5 (Accel time) —> to change acceleration times to resolve the data conflict.

```
Dual Gun check
EQ:  1
                            Gun A    Gun B
1.Tip displacement (mm/rev):15.430   14.050
2.Maximum speed (mm/s):      771.5    702.5
3.Accel time1 (ms):            200      200


Speed differs, press F4 to update speed


              |        |        |        | SETSPD | SETACC |
```

17.3.4   Pressure Calibration

Pressure Calibration must be performed separately for both Gun A and Gun B.
The motion control system for servo gun will guarantee synchronized contact to the programmed metal surface at the calibrated contact speed, during execution of SPOT instructions. To support this feature, both Gun A and Gun B must be pressure calibrated with the same contact speeds.
If the contact speed will not be set to the same value for all calibration points, then the procedure below must be followed to ensure there is no mismatch between Gun A and Gun B contact speed data.
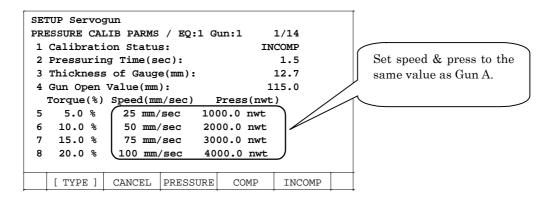
1   Complete Pressure Calibration for Gun A normally.

NOTE
During pressure calibration of a dual gun, the contact speed is not automatically updated when torque is the input. Adjust the contact speed while monitoring the pressure wave.

```
SETUP Servo Gun
PRESSURE CALIB PARMS/EQ:1 Gun:1          1/14
 1 Calibration Status:               INCOMP
 2 Pressuring Time (s):                 1.5
 3 Thickness of Gauge (mm):            12.7
 4 Gun Open Value (mm):               115.0
   Torque (%) Speed (mm/s)   Press (nwt)
 5    5.0%      25 mm/s    1000.0 nwt
 6   10.0%      50 mm/s    2000.0 nwt
 7   15.0%      75 mm/s    3000.0 nwt
 8   20.0%     100 mm/s    4000.0 nwt


   [TYPE] | CANCEL | PRESSURE |  COMP  | INCOMP |
```

2   As for Gun B, set the contact speed and pressure set-points the same value as Gun A at first.

```
SETUP Servogun
PRESSURE CALIB PARMS / EQ:1 Gun:1      1/14
 1 Calibration Status:            INCOMP
 2 Pressuring Time(sec):             1.5
 3 Thickness of Gauge(mm):          12.7
 4 Gun Open Value(mm):             115.0
   Torque(%) Speed(mm/sec)    Press(nwt)
 5    5.0 %    25 mm/sec    1000.0 nwt
 6   10.0 %    50 mm/sec    2000.0 nwt
 7   15.0 %    75 mm/sec    3000.0 nwt
 8   20.0 %   100 mm/sec    4000.0 nwt

   [ TYPE ]  CANCEL  PRESSURE   COMP   INCOMP
```

Set speed & press to the same value as Gun A.

3   Configure the Torque (%) for Gun B that matches each contact speed and pressure set-point of Gun A value.

Refer to 2.6 PRESSURE CALIBRATION for the details and information on pressure calibration.

17.4   DUAL-GUN MANUAL AND PROGRAM OPERATION

Refer to 4. MANUAL OPERATIONS and 5. PROGRAMMING for general details about the following operations
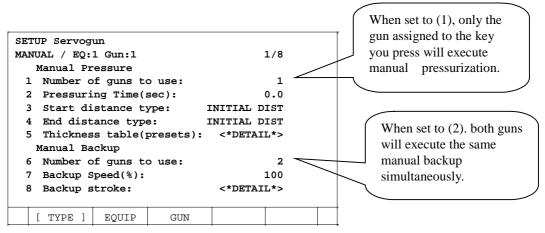
17.4.1   Manual Operations

Manual Pressurization and Manual Backup Stroke

TP hard keys for the manual pressurization and manual backup stroke operations are the same for Gun A as in the single-gun system. These operations are controlled by manual operation keys UK1 and UK2.
Manual pressurization and manual backup operation for Gun B are controlled by manual operation keys UK3 and UK4, respectively. These settings cannot be changed for a dual gun.

You can specify whether each gun, A & B, can operate independently or together for these manual operations by specifying this in the Manual Operation Setup screen.
When the item labeled "Number of Guns to Use" is set to (2), both hard keys associated with the operation (pressuring or backup) will operate both guns when pressed. When set to (1), only the gun assigned to the hard key you press will operate. In each case, the schedule that appears in the prompt box at the upper right corner of the teach pendant will be executed.

```
SETUP Servogun
MANUAL / EQ:1 Gun:1                     1/8
   Manual Pressure
 1 Number of guns to use:            1
 2 Pressuring Time(sec):           0.0
 3 Start distance type:     INITIAL DIST
 4 End distance type:       INITIAL DIST
 5 Thickness table(presets):  <*DETAIL*>
   Manual Backup
 6 Number of guns to use:            2
 7 Backup Speed(%):                100
 8 Backup stroke:            <*DETAIL*>

   [ TYPE ]   EQUIP     GUN
```

When set to (1), only the gun assigned to the key you press will execute manual   pressurization.

When set to (2). both guns will execute the same manual backup simultaneously.

Manual Weld
The manual weld function works nearly the same for a dual gun as for a single gun. The weld schedule must be specified for both Guns A and B.

When the weld schedule is set to (0), the gun assigned to that weld schedule will not close or weld.
For the settings shown on the sample screen below:
Gun A of the dual gun will execute a weld with weld schedule #16.
Gun B of the dual gun will not execute a weld, it will stop closing at the start distance, wait until the weld operation is done on Gun A, then open to the End distance.

```
SETUP Servogun
                             1/7
 Manual Weld          (Last Weld)
  1  Start distance sched:     (   0)    1
  2  Pressure schedule:        (   0)    4
  3  Wld sch(G1):       (     0)     16
  4  Wld sch(G2):       (     0)      0
  5  End distance sched:       (   0)    1
  6  Thickness  G1:     ( 0.0)   2.0
  7  Thickness  G2:     ( 0.0)   0.0
     Weld duration(ms):                  0

   [ TYPE ]              EXEC   RECD THK MEAS THK
```

Gun A of the dual-gun will execute a weld with weld schedule #16.

Gun B of the dual-gun will not execute a weld, it will stop closing at the start distance, wait until the weld operation is done on Gun A, then open to the End distance.

17.4.2   Gun Jog Operation

Gun A is jogged with the J1 jog keys (+X, −X)
Gun B is jogged with the J2 jog keys (+Y, −Y)
As always, you must select the motion group assigned to the servo gun before you begin a jog operation.

17.4.3   Programming Operation

SPOT Instruction Format
The basic spot instruction format is designed to allow you to selectively weld with one or both of the guns.
The spot instruction includes a unique weld schedule parameter for both Guns A and B.
The basic format is shown below:

SPOT [SD=m, P=n, t=i, S=(j,k) ED=m]

---

j: Welding schedule number assigned to Gun A
k: Welding schedule number assigned to Gun B
If either Gun A or B is assigned the welding schedule (0), then that gun will not operate during the welding sequence. Instead, that gun will wait at the open position specified by the Start Distance (SD) condition and move to the open position specified by the End Distance (ED) condition after the welding operation is complete. If both welding schedules are specified, then welding is performed simultaneously by both guns.

```
STYLE01                                  i
                                       1/2
  1: !Dual Gun Spot Program Example
  2: !Dual Gun
  3:L P[1] 2000mm/sec CNT100
   : SPOT[SD=1,P=1,t=2.0,S=(1,1),ED=1
   : ]
  4: !GUN A
  5:L P[2] 2000mm/sec CNT100
   : SPOT[SD=1,P=1,t=2.0,S=(1,0),ED=1
   : ]
  6: !GUN B
  7:L P[3] 2000mm/sec CNT100
   : SPOT[SD=1,P=1,t=2.0,S=(0,1),ED=1
   : ]
[End]

      [ INST ]                          [EDCMD]   >
```

Line 3: Both Gun A & B will execute Weld Schedule #1

Line 5: Only Gun A will execute Weld Schedule #1

Line 7: Only Gun B will execute Weld Schedule #1

NOTE
If \$SPOTCONFIG.\$REWELD_PREV is FALSE, after program was suspended by HOLD during welding, weld schedule are not output at next resume. If \$SPOTCONFIG.\$REWELD_PREV is TRUE, after program was suspended by HOLD during welding, weld schedule are output at next resume. Standard value of \$SPOTCONFIG.\$REWELD_PREV is FALSE.

Press Motion Instruction Format
The basic press motion instruction format is also designed to allow you to selectively pressurize with one or both guns.

The basic format is shown below:

PRESS_MOTN [SD=m,P=n,SEL=(j,k),t=i]

---
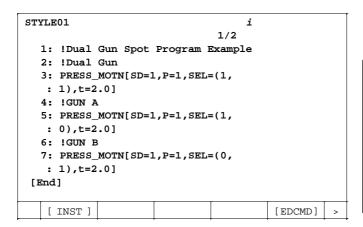
j: Pressure flag number assigned to Gun A
k: Pressure flag number assigned to Gun B
Each pressure flag is set to (1) or (0). If a pressure flag is set to (1), the gun that correspond to the pressure flag will pressurize. If the pressure flag is set to (0), the gun will not close or pressurize. Instead, it will stop closing at the Start Distance, wait for the press motion to complete.
If both flags are set to (1), both guns will pressurize.

Below are examples of the Press_Motn instruction for a dual gun:

```
STYLE01                              i
                              1/2
  1: !Dual Gun Spot Program Example
  2: !Dual Gun
  3: PRESS_MOTN[SD=1,P=1,SEL=(1,
   : 1),t=2.0]
  4: !GUN A
  5: PRESS_MOTN[SD=1,P=1,SEL=(1,
   : 0),t=2.0]
  6: !GUN B
  7: PRESS_MOTN[SD=1,P=1,SEL=(0,
   : 1),t=2.0]
 [End]


   [ INST ]                        [ EDCMD ]  >
```

Line 3: Both Gun A & B will execute Pressure Schedule #1

Line 5: Only Gun A will execute Pressure Schedule #1

Line 7: Only Gun B will execute Pressure Schedule #1

TIPDRESS Instruction Format
The basic format is shown below:

TIPDRESS [SD=m, P=n, t=i, T=(j,k) ED=m]

---

j: Tip dress schedule number assigned to Gun A
k: Tip dress schedule number assigned to Gun B
In the TIPDRESS instructions, tip dressing cannot be performed simultaneously in both guns. Select one of the guns (T=(1,0), T=(0,1)). If you select both guns (T=(1,1)), then an alarm SPOT-079: "Bad Tip Dress Schedule." is generated.

17.4.4   Tip Wear and Gun Sag Compensation

Tip wear and gun sag compensation for the dual gun are supported. With tip wear detection, the wear amount of each gun can be measured by executing the detection operation for each gun.
Tip wear compensation for the servo gun TCP (robot tip) is performed in the following manner.

Only Gun A is used for pressing and welding
Position compensation for the servo gun TCP is performed on the basis of the robot tip wear and gun sag compensation amount of Gun A.
Only Gun B is used for pressing and welding
Position compensation for the servo gun TCP is performed on the basis of the robot tip wear and gun sag compensation amount of Gun B.
Both Guns A and B are used for pressing and welding
Position compensation for the servo gun TCP is performed on the basis of the robot tip wear and gun sag compensation amount of Gun A.

If the robot/fixed tip wear amount between Gun A and Gun B varies by too much this may cause a problem with the welding operation. The system variable $SGDGCFG[eq#].$MAX_DG_DIFF specifies the maximum allowable difference between the robot tip wear on Gun A and Gun B before the alarm SVGN-034:"Excessive Robot Tip Difference" is posted. This is set to 5.0mm by default, but you can change this value if necessary.

17.4.5   Part Thickness Check
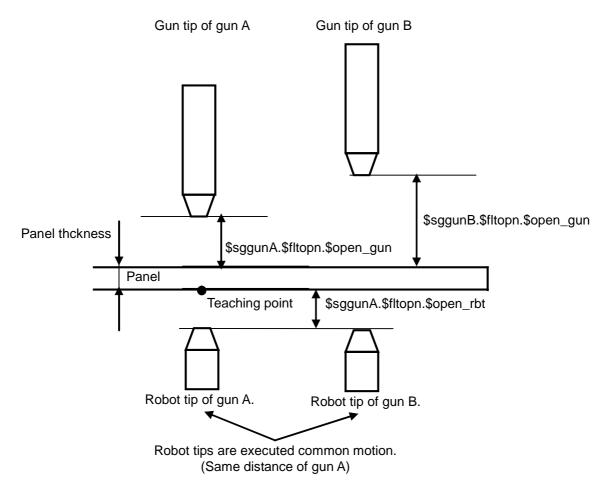
The part thickness check can be performed for both Gun A and Gun B on a dual-gun. If part thickness check is enabled for both guns, then the measurement is performed in the following sequence:

1   Gun tips close
2   Both tips achieve specified tip pressure
3   Wait for the longer of the (2) settling times
4   Measure thickness for both guns sequentially
5   Initiate welding sequence

17.4.6   Gun Open Function at Weld Fault

The gun open function at weld fault is also supported in a dual gun. The opening distances of Guns A and B are determined on the basis of the system variables, as in the following:

- The opening distance of the robot tip (Robot TCP) of Guns A and B is the value specified for Gun A ($sggunA.$fltopn.$open_rbt).
- The opening distance of the gun tip of Gun A is the value specified for Gun A ($sggunA.$fltopn.$open_gun).
- The opening distance of the gun tip of Gun B is the value specified for Gun B ($sggunB.$fltopn.$open_gun).

Gun tip of gun A   Gun tip of gun B

Panel thckness

$sggunB.$fltopn.$open_gun

$sggunA.$fltopn.$open_gun

Panel

Teaching point $sggunA.$fltopn.$open_rbt

Robot tip of gun A.   Robot tip of gun B.

Robot tips are executed common motion.
(Same distance of gun A)

Refer to 16. GUN OPEN FUNCTION at WELD FAULT for details.
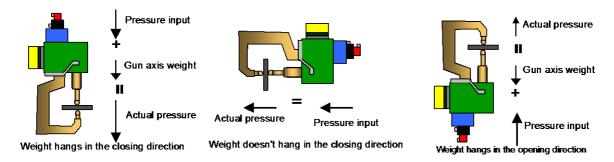
18   SERVO GUN WEIGHT COMPENSATION

18.1   OVERVIEW

Welding   The weight of the gun moving element might influence a tips and driving system of the servo gun at a certain welding position. Therefore, an actual pressure might not be able to satisfy the pressure of desire. In the spot welding, the change of the pressure causes the poor weld and the spatter, and exerts a bad influence on the welding quality.

> **NOTE**
>   No special hardware is required.

This function can suppress the change of the pressure by the weight of the gun moving element according to the welding position.
The accuracy of an actual pressure that relates to the welding quality can be improved by using this function.

Kind/shape of the servo gun that can use this function is C gun and X gun.

This function consists of the following three functions.
Auto weight compensation function
Semi-auto weight compensation function
Manual weight compensation function

18.2   SERVO GUN WEIGHT COMPENSATION FUNCTION

Auto/Semi-auto weight compensation function

This function estimates the weight of the gun moving element beforehand, the compensation value corresponding to the welding position is calculated based on the weight estimation result and the welding position, and the compensation value is added to the pressure.

The procedure of the weight estimation is different depending on an auto weight compensation function and a semi-auto weight compensation function.

Function	Procedure
Auto weight compensation function	The weight of the gun moving element is automatically estimated by opening and closing the gun. Kind/shape of the servo gun that can use auto weight compensation function is C gun. X gun cannot use the auto weight compensation function.
Semi-auto weight compensation function	<u>C gun</u> Add arbitrary pressure at a welding position different from the posture at the pressure calibration. The weight of the gun moving element is estimated based on the measurement result and the welding position at that time. <u>X gun</u> Add arbitrary pressure at two welding positions different from the posture at the pressure calibration. The weight of the gun movable element is estimated based on the measurement results and the welding positions at those times.

Manual weight compensation function

This function makes the pressure-welding position table beforehand, forecasts the change of the pressure corresponding to the welding position from this table when the spot instruction is executed, and compensates the pressure based on the amount of the change.

18.3   SETTING EACH WEIGHT COMPENSATION FUNCTION

This chapter explains the following items.
- Initial setting
- Setting auto weight compensation function: About the weight estimation procedure
- Setting semi-auto weight compensation function: About the weight estimation procedure
- Setting manual weight compensation function: About the pressure-welding position table making procedure

18.3.1   Initial Setting

Complete the following settings before starting the setting of each weight compensation function.

> **NOTE**
> Initial setting is common in the each weight compensation function.
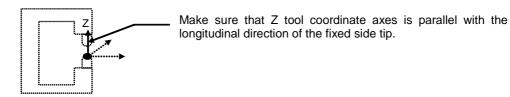
> ⚠**WARNING**
> Complete initial setting before executing the pressure calibration when you use the semi-auto/manual weight compensation function. It is necessary to execute the pressure calibration again when the initial setting is completed after the pressure calibration.
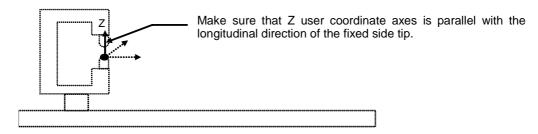
SETTING THE COORDINATE SYSTEM

Make sure that Z tool coordinate axis is parallel with the longitudinal direction of the fixed side tip.
Make sure that Z user coordinate axis is parallel with the longitudinal direction of the fixed side tip.

- **Carried gun**

Make sure that Z tool coordinate axes is parallel with the longitudinal direction of the fixed side tip.

- **Pedestal gun**

Make sure that Z user coordinate axes is parallel with the longitudinal direction of the fixed side tip.

NOTE
1. Refer to the 2.2 SETTING THE COORDINATE SYSTEM for details concerning the setting of the coordinate system.
2. Set the user coordinate system by using the variable remote TCP function when this function is used due to pedestal gun. This function need not be used in the pedestal gun system to which the variable remote TCP function is needless.

⚠ WARNING
The accuracy of Z tool/user coordinate axes largely depends on the accuracy of the weight estimation and the weight compensation in this function. All settings must be made to maximize the accuracy of Z tool/user coordinate axes.
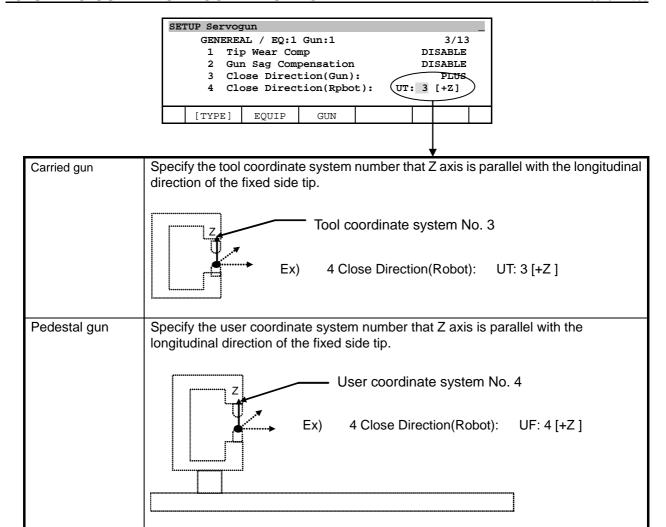
SETTING THE COORDINATE SYSTEM NUMBER

Set the coordinate system number according to the following table.
The coordinate system number set here is used for the weight estimation and the weight compensation of this function.

1. Press the [MENU] key to display the Screen menu.
2. Select 6 SETUP.
3. Press F1 TYPE to display the Screen Selection menu.
4. Select "Servo Gun", set cursor on "<*Detail*>" of the general setting, press the "ENTER" key to display the general setting screen.

```
SETUP Servogun                                    _
     GENEREAL / EQ:1 Gun:1                       3/13
      1  Tip Wear Comp                        DISABLE
      2  Gun Sag Compensation                 DISABLE
      3  Close Direction(Gun):                   PLUS
      4  Close Direction(Rpbot):     UT:  3 [+Z]

      [TYPE]    EQUIP     GUN
```

Carried gun	Specify the tool coordinate system number that Z axis is parallel with the longitudinal direction of the fixed side tip.
	Z — Tool coordinate system No. 3 Ex) 4 Close Direction(Robot): UT: 3 [+Z]
Pedestal gun	Specify the user coordinate system number that Z axis is parallel with the longitudinal direction of the fixed side tip.
	Z — User coordinate system No. 4 Ex) 4 Close Direction(Robot): UF: 4 [+Z]

SETTING SERVO GUN TYPE

The procedure of the setting of the each one weight compensation function is different according to kind/shape of the servo gun. Kind/shape of the servo gun that can use this function is C gun and X gun now. Other servo gun cannot use this function. Here, kind/shape of the servo gun that wants to compensate the weight is specified.

Set the servo gun type according to the following table.

1   Press the [MENU] key to display the Screen menu.
2   Select 1 UTILITIES.
3   Press F1 TYPE to display the Screen Selection menu.
4   Select Gun Setup. Move the cursor on <*DETAIL*> of Press Compensation Setup and press the [ENTER] key.
5   Move the cursor on Weight Compensation, press F4 CHOICE and select the servo gun type. In case of dual gun, same servo gun type have to be selected. Specify "DISABLE" to servo gun type when you do not use this function.

```
UTILS Gun setup                        _        Press Compens                         _
       EQ:1 Gun:1                  2/3                EQ:1 Gun:1                  1/2
      1.Set gun motion sign:       COMP
      2.Set Gun specs, master gun:   COMP             1.Weight Compensation:      CgunType
           Tip Displacement:  15.00(mm/rev)           2.Temperature Compensation:  DISABLE
           Open stroke limit:   -150.0(mm)
           Close stroke limit:    20.0(mm)
      3.Auto Tune:                 COMP
      4.Press Compensation Setup: <*DETAIL*>
      5.Thickness Check calibration: INCOMP

Press enter to setup for this item.
   [TYPE]    EQUIP    EXEC    RESTART            [TYPE]              RETURN  [CHOICE]
```

> **NOTE**
>   Please choose servo gun type from 3 options (C gun type, X gun type, and
>   disable) to suit kind/shape of the servo gun. When servo gun weight
>   compensation function is not used, please set servo gun type to disable.

SET UP UT CORRECT ANGLE

If "X gun type" was selected in "Weight compen gun type", you need to input "UT correct ang" in the
"WEIGHT COMPEN SETUP". The UT correct angle is the angle between the Y-axis of X gun's posture
frame and the Y-axis of tool or user frame (ϕ in the figure below). The region of UT correct angle is 0 to
360 degree based on Y-axis of tool or user frame. Gun posture frame is defined following,
1   Z-axis of gun posture frame is parallel to Z-axis of tool or user frame.
2   Y-axis of gun posture frame is parallel to the axis of rotation that movable tip of X gun is rotated.
3   X-axis of gun posture frame is oriented from the axis of rotation of movable tip to pressurize point.

If "C gun type" was selected in "Weight compen gun type", you don't need to input it.


```
SETUP Servogun
    WEIGHT COMPEN SETUP / EQ:1 Gun:1          1/6
      1 Semi-auto weight compen:    <*DETAIL*>
      2 Manual weight compen:       <*DETAIL*>
      3 WT compen UT Correct ang(deg):    30.0     =ψ
      4 WT compn press low lim  (nwt):     0.0
      5 WT compn val upper lim(nwt):       0.0
      6 WT compn val lower lim(nwt):       0.0

      [TYPE]    EQUIP    GUN                    >
```

18.3.2 Setting Auto Weight Compensation Function

This chapter explains the procedure of the weight estimation for the auto weight compensation function. Set the auto weight compensation function according to the following procedures.
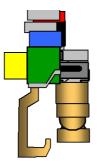
NOTE

To perform the setting here, after selecting the pressure compensation setup in the utility screen, select a servo gun type in the weight compensation function in advance. Please refer to the previous section about selection of servo gun type.

---

1   Press the [MENU] key to display the Screen menu.
2   Select 1 UTILITIES.
3   Press F1 TYPE and select Gun Setup.
4   Select "Weight compensation". (Move the cursor on <*DETAIL*> and press the [ENTER] key.) The following screen will be displayed.

```
UTILS WT compens setup                          _
        EQ:1 Gun:1                      1/6
        1.Weight caluculation:        INCOMP
        2.Weight of axis        =     0.0(N)
        3.Angle at calculation  =    90.0(deg)
        4.Angle at pressurization =   30.0(deg)
        5.Angle at pressure cal  =    0.0(deg)
        6.Pressure for compens   =    0.0N

     [TYPE]   EQUIP    EXEC    RESET
```
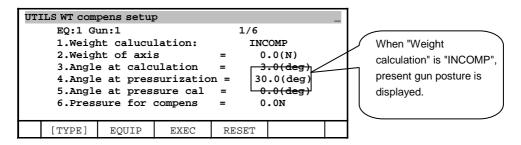
5   Move the servo gun until the value of "Angle at calculation" becomes about 0 degrees.
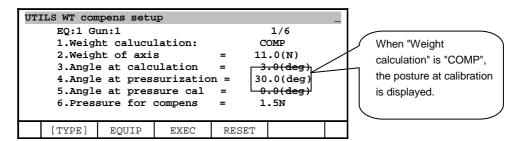
Angle at calculation = 0 degrees

NOTE

Angle at calculation = 0 degrees: the pressure direction becomes perpendicular and downward. The accuracy of the weight estimation improves as the value of the "Angle at calculation" approaches 0 degrees. Therefore, move the posture of the servo gun so that the value of "Angle at calculation" may become about 0 degrees. The tolerance of "Angle at calculation" is ±5 degrees.

```
UTILS WT compens setup                          _
        EQ:1 Gun:1                      1/6
        1.Weight caluculation:        INCOMP
        2.Weight of axis        =     0.0(N)
        3.Angle at calculation  =     3.0(deg)
        4.Angle at pressurization =   30.0(deg)
        5.Angle at pressure cal  =    0.0(deg)
        6.Pressure for compens   =    0.0N

     [TYPE]   EQUIP    EXEC    RESET
```

When "Weight calculation" is "INCOMP", present gun posture is displayed.

6   Move the cursor to "Weight calculation" and press SHIFT + F3 to start the weight estimation process.
     If weight estimation completed successfully the following screen will be displayed, and the result of
     weight estimation is displayed in "Weight of axis".

```
┌─────────────────────────────────────────────┐
│ UTILS WT compens setup                    _   │
│      EQ:1 Gun:1                     1/6       │
│      1.Weight caluculation:         COMP      │
│      2.Weight of axis        =     11.0(N)    │
│      3.Angle at calculation  =      3.0(deg)  │
│      4.Angle at pressurization =   30.0(deg)  │
│      5.Angle at pressure cal =      0.0(deg)  │
│      6.Pressure for compens  =      1.5N      │
│                                               │
│ ┌──────┬──────┬──────┬──────┬──────┬──────┐  │
│ │[TYPE]│EQUIP │ EXEC │RESET │      │      │  │
│ └──────┴──────┴──────┴──────┴──────┴──────┘  │
└─────────────────────────────────────────────┘
```

When "Weight calculation" is "COMP", the posture at calibration is displayed.

⚠ **WARNING**

The servo gun axis moves at 30mm/s during weight estimation. Weight estimation can be performed in T2 mode or Auto mode. When performing weight estimation in Auto mode, make sure that no person is in the area close to the servo gun.

NOTE

The following conditions must be met for the weight estimation process to start from the Gun Setup Utility:
- Not in STEP mode
- No faults exist
- No holds exist
- Servo gun is not in machine lock (In the test cycle screen, enable "Group Motion")
- The control reliable keyswitch is in AUTO or T2.
- Gun is in the STROKE mode (Refer to 10. Test Cycle.)

NOTE

When robot is in T2 mode, TP is ENABLE, user have to keep pressing the [SHIFT] key and deadman switch. When robot is in AUTO mode, TP is DISABLE, user does not have to keep pressing the [SHIFT] key and deadman switch.

The meaning of each item displayed on this screen is the following. Confirm the status of each item.

Item	Description
Weight calculation	Whether the weight estimation for automatic weight compensation is completed or not is displayed.
Weight of axis	Weight used for automatic weight compensation is displayed. This value can be adjusted using the estimate as reference. Refer to the following weight adjustment method for details of the adjustment.
Angle at calculation	When "Weight calculation" is COMP, the posture of the gun when estimating is displayed. When "Weight calculation" is INCOMP, the posture of the present gun is displayed.
Angle at pressurization	Used for the example calculation of pressure for compensation.
Angle at pressure cal	Used for the example calculation of pressure for compensation. When pressure calibration is COMP, the posture of the gun when calibrating is displayed. When pressure calibration is INCOMP, 0 degrees are displayed.
Pressure for compens	The pressure for compensation is displayed using the current weight based on the posture indicated by the angle at pressurization.

Weight adjustment method

Adjust the value of "Weight of axis" when the compensation to the pressure is not good. The adjustment procedure is as follows.

1   Move the cursor to " Weight calculation " and press the [ENTER] key. The following screen will be displayed.
2   Input the weight. The weight calculated by the weight estimation is displayed. Refer when you input the weight.
3   Press F3 COMP. The following prompt is displayed. Select YES if there is no problem after confirming the content of the input.

```
Set weight of axis                    _
    EQ:1 Gun:1                    2/3
    Set weight of axis for compensation.
    Result of detection is    74.3(N).
    Input weight for calculation.
       82.0 (N)
    Press F3 COMP when finished.



     [TYPE]          COMP
```

```
Weight of axis for
Calculation can be update.
Weight changes
   82.0 Nwt
Do you wish to update weight
of axis?


   [ YES ]    NO
```

> **NOTE**
> X gun cannot use the auto weight compensation function.

18.3.3   Setting Semi-auto Weight Compensation Function

This chapter explains the procedure of the weight estimation for the semi-auto weight compensation function.
The weight estimation in the semi-auto weight compensation function estimates the weight of the gun moving element from an actual pressure. Do the following work after completing the 12.2.1 Initial setting.

1.   Execute the pressure calibration.

> ⚠**WARNING**
> Complete 12.2.1 Initial setting before executing the pressure calibration. When Initial setting is done after the pressure calibration is completed, it is necessary to execute the pressure calibration again.

2.   Prepare a manual pressurization. (Refer to 4.1 MANUAL PRESSURIZATION.)

> ⚠**WARNING**
> Follow the following limitations when you specify the pressure schedule of a manual pressurization.
> • Specify DISABLE for "Weight compensation type".
> • The weld pressure must specify the pressure most often used.
> • Specify the weld pressure within the range from the minimum pressure to the maximum pressure specified by the pressure calibration.

Set the semi-auto weight compensation function according to the following procedures after completing the above-mentioned work.

1   Press the [MENU] key to display the Screen menu.
2   Select 6 SETUP.
3   Press F1 TYPE to display the Screen Selection menu.
4   Select Servo Gun. Move the cursor on <*DETAIL*> of General Setup and press the [ENTER] key.

5   Select "Weight compensation". (Move the cursor on <*DETAIL*> and press the [ENTER] key.)
     Weight compensation setup screen will be displayed.
6   Select "Semi-auto weight compen". (Move the cursor on <*DETAIL*> and press the [ENTER] key.)
     Semi- auto weight compensation setup screen will be displayed.
7   The procedures below should be conducted depending on the shape and type of the guns.
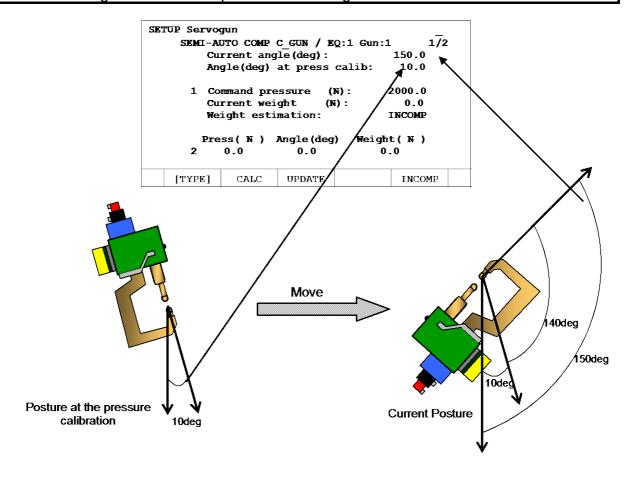
Case: C gun

The pressure is measured at a welding position different from the posture at the pressure calibration. The
weight of the gun moving element is estimated based on the measurement result and the welding position at
that time.
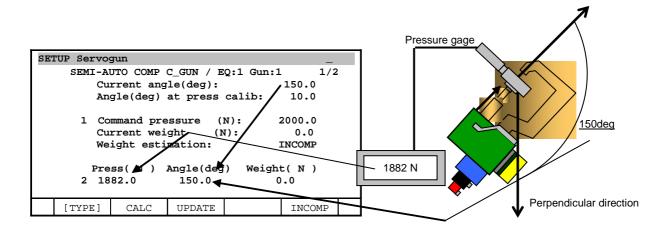
1   in the center of the screen, input the same value as the weld pressure of the manual pressurization
     prepared to the "Command pressure".
2   Move servo gun to the position separated from the angle at the pressure calibration 70 degrees or more.
     The movement angle of servo gun will be able to be obtained from "Current angle(deg)" and
     "Angle(deg) at press calib".

> **NOTE**
> The angle between the posture at the pressure calibration and the posture of
> present servo gun influences the accuracy of the weight estimation. The accuracy
> of the weight estimation improves as this angle increases.

3   Input the value displayed in "Current angle (deg)" to "Angle (deg)" after completing the movement of
     the servo gun.
4   In the same posture, execute a manual pressurization prepared before, and measure the pressure with a
     pressure gage.
5   Input the value of the pressure gage to "Press".

```
SETUP Servogun                              _
    SEMI-AUTO COMP C_GUN / EQ:1 Gun:1        1/2
        Current angle(deg):          150.0
        Angle(deg) at press calib:    10.0

    1  Command pressure  (N):       2000.0
        Current weight    (N):         0.0
        Weight estimation:          INCOMP

      Press( N ) Angle(deg)  Weight( N )
    2 1882.0       150.0         0.0


    [TYPE]    CALC    UPDATE         INCOMP
```
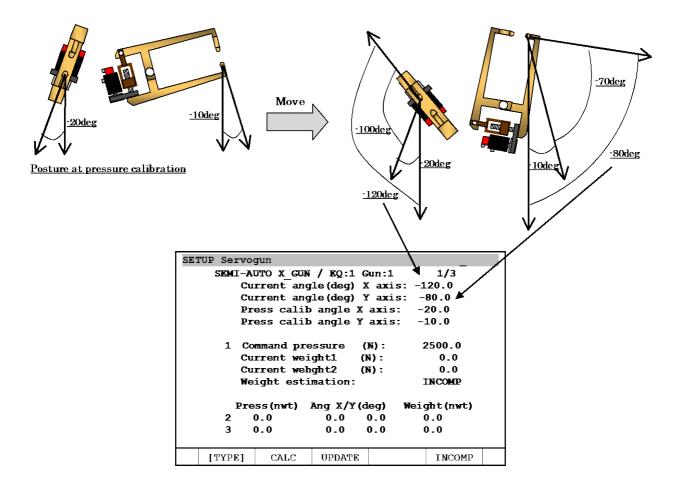
6   Press F2 CALC. The weight is estimated, and the weight is displayed in "Weight".
7   When you use the weight obtained in 6, press F3 UPDATE. The current weight is updated to the latest weight, and "Weight estimation" is changed to "COMP."
8   The "Current Weight" can be directly adjusted. In this case, place the cursor on "Current Weight" and enter a number. To use that value, press F3 "UPDATE."
9.   Press F5 INCOMP when you do the weight estimation over again.
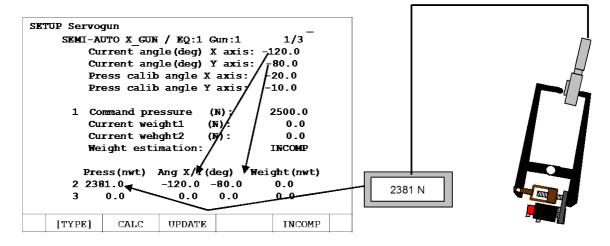
Case: X gun

Add an arbitrary pressure at a welding posture different from the posture at the pressure calibration for the X gun as well. For the X gun, the arbitrary pressure needs to be performed in two postures. The weight of the gun movable element is estimated based on the two measurement results and the two welding positions at those times.

1   Input the same value as the weld pressure of the manual pressurization to the "Command pressure" in the center of the screen.
2   Move the servo gun posture to a position where the current welding position is well separated from the posture at the pressure calibration. The posture at the pressure calibration is shown at the "angle at pressure calibration" and the current posture of the servo gun is displayed at the "current angle." **When you decide welding positions, refer to "The guide of the welding position for weight estimation".**

```
SETUP Servogun                              _
     SEMI-AUTO X_GUN / EQ:1 Gun:1        1/3
          Current angle(deg) X axis: -120.0
          Current angle(deg) Y axis:  -80.0
          Press calib angle X axis:   -20.0
          Press calib angle Y axis:   -10.0

     1  Command pressure    (N):       2500.0
          Current weight1     (N):        0.0
          Current wehght2     (N):        0.0
          Weight estimation:            INCOMP

          Press(nwt)  Ang X/Y(deg)   Weight(nwt)
     2      0.0         0.0    0.0      0.0
     3      0.0         0.0    0.0      0.0

   [TYPE]    CALC    UPDATE            INCOMP
```

3   Input the value displayed in "Current angle (deg) X axis" and "Current angle (deg) Y axis" to "Ang_X/Y(deg)" after completing the movement of the servo gun.

4   In the same posture, execute the manual pressurization prepared before, and measure the pressure with a pressure gage.

5   Input the value of the pressure gage to "Press".


```
SETUP Servogun                              _
     SEMI-AUTO X_GUN / EQ:1 Gun:1        1/3
          Current angle(deg) X axis: -120.0
          Current angle(deg) Y axis:  -80.0
          Press calib angle X axis:   -20.0
          Press calib angle Y axis:   -10.0

     1  Command pressure    (N):       2500.0
          Current weight1     (N):        0.0
          Current wehght2     (N):        0.0
          Weight estimation:            INCOMP

          Press(nwt)  Ang X/Y(deg)   Weight(nwt)
     2   2381.0      -120.0   -80.0     0.0
     3      0.0         0.0    0.0      0.0

   [TYPE]    CALC    UPDATE            INCOMP
```

2381 N

6   Repeat steps 2-5, and enter two sets of pressure and welding positions.

7   Press F2 CALC. The weights are estimated, and the weights are displayed in "Weight" at the bottom of the screen.

8   To use the weight obtained in 7, Press F3 "UPDATE." The calculated current weights are shown in "Current Weight 1" and "Current Weight 2" in the center of the screen, and the weight estimation item is completed.

9   Press F5 INCOMP when you do the weight estimation again.

Guide of the welding position for weight estimation for the X gun

In order to estimate the weights of movable element in the gun correctly, be careful of the following points when you decide a welding positions.

- The two positions are rotated around different axis of rotation, for example 1st position is rotated around Y-axis from posture at pressure calibration, and then 2nd position is rotated around X-axis from 1st position.
- The posture at pressure calibration and two welding points should be very different. As a guideline, they should be separated by approximately 70 degrees or more around the X-axis or Y-axis.

18.3.4   Setting Manual Weight Compensation Function

This chapter explains the procedure to make the pressure-welding position table in the manual weight compensation function.

In the manual weight compensation, an actual pressure is measured at multiple welding positions, and the pressure-welding position table is made based on the measurement result, and the compensation formula is made from the table. Do the following work after completing the 12.2.1 Initial setting.

1   Execute the pressure calibration.

⚠**WARNING**
Complete 12.2.1 Initial setting before executing the pressure calibration. When Initial setting is done after the pressure calibration is completed, it is necessary to execute the pressure calibration again.

---

2   Prepare a manual pressurization. (Refer to 4.1 MANUAL PRESSURIZATION.)

⚠**WARNING**
Follow the following limitations when you specify the pressure schedule of a manual pressurization.
- Specify DISABLE for "Weight compensation type".
- The weld pressure must specify the pressure most often used.
- Specify the weld pressure within the range from the minimum pressure to the maximum pressure specified by the pressure calibration.

Set the manual weight compensation function according to the following procedures after completing the above-mentioned work.

1   Press the [MENU] key to display the Screen menu.
2   Select 6 SETUP.
3   Press F1 TYPE to display the Screen Selection menu.
4   Select Servo Gun. Move the cursor on <*DETAIL*> of General Setup and press the [ENTER] key.
5   Select "Weight compensation". (Move the cursor on <*DETAIL*> and press the [ENTER] key.) Weight compensation setup screen will be displayed.
6   Select "Manual weight compen". (Move the cursor on <*DETAIL*> and press the [ENTER] key.) Manual weight compensation setup screen will be displayed.
7   The procedures below should be conducted depending on the shape and type of the guns.
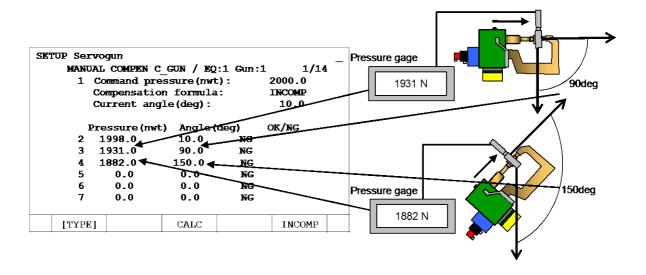
Case: C gun

An arbitrary pressurizing is done at multiple welding positions, and the pressure is measured. And the pressure-welding position table is made based on the pressure measurement result and welding positions.

1   Input the same value as the weld pressure of the manual pressurization prepared to the "Command pressure".
2   Move the servo gun suitably.
3   Input the value displayed in "Current angle (deg)" to "Angle (deg)" after completing the movement of the servo gun.
4   In the same posture, execute the manual pressurization prepared before and measure the pressure with a pressure gage.
5   Input the value of the pressure gage to "Press".
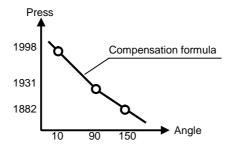
6   Repeat the procedure 2-5 two or more times.

NOTE
The accuracy of the manual weight compensation function depends on the number of data of "Press" and "Angle". Therefore, to improve the accuracy of the manual weight compensation function, a lot of data is required.

7   When you press F3 "CALC," you will be asked whether to calculate the Compensation formula or not. Press F4 "Yes" to calculate. When "Calculation succeeded" is shown in the bottom of the screen, it is completed. Please confirm that the weight compensation formula calculation was "Complete."
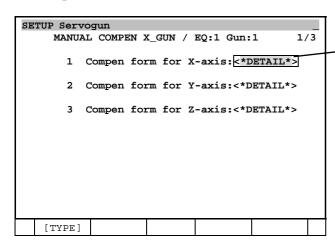
8   Press F3 INCOMP when you do the calculation again.

Case: X gun

For X gun, the pressure change differs depending on the rotational axis. The relation between the rotation angle and pressure needs to be obtained for each rotational axis.
Enter numerical values by following the procedure below.
1   A screen to select an item to calculate compensation formula for each of X, Y, Z axis is displayed. Select one of these and press [ENTER] key to open the screen to calculate the manual compensation formula.
2   Input the same value as the weld pressure of the manual pressurization prepared to the "Command pressure".
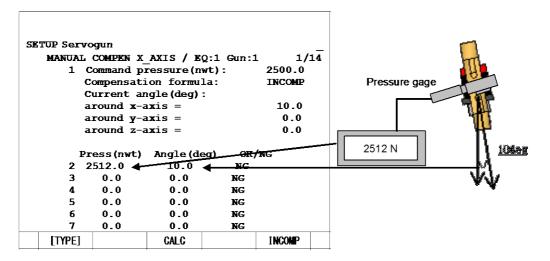
```
SETUP Servogun                            _
    MANUAL COMPEN X_GUN / EQ:1 Gun:1      1/3


    1  Compen form for X-axis:<*DETAIL*>

    2  Compen form for Y-axis:<*DETAIL*>

    3  Compen form for Z-axis:<*DETAIL*>







    [TYPE]
```
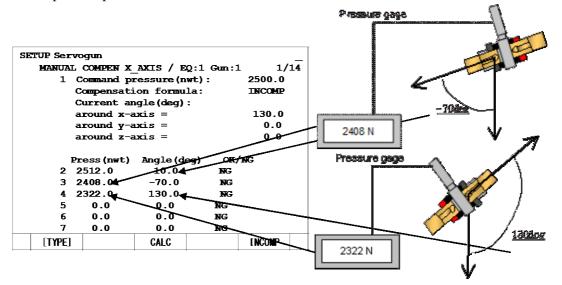
```
SETUP Servogun                            _
    MANUAL COMPEN X_AXIS / EQ:1 Gun:1      1/14
    1  Command pressure(nwt):      1000.0
       Compensation formula:       INCOMP
       Current angle(deg):
       around x-axis =                0.0
       around y-axis =                0.0
       around z-axis =                0.0

       Press(nwt)  Angle(deg)   OK/NG
    2     0.0         0.0        NG
    3     0.0         0.0        NG
    4     0.0         0.0        NG
    5     0.0         0.0        NG
    6     0.0         0.0        NG
    7     0.0         0.0        NG

    [TYPE]          CALC              INCOMP
```

3   Move the servo gun suitably. When you decide welding positions, refer to "The guide of the welding position to measure the pressure".
4   Input the value displayed in "Current angle (deg)" on selected axis to "Angle (deg)" after completing the movement of the servo gun.
5   With the same posture, execute the manual pressurization prepared before, and measure the pressure with a pressure gage.
6   Input the value of the pressure gage to "Press".

```
SETUP Servogun
    MANUAL COMPEN X_AXIS / EQ:1 Gun:1          1/14
        1  Command pressure(nwt):         2500.0
           Compensation formula:          INCOMP
           Current angle(deg):
           around x-axis =                  10.0
           around y-axis =                   0.0
           around z-axis =                   0.0

           Press(nwt)   Angle(deg)      OK/NG
        2  2512.0        10.0           NG
        3     0.0         0.0           NG
        4     0.0         0.0           NG
        5     0.0         0.0           NG
        6     0.0         0.0           NG
        7     0.0         0.0           NG
  [TYPE]              CALC              INCOMP
```

7   Repeat the procedure 3-6 two or more times.


```
SETUP Servogun
    MANUAL COMPEN X_AXIS / EQ:1 Gun:1          1/14
        1  Command pressure(nwt):         2500.0
           Compensation formula:          INCOMP
           Current angle(deg):
           around x-axis =                 130.0
           around y-axis =                   0.0
           around z-axis =                   0.0

           Press(nwt)   Angle(deg)      OK/NG
        2  2512.0        10.0           NG
        3  2408.0       -70.0           NG
        4  2322.0       130.0           NG
        5     0.0         0.0           NG
        6     0.0         0.0           NG
        7     0.0         0.0           NG
  [TYPE]              CALC              INCOMP
```

8   Press F3 CALC. The message "Calculation?" is displayed.   When F4 YES is pressed, the compensation formula is calculated, and "Compensation formula" is changed to "COMP."
9   Press the [PREV] key and select other axis, and then execute same procedure for selected axis.
10   Complete calculation for all axes, and then you able to use manual weight compensation function.
11   Press F5 INCOMP when you do the calculation over again.

The guide of the welding position to measure the pressure
Be careful of the following points when you decide welding positions.

•   Set position to the condition that the "Current angle around y-axis" nearly equals zero, when you calculate the compensation formula for X-axis.
•   Set position on the condition that "Current angle around x-axis" nearly equal zero, when you calculate the compensation formula for Y-axis. However, if "Current angle around y-axis" is close to ±90 degrees, the angle around the X-axis does not need to be close to zero.
•   Set position on the condition that "Current angle around x-axis" and "Current angle around y-axis" nearly equal zero, when you calculate the compensation formula for Z-axis.

18.4 PRESSURE COMPENSATION
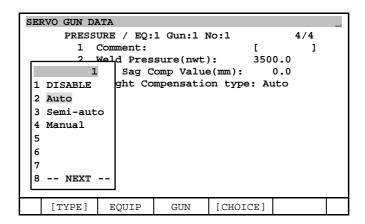
This chapter explains the following.
- Setting weight compensation type
- Weight compensation status

18.4.1 Setting Weight Compensation Type

Weight compensation type can be specified for each pressure schedule.
Set the weight compensation type according to the following procedures.

1 Press the [MENU] key to display the Screen menu.
2 Press 0 NEXT and 3 DATA.
3 Press F1 TYPE to display the Screen Selection menu.
4 Select PRESSURE, place cursor on the pressure schedule you want, press F1 TYPE to display the detailed pressure schedule screen.
5 Press F4 CHOICE for the selection of the weight compensation and select a compensation type.

TYPE	Description
Auto	The pressure is compensated by using the auto weight compensation function.
Semi-auto	The pressure is compensated by using the semi-auto weight compensation function.
Manual	The pressure is compensated by using the manual weight compensation function.
DISABLE	The pressure is not compensated.

```
SERVO GUN DATA                                    _
       PRESSURE / EQ:1 Gun:1 No:1            4/4
         1   Comment:               [        ]
         2  Weld Pressure(nwt):      3500.0
            1 │ Sag Comp Value(mm):     0.0
  1 DISABLE    ght Compensation type: Auto
  2 Auto
  3 Semi-auto
  4 Manual
  5
  6
  7
  8 -- NEXT --


    [TYPE]   EQUIP    GUN    [CHOICE]
```

> **NOTE**
> The "Auto" cannot be selected to the weight compensation type when X gun is specified to the servo gun type.
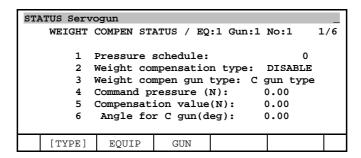
18.4.2 Weight Compensation Status

The status of the compensation can be confirmed on the weight compensation status screen.

1 Press the [MENU] key to display the Screen menu.
2 Press 0 NEXT and 4 STATUS.
3 Press F1 TYPE to display the Screen Selection menu.
4 Select Servo Gun. Move the cursor on <*DETAIL*> of Weight compen status and press the [ENTER] key. Weight compensation status screen is displayed.

The following items can be referred to on this screen.

Case: C gun

```
STATUS Servogun                                        _
    WEIGHT COMPEN STATUS / EQ:1 Gun:1 No:1      1/6

        1  Pressure schedule:              0
        2  Weight compensation type:  DISABLE
        3  Weight compen gun type:  C gun type
        4  Command pressure (N):       0.00
        5  Compensation value(N):      0.00
        6   Angle for C gun(deg):      0.00


      [TYPE]    EQUIP    GUN
```

Item	Description
Pressure schedule	Pressure schedule number being executed or last used is displayed.
Weight compensation type	The weight compensation type specified in the pressure schedule is displayed.
Weight compen gun type	The status of the servo gun type that has been selected is displayed now.
Command pressure	The pressure specified in the pressure schedule is displayed.
Compensation value	Indicates the compensation value calculated by the weight compensation function currently selected.
Angle(deg) for C gun	Indicates the welding position.

Case: X gun

```
STATUS Servogun                                        _
    WEIGHT COMPEN STATUS / EQ:1 Gun:1 No:1      1/9

        1  Pressure schedule:              0
        2  Weight compensation type:  DISABLE
        3  Weight compen gun type: X gun type
        4  Command pressure (N):       0.00
        5  Compensation value(N):      0.00
        6  X gun:
        7   Angle for X axis(deg):     0.00
        8   Angle for Y axis(deg):     0.00
        9   Angle for Z axis(deg):     0.00


      [TYPE]    EQUIP    GUN
```

Item	Description
Pressure schedule	Indicates the pressure schedule number being executed or last used.
Weight compensation type	The weight compensation type specified in the pressure schedule is displayed.
Weight compen gun type	The status of the servo gun type that has been selected is displayed now.
Command pressure	The pressure specified in the pressure schedule is displayed.
Compensation value	Indicates the compensation value calculated by the weight compensation function currently selected.
Angle for X axis(deg)	Indicates the welding position at the execution of the spot welding instruction for each axis.
Angle for Y axis(deg)	
Angle for Z axis(deg)	

18.5   OTHER FUNCTIONS

This chapter explains other functions.
1   Press the [MENU] key to display the Screen menu.
2   Select 6 SETUP.
3   Press F1 TYPE to display the Screen Selection menu.
4   Select Servo Gun. Move the cursor on <*DETAIL*> of General Setup and press the [ENTER] key.
5   In case of single gun, select "Weight compensation". (Move the cursor on <*DETAIL*> and press the [ENTER] key.) Weight compensation setup screen will be displayed.

Item	Description
WT compn press low lim Default:0.0 (Disable) Maximum:9999.9 Minimum:0.0 (Disable)	When the weight compensation function is enabled and the pressure used is lower than the value specified, the alarm "SVGN-218 This press can't be compensated" can be generated.
WT compn val upper lim Default:0.0 (Disable) Maximum:9999.9 Minimum:0.0 (Disable)	The upper limit value of the compensation value can be specified. When the calculated compensation value is higher than the value specified here, the compensation value is automatically changed to the value specified here.
WT compn val lower lim Default:0.0 (Disable) Maximum:0.0 (Disable) Minimum:-9999.9	The lower limit value of the compensation value can be specified. When the calculated compensation value is lower than the value specified here, the compensation value is automatically changed to the value specified here.

19   SERVO GUN TEMPERATURE COMPENSATION

19.1   OVERVIEW

The temperature compensation function suppresses the change of the pressure caused by the temperature change of the motor driving servo gun.

> **NOTE**
> Temperature compensation function uses the motor temperature. The following motor or Pulsecoder that can output motor temperature is recommended to be used when the temperature compensation function is used.
> - Motor: A06B-0235-B600 (This is a motor that Pulsecoder of A06B-0235-B605 is changed from A860-2010-T341 to A860-2000-T301.)
> - Pulsecoder: A860-2000-T301
> Install a commercial temperature sensor etc. in the motor when you use motor or Pulsecoder other than the above. And, input motor temperature by using I/O.

> **NOTE**
> Please do warm-up beforehand even if you use temperature compensation function.

19.2   INITIAL SETTING

Complete the following settings to use temperature compensation function. Complete the settings in order.

1   Installation of motor or Pulsecoder that can output motor temperature OR Installation of commercial temperature sensor.

> **NOTE**
> Temperature compensation function uses the motor temperature. The following motor or Pulsecoder that can output motor temperature is recommended to be used when the temperature compensation function is used.
> - Motor: A06B-0235-B600 (This is a motor that Pulsecoder of A06B-0235-B605 is changed from A860-2010-T341 to A860-2000-T301.)
> - Pulsecoder: A860-2000-T301
> Install a commercial temperature sensor etc. in the motor when you use motor or Pulsecoder other than the above. And, input motor temperature by using I/O.
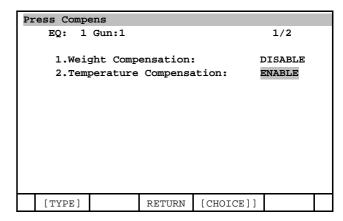
2   Gun Auto tuning
3   Enable temperature compensation function.
     Enable "Temperature Compensation" in pressure compensation setup on the servo gun adjustment utility screen.

```
UTILS Gun setup
  EQ: 1 Gun:1                    2/4
    1. Set gun motion sign:           COMP
    2. Set Gun specs, master gun      COMP
           Tip Displacement: 20.000(mm/rev)
           Open stroke limit:   -200.0(mm)
           Close stroke limit:    20.0(mm)
    3. Auto Tune:                     COMP
    4. Press Compensation Setup:<*DETAIL*>
    5. Weight Compensation Setup:   INCOMP
    6. Thickness Check calibration: INCOMP


Press enter to setup for this item

   [TYPE]   EQUIP   EXEC   RESTART   INDEX
```

```
Press Compens
  EQ:  1 Gun:1                    1/2


    1.Weight Compensation:        DISABLE
    2.Temperature Compensation:   ENABLE






   [TYPE]            RETURN  [CHOICE]]
```
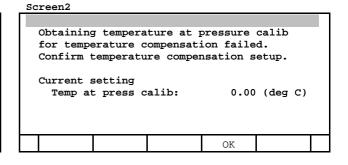
4   Confirmation of motor temperature.
     Confirm motor temperature can be correctly obtained by seeing "Current temperature" in the temperature compensation setting screen. Change the settings as needed.
5   Pressure calibration

After the pressure calibration is completed, the screens(following 1 and 2) concerning the temperature compensation function are displayed.

- Select F4 YES in screen 1. However, push F5 NO when not performing pressure calibration in reality.
- Select F4 OK in screen 2. In this case, the obtaining of the temperature at pressure calibration has failed because it cannot correctly obtain motor temperature. In the situation in which the motor temperature is correctly obtained, re-perform the pressure calibration. Or, specify temperature at pressure calibration directly in the temperature compensation setting screen. It can be confirmed whether motor temperature can be correctly obtained by seeing "Current temperature" in the temperature compensation setting screen.

Screen1

```
   Is temperature at pressure calib used by
   temperature compensation func changed?

   Yes(F4 key): New value
      Temp at press calib:     32.00 (deg C)

   No (F5 key): Old value
      Temp at press calib:     28.00 (deg C)

                              YES    NO
```

Screen2

```
   Obtaining temperature at pressure calib
   for temperature compensation failed.
   Confirm temperature compensation setup.

   Current setting
     Temp at press calib:      0.00 (deg C)



                              OK
```

19.3   TEMPERATURE COMPENSATION SETTING SCREEN

Set temperature compensation per the following procedures
1   Press the [MENU] key.
2   Press 6 SETUP.
3   From F1 [TYPE], select [Servo gun].
4   From the Servo Gun Setup screen, select "General Setup: <*DETAIL*>"
5   From the Servo Gun General Setup screen, select "Temperature Compensation"

```
SETUP Servo gun
TEMPERATURE COMPEN / EQ:1 Gun:1              1/14
       Current temperature (deg C):         32.0

  1    Temperature compensation mode:       CMPNS
  2    Temperature coefficient (%):         0.088
  3    Compensation onset temp (deg C):       20
  4    Abnl press incre up lim (%):            0
  5    Abnl press decre low lim (%):           0
  6    Abnormal temp up lim (deg C):         140
  7    Abnormal temp low lim (deg C):          0
  8    Abnormal alarm severity:            FAULT
  9    Abnormal alarm signal:             DO[ 0]
 10    Temp at pressure cal (deg C):        32.0
 11    Temperature information type:       AI[ ]
 12    Temperature info port number:           2
 13    AI,GI conversion factor:           1.0000
 14    AI,GI intercept (vertical):           0.0


      [TYPE]   EQUIP   GUN    END    UPDATE
```

ITEM	DESCRIPTION
Current temperature (deg C)	Current motor temperature is indicated to this item. When the motor temperature is not obtained, ***** is displayed in this item. Confirm motor temperature is correctly obtained by using this item. When F5 UPDATE is pressed, current temperature is updated.
Temperature compensation mode Default value: CMPNS	If "CMPNS" is selected for this item, the pressure is compensated according to the motor temperature during pressurization. If "CHECK" is selected for this item, the pressure is not compensated. It is used to check the change in motor temperature and the pressure loss.
Temperature coefficient (%) Default value: 0.088% (Alpha iS Series)	To this item, specify the ratio of the pressure that decreases every time the motor temperature increases by 1.0 deg C. When the FANUC motors are used, this item is automatically decided according to the following table. | Motor	Temperature coefficient
--------	--------------------------
60s: Alpha iS series	0.088%
80s: Beta iS series	0.088%
100s: Alpha iF series	0.168%
50s: Alpha M6	0.168%
Other	0.0% | A default value of this item is 0.0% when the motor is not FANUC motor. Therefore, refer to the motor maker about the temperature coefficient and change this item directly.

ITEM	DESCRIPTION
Compensation onset temp (deg C) Default value: 20 deg C	This item is a temperature compensation onset temperature. After the motor temperature has exceeded the temperature specified here, the pressure compensation starts. In FANUC motor case, 20 deg C is automatically specified to this item because a decrease in pressure starts when motor temperature exceeds 20 deg C. If the motor is not a FANUC motor, refer to the motor maker about the temperature that a decrease of torque starts, and change this item directly.
Abnl press incre up lim Default value: 0% (Disabled)	If the estimated pressure increase caused by a motor temperature change is greater than this value, the following alarm is initiated. ・ SVGN-470 Prs incre exceed abnl up lim:G%d You can choice unit for tolerance, "%" or "kgf/lbf/nwt"(depending on current force unit). The followings show how to calculate estimated pressure increase. CASE "%": Estimated pressure increase [%] = (Estimated pressure – Base pressure) / (Base pressure) CASE "kgf/lbf/nwt": Estimated pressure increase [kgf/lbf/nwt] = Estimated pressure – Base pressure
Abnl press decre low lim Default value: 0% (Disabled)	If the estimated pressure decrease caused by a motor temperature change is less than this value, following alarm is initiated. ・ SVGN-471 Prs decre below abnl low lim:G%d You can choice unit for tolerance, "%" or "kgf/lbf/nwt"(depending on current force unit). The followings show how to calculate estimated pressure decrease. CASE "%": Estimated pressure decrease [%] = (Base pressure – Estimated pressure) / (Base pressure) CASE "kgf/lbf/nwt": Estimated pressure decrease [kgf/lbf/nwt] = Base pressure – Estimated pressure
Abnormal temp up lim (deg C) Default value: 140 deg C	The following alarm will be occurred if the motor temperature exceeds this upper limit value value when spot instruction executed. ・ SVGN-294 Temp exceed abnormal up lim:G%d Specify a value that is larger than Temp at pressure cal to here.
Abnormal temp low lim (deg C) Default value: 0 deg C	The following alarm will be occurred if the motor temperature falls below this lower limit value when spot instruction executed. ・ SVGN-295 Temp below abnormal low lim:G%d Specify a value that is larger than Temp at pressure cal to here.
Abnormal alarm severity Default value: FAULT	This is the severity of the following alarms. It can be a Fault or Warning. ・ SVGN-470 Prs incre exceed abnl up lim:G%d ・ SVGN-471 Prs decre below abnl low lim:G%d ・ SVGN-294 Temp exceed abnormal up lim:G%d ・ SVGN-295 Temp below abnormal low lim:G%d
Abnormal alarm signal Default value: 0	When one of the following alarms is generated, pulse of 0.5 msec is output. ・ SVGN-470 Prs incre exceed abnl up lim:G%d ・ SVGN-471 Prs decre below abnl low lim:G%d ・ SVGN-294 Temp exceed abnormal up lim:G%d ・ SVGN-295 Temp below abnormal low lim:G%d
Temp at pressure cal (deg C) Default value: 0 deg C	Motor temperature at the pressure calibration is indicated to this item. When pressure calibration is executed in the situation in which the motor temperature is correctly obtained, this item is automatically set.

ITEM	DESCRIPTION

Temperature type
Default value:Motor
	Specify the method of obtaining the motor temperature.
	• Motor
	  Select this if you use the following motor or Pulsecoder.
	  • Motor: A06B-0235-B600
	  • Pulsecoder: A860-2000-T301
	
	• AI
	  Select this if you receive the motor temperature via AI from a
	  temperature sensor etc.
	
	• GI
	  Select this if you receive the motor temperature via GI from a
	  temperature sensor etc.

Temperature info port number Default value: 0	The port number of the method to obtain the motor temperature information for GI or AI. Power OFF/ON after changing this item.

AI,GI conversion factor
Default value: 1.0
	This item is a factor used to convert value of GI or AI into motor
	temperature.
	
	  Motor temperature(deg C) =
	        AI,GI conversion factor * AI,GI Input value+AI,GI intercept

AI,GI intercept (vertical)
Default value: 0.0
	This item is a vertical intercept used to convert value of GI or AI into motor
	temperature.
	
	  Motor temperature(deg C) =
	        AI,GI conversion factor * AI,GI Input value+AI,GI intercept

NOTE
   The output range of the following motor or Pulsecoder that can output motor
   temperature is 0 deg C - 140 deg C.
   - Motor: A06B-0235-B600
   - Pulsecoder: A860-2000-T301

19.4   PRESSURE COMPENSATION

This chapter explains the following.
- Pressure compensation condition
- Temperature compensation status

19.4.1   Pressure Compensation Condition

When fulfilling all the following conditions, the pressure is compensated according to the motor temperature during execution of SPOT instructions.
- Motor temperature is correctly obtained.
- Motor temperature exceeds the "Compensation onset temp".
- "Temperature compensation " on the temperature compensation setting screen is enabled.

19.4.2   Temperature Compensation Status

The status of the pressure compensation during pressurization can be confirmed on the temperature compensation status screen.

1   Press the [MENU] key to display the Screen menu.
2   Press 0 NEXT and 4 STATUS.
3   Press F1 TYPE to display the Screen Selection menu.
4   Select Servo Gun. Move the cursor on <*DETAIL*> of Temp compen status and press the [ENTER] key. The Temperature compensation status screen is displayed.

The following items can be referred to on this screen.

```
STATUS Servogun
TEMPERATURE COMPEN / EQ:1 Gun:1                1/4

  1   Pressure schedule:                         0
  2   Command pressure(N):                    0.00
  3   Compensation value(N):                  0.00
  4   Motor temperature(deg C):                0.0

     [TYPE]    EQUIP    GUN
```

ITEM	DESCRIPTION
Pressure schedule	Indicates the pressure schedule number specified for the spot welding instruction being executed. If no spot welding instruction is being executed, the pressure schedule for the most recently executed spot welding instruction is indicated.
Command pressure	The pressure specified in the pressure schedule is displayed.
Compensation value or Estimation press loss	When the temperature compensation mode on the temperature compensation setting screen is set to "CMPNS", the compensation value of the pressure is displayed. When the temperature compensation mode on the temperature compensation setting screen is set to "CHECK", the estimated pressure loss amount is displayed.
Motor temperature(deg C)	Indicates the motor temperature.
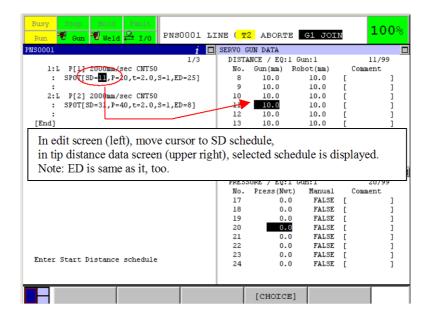
20 RELATED VIEW FUNCTION
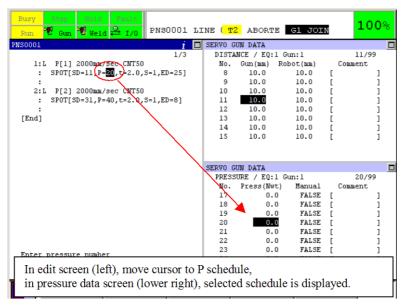
This section describes the following functions.
- Related view function
- Quick view function

20.1 RELATED VIEW FUNCTION

This function can help to refer to pressure and tip distance schedule for SPOT instruction, PRESS_MOTN instruction, and TIP_DRESS instruction. Using multi screen displaying of the teach pendant, with the feature enabled, when user moves the cursor through an allocation instruction in edit screen on the left side, then related schedule is automatically displayed on the right side screen.
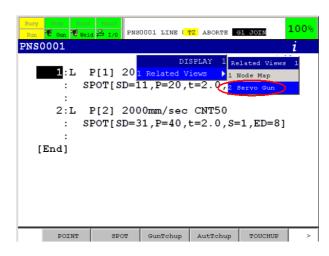
20.2   OPERATION FOR RELATED VIEW FUNCTION

Use related view function by the following procedure 1 or 2.
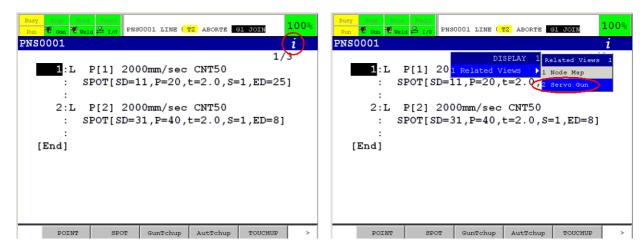
Procedure 1
1   Display edit screen.
2   Press FCTN key + *i* key.
3   The following screen is displayed. Select "Related Views" → "Servo Gun."

Procedure 2
1   Display edit screen.
2   Press the *i* icon in far right of the title bar. (See the part circled in red at the following left figure.)
3   The screen shown in the right figure below is displayed. Select "Related Views" → "Servo Gun."
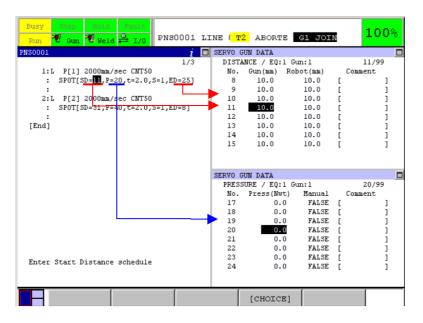
> **NOTE**
> When the related view function is enabled, a multiscreen display (triple) of the teach pendant is enabled automatically.
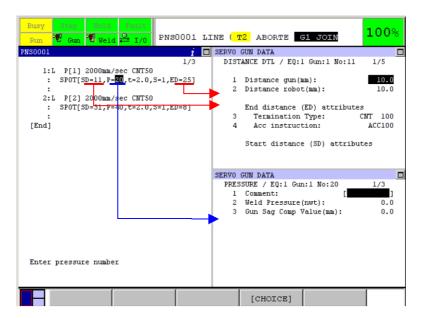
> **NOTE**
> When related view function is enabled, right screens have light blue title bars. It means right screens are linked to left screen.

If the multiscreen display (triple) of the teach pendant is enabled, when pressure and tip distance schedule(SD,P,ED) are selected by cursor on edit screen of the left side, displaying cursor automatically jumps to the selected schedule number on schedule list screen of the right side.

In addition, by displaying detail screens of tip distance schedule screen and pressure schedule screen in advance, when the cursor is moved, detail screen of the selected schedule number is automatically displayed.
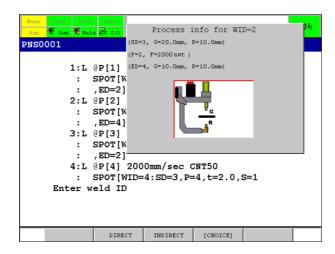
20.3 QUICK VIEW FUNCTION

This function can be referred to pressure and tip distance schedule for SPOT instruction and TIP_DRESS instruction quickly. This function displays the detailed data of the schedule used in the instruction on the right of the screen without using multiple screens.

The following option is necessary if you want to use this function.

4D Graphics function	A05B-2***-R764

ITEM	DESCRIPTION
Process info for WID=	WID in instruction that you selected is displayed here. If WID is disabled, 1 is always displayed here.
(SD= , G= , R=)	Start distance schedule in instruction that you selected is displayed here. SD: Start distance schedule number G: Gun distance (movable tip) R: Robot distance (fixed tip)
(P= , F=)	Pressure schedule in instruction that you selected is displayed here. P: Pressure schedule number F: Force
(ED= , G= , R=)	End distance schedule in instruction that you selected is displayed here. ED: End distance schedule number G: Gun distance (movable tip) R: Robot distance (fixed tip)

20.4   OPERATION FOR QUICK VIEW FUNCTION

Procedure

1   Display edit screen.
2   Position your cursor anywhere on one of the fields in the SPOT[…] instruction.
3   Press and hold down the *i* key. You should see setting data in a window.
4   Release the *i* key to dismiss the window.

NOTE

Specify 0 to $UI_CONFIG.$IHELP_TIMER if you want to use Quick View. Quick View is only active when viewing TP program in Pane 1.

NOTE

To use the quick view function when using the multiscreen display function, display the edit screen in the left screen. If the edit screen is not displayed in the left screen, the quick view function will not be available.

---

21   SPOT PROGRAM TOUCHUP FUNCTION

21.1   OVERVIEW

The spot program touchup function continuously and automatically touches up positions at each spot-welding point in a program to correct position shift in the spot point direction. The spot program touchup function can improve the efficiency of the touchup work in the following ways:
- Reducing the time to touchup an entire program
- Checking and viewing the touchup results by each UIF
- Recording touchup results

To use this function, the following options are required:

Spot program touchup function	A05B-2***-R725
Servogun option	A05B-2***-J643

For the 7DC1 software, which has A05B-2**-R651 for Standard Setting, it needs the following option:

Servo gun setup package	A05B-2***-J979

⚠ **WARNING**
Touchup accuracy depends on servogun mechanical design and the clamping condition of the workpiece. Accuracy may be adversely affected in the following cases:
- When a gun with low arm rigidity is used, such as large X guns and C guns with offset
- When a gun having a large frictional resistance at the driving part
- When a gun having a backlash larger than the required accuracy at the driving part
- When the gun is provided with an equalizer or float mechanism, which causes the gun to move when the tip contacts the workpiece
- When the workpiece is not sufficiently secured, and even a small force causes the workpiece to become deflected or changes the workpiece location
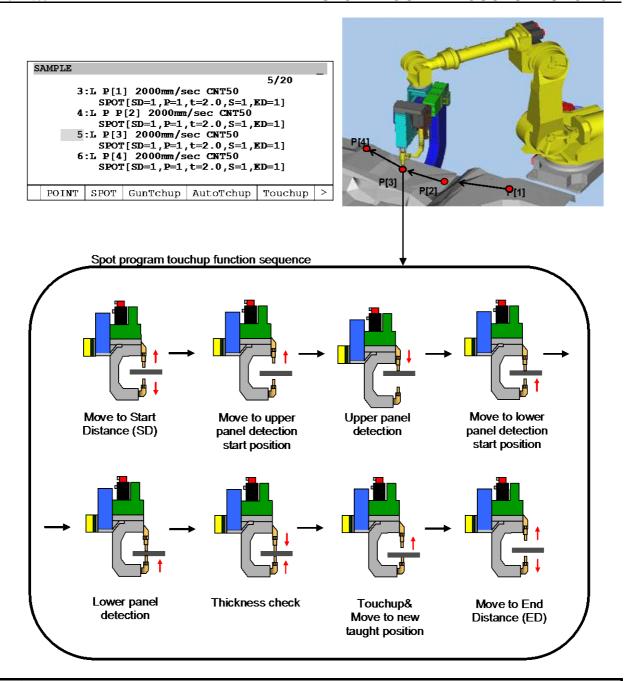
⚠ **CAUTION**
Detection result information is recorded with WARN alarm (in the alarm log) by the spot program touchup function. This information is not recorded depending on the warning history deletion function setting.
Therefore, it is recommended to set system variable $ER_NOHIS = 0 (no function) or 2 (do not record reset in history). Warn history (messages) are recorded if this setting is used.
Refer to Appendix C "SYSTEM VARIABLES" in FANUC Robot series OPERATOR'S MANUAL (Basic Operation) (B-83284EN) for more information about deleting warning history.

B-83264EN/05 21. SPOT PROGRAM TOUCHUP FUNCTION

```
SAMPLE
                                          5/20
      3:L P[1] 2000mm/sec CNT50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
      4:L P P[2] 2000mm/sec CNT50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
      5:L P[3] 2000mm/sec CNT50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
      6:L P[4] 2000mm/sec CNT50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]

  POINT | SPOT | GunTchup | AutoTchup | Touchup | >
```

Spot program touchup function sequence

Move to Start Distance (SD) → Move to upper panel detection start position → Upper panel detection → Move to lower panel detection start position → Lower panel detection → Thickness check → Touchup& Move to new taught position → Move to End Distance (ED)

⚠ **WARNING**
Where TP disable or where TP enable and Thickness update function disable, this function is done by above sequence. Where TP enable and Thickness update function enable, refer to Chapter "21.9 THICKNESS UPDATE SETUP "

⚠ **WARNING**
During the upper panel detection process in the above sequence, the robot/gun trajectory may become larger than the normal spot trajectory. Therefore, confirm that the robot or gun does not interfere with any part of the workpiece or peripheral devices when using the spot program touchup function in a complex environment.

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> ⚠ **WARNING**
> During the above sequence of program touchup, servogun and robot move at a fixed low speed regardless of override.

> ⚠ **CAUTION**
> PR[90] is the default position register for the robot motion during the above sequence. Do not use this position register for another purpose. The register number of this position resister can be changed on the Spot Program Touchup Setup screen, which will be described later.

21.2 PREPARATIONS BEFORE TEACHING

The following items needs to be completed to use the spot program touchup function:
- Gun autotuning
- Pressure calibration
- Setting the tool coordinate system
- Tip wear standard value acquisition
- Specification of "NOWELD" to weld controller mode (NOWELD: the weld controller does not pass current to gun.)
- Enabling of gun stroke.

The following items must be performed before the executing spot program touchup.
- Tip wear detection
- Thickness check calibration

Thickness check calibration can also be performed with a TP program. Please refer to Chapter "21.20 THICKNESS CHECK CALIBRATION."

> ⚠ **CAUTION**
> The TCP of the fixed side tip and master position of the gun axis must be accurate to use the spot program touchup.
> Execute tip wear detection to ensure that the wear amounts of the movable side tip and fixed side tip are correct.

> ⚠ **CAUTION**
> For safety reasons, the operator teaches the spot position with weld controller mode specified as "NOWELD" (NOWELD: weld controller doesn't pass a current to gun.). Spot program touchup should execute with weld controller mode specified to "NOWELD" for safety, too.

21.3   SPOT PROGRAM TOUCHUP EXECUTION PROCEDURE

Spot program touchup executes when program touchup mode is enabled.
Program touchup supports two different execution modes:
1.   Touchup/modify: determine correct position and modify position data (if position is in tolerance)
2.   Verify: determine correct position, but do not modify position data (if position is in tolerance)
Default mode is touchup/modify. Refer to Chapter 21.4 "SPOT PROGRAM TOUCHUP SETUP SCREEN" for details on the Verify mode.
If TP is enabled, the following two execution modes can be selected (subsequent to 7DC2 software):
3.   Measure offset: Determine offset for panel deflection at upper detection. Position data is modified simultaneously.
4.   Path check: Execute a motion to check path for spot program touchup function. Position data is not modified.
Refer to Chapter "21.21 SIMPLE SEARCH MODE FOR UPPER DETECTION" about Measure offset.
Refer to Chapter "21.22 PATH CHECK MODE" about Path check.
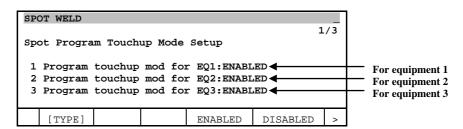
⚠ **CAUTION**
  Assume that execution mode as "touchup/modify" – unless noted otherwise – in this chapter.

Enable program touchup mode, using the procedure below:

TP enable
1   Press the [MENU] key to display the Screen menu.
2   Go to spot program teach setup screen, item "Execution mode for TEACH" and select TOUCHUP mode if you wish to modify points, verify mode if you do not wish to modify points.
3   Press 2 TEST CYCLE.
4   Press F1 TYPE to display the Screen Selection menu.
5   Select Spot Prog Touch. The spot program touchup screen will be displayed.
6   Press F4 ENABLED. Program touchup mode is enabled.

```
SPOT WELD                                        _
                                            1/3
Spot Program Touchup Mode Setup

 1 Program touchup mod for EQ1:ENABLED◄          For equipment 1
 2 Program touchup mod for EQ2:ENABLED◄          For equipment 2
 3 Program touchup mod for EQ3:ENABLED◄          For equipment 3

   [TYPE]              ENABLED  DISABLED  >
```

⚠ **CAUTION**
  Message will be displayed on prompt line of test cycle screen, when touchup mode becomes enabled.
  If TOUCHUP mode: TOUCHUP execution mode enabled EQ:1
  If VERIFY mode: VERIFY execution mode enabled EQ:1
  If MEAS OFS mode: Det offset for simple search enabled EQ:1
  If PATH CHECK mode: Path check mode enabled EQ:1
  MEAS OFS and PATH CHECK modes are supported since 7DC2 software.
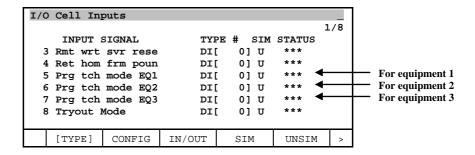
---
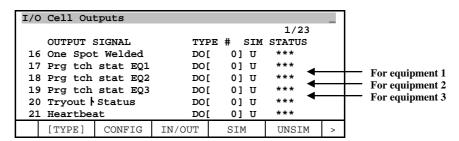
7.   Execute the program to be touched up. When the spot instructions executes, spot program touchup executes automatically.

TP disable

1 Press the [MENU] key to display the Screen menu.
2 Go to spot program teach setup screen, item "Execution mode for AUTO" and select TOUCHUP mode if you wish to modify points, verify mode if you do not wish to modify points.
3 Press 5 I/O.
4 Press F1 TYPE to display the Screen Selection menu.
5 Select Cell Interface. The cell input screen or cell output screen will be displayed.
6 To switch between the input screen and the output screen, press F3 IN/OUT.
7 Move the cursor to Prg tch mode EQ*n* in the input screen, and allocate the input signal. (Refer to R-30*i*B CONTROLLER Spot Welding OPERATOR'S MANUAL (B-83284EN-4) for more information about the cell interface I/O.)

```
I/O Cell Inputs                                _
                                             1/8
     INPUT SIGNAL         TYPE #  SIM STATUS
  3 Rmt wrt svr rese      DI[  0] U   ***
  4 Ret hom frm poun      DI[  0] U   ***
  5 Prg tch mode EQ1      DI[  0] U   ***   ◄──────  For equipment 1
  6 Prg tch mode EQ2      DI[  0] U   ***   ◄──────  For equipment 2
  7 Prg tch mode EQ3      DI[  0] U   ***   ◄──────  For equipment 3
  8 Tryout Mode           DI[  0] U   ***

    [TYPE]   CONFIG   IN/OUT   SIM    UNSIM   >
```

8. Move the cursor to Prg tch stat EQ*n* in the output screen, and allocate the output signal.

```
I/O Cell Outputs                               _
                                            1/23
     OUTPUT SIGNAL        TYPE #  SIM STATUS
 16 One Spot Welded       DO[  0] U   ***
 17 Prg tch stat EQ1      DO[  0] U   ***
 18 Prg tch stat EQ2      DO[  0] U   ***   ◄──────  For equipment 1
 19 Prg tch stat EQ3      DO[  0] U   ***   ◄──────  For equipment 2
 20 Tryout Status         DO[  0] U   ***   ◄──────  For equipment 3
 21 Heartbeat             DO[  0] U   ***

    [TYPE]   CONFIG   IN/OUT   SIM    UNSIM   >
```

9.   Power OFF/ON.
10. Turn on Prg tch mode EQ*n*. Program touchup mode is enabled. Prg tch stat EQ*n* is automatically turned on when program touchup mode is enabled.
11. Execute the program to be touched up. When the spot instructions executes, spot program touchup executes automatically.

⚠ **WARNING**
Before starting program touchup, confirm program touchup mode status, with one of the following indicators:
- Program touchup mode status item on spot program touchup screen
- "Spot program touchup in progress: EQ*n*" status message (displayed when program executes)
- Prg tch stat EQ*n* output signal: ON

⚠**CAUTION**
Spot program touchup process does not execute when any of the following instructions is specified:
- Press motion instruction
- Standalone SPOT inspection
- Tip dress Instruction
- Spot instruction with SpotProgTouch_Dsb attached (Refer to Chapter "21.13 SPOT PROGRAM TOUCHUP DISABLE INSTRUCTION".).

Spot program touchup does not execute in the following condition.
- When the gun operation(mode) is nostroke and single step is enabled.

⚠**CAUTION**
Program touchup mode automatically changes from ENABLED to DISABLED under the following conditions:
If TP is ENABLED
- When program touchup mode is disabled on the spot program touchup screen
- When the TP enable switch changes to disabled (case where Prg tch mode EQn has been turned on is excluded.)
- When gun operation(mode) changes to NOSTROKE (Refer to Chapter "10. TEST CYCLE.")
- When power is turned OFF or ON
- When equipment type changes to air gun

If TP is DISABLED
- When Prg tch mode EQn input signal is turned off
- When Prg tch mode EQn input signal is not correctly allocated
- When the TP is switched to enabled
- When gun operation changes to NOSTROKE (Refer to Chapter "10.TEST CYCLE".)
- When equipment type changes to air gun

⚠**CAUTION**
Spot program touchup, cannot be performed on multiple arms simultaneously (in multi-arm control systems).

21.4   SPOT PROGRAM TOUCHUP SETUP SCREEN

Each setting item of spot program touchup is found on the same screen as the Spot Point Touchup Function on the Servogun GENERAL SETUP screen.
Set spot program touchup per the following procedures.

1   Press the [MENU] key to display the Screen menu.
2   Press 6 SETUP.
3   Press F1 TYPE and select Servogun.
4   On the Servogun SETUP screen, select <*DETAIL*> of GENERAL Setup.
5   On the Servogun GENERAL SETUP screen, select GUN TEACH SETUP.

```
SETUP Servogun                          _
        GENERAL / EQ:1 Gun:1            1/14
     1   Tip Wear Comp          ENABLE
     2   Gun Sag Compensation   DIABLE
     3   Close Direction(Gun):    PLUS
     4   Close Direction(Robot):UT: 1 [+Z ]
     5   Max Motor Torque(%):    100.0
     6   Max Pressure  (nwt):   4000.0
         Max Gun Torque(%):      23.0
     7   Tip stick detect distance(mm):5
     8   Tip Wear Detection:     <*DETAIL*>
     9   Pressure Cal:    COMP  <*DETAIL*>
    10   Tip Wear Standard:INCOMP<*DETAIL*>
    11   Thickness check:        <* DETAIL *>
    12   Gun Stroke limit:       <* DETAIL *>
    13   OverTorque protection:  <* DETAIL *>
    14   Gun Teach setup:        <* DETAIL *>



    [TYPE]    EQUIP     GUN
```

```
SETUP Servogun                            _
  GUN TEACH SETUP / EQ:1 Gun:1      1/30

   Common Setup: point + program touchup
      Gun offset @record(mm):        5.0
      Speed of offset motion(mm/sec): 50
      Position register(PR[#]):       90
      Position error offset(mm):     0.0
      Upper det simple search mode:DISABLE
   Thickness check Setup
      Over thickness tolerance(mm):  0.5
      Under thickness tolerance(mm)  2.0
      Pressure Limit@Check(nwt):     0.0
      Low pnl detect dist Enb/DSB: DISABLE
      Low pnl detection distance(mm): 5.0
   Gun mechanical compensation:
      Compensation Enb/Dsb:        DISABLE
      Compensation Dist Calib:      INCOMP
      Compensation Dist (mm):        0.0
   Parameter to correct position for Xgun
      Distance correction Enb/Dsb: DIABLE
      Detect pos correct dist(mm):   0.0

   Point touchup Setup
      Execute Thickness check:      ENABLE

   Program touchup Setup
      Execution mode for AUTO:      TOUCHUP
      Execution mode for TEACH:     TOUCHUP
      Verify mode active DO[#]:       0
      Max allowable position err(mm): 2.0
      Min allowable position err(mm): 0.0
      Position error DO[#]:           0
      Thickness error DO[#]:          0
      Detection error DO[#]:          0
      Program touchup incomplt DO[#]: 0
      Reset DI[#]:                    0
      Upper panel search margin(mm):  5.0
      Maximum retry number:           2
   Pause mode Setup
      Det/Thk/Pos error pause Sev: DISABLE
      SpotProgTouch_Dsb pause Sev: DISABLE
      Pause mode status DO[#]:        0
      Speed of path check motion(mm/s):20

    [TYPE]    EQUIP     GUN     END        >
```

> **NOTE**
> Displayed screens and setting items may differ depending the software version and/or software option configuration.

ITEM	DESCRIPTION
Common Setup: point + program touchup	
Gun offset @record (mm) Default value: 50mm	This item specifies the taught position for the movable side tip at touchup. The actual taught position for the movable side tip is (panel thickness + gun offset @record). Note: The movable side tip does not pass the taught point when spot instructions are continuously executed. The robot pauses only when a spot instruction is executed with a single step enabled.
Speed of offset motion (mm/sec) Default value: 50mm/sec	This item specifies the robot's speed during motions other than non-detection motions. Note the following when changing the speed: this speed is override-independent; that is, the execution speed is the specified speed regardless of the override setting.
Position register (PR[#]) Default value: 90	This item specifies the position register number that is used internally for robot motion. Do not use the position register specified here for another purpose.
Position error offset(mm) Default value: 0.0mm	The offset specified here is added to the position error correction at the touchup.
Upper det simple search mode Default: DISABLE	Select Enable/Disable for Simple search mode. Refer to Chapter "21.21 SIMPLE SEARCH MODE FOR UPPDER DETECTION" for more information about this function.
Thickness check Setup	
Over thickness tolerance (mm) Default value: 0.5mm	This item is the tolerance for the difference between the observed thickness and specified thickness values when the observed thickness value is greater than the specified thickness. For example, when Over thickness tolerance is 0.5 mm: OK: Specified thickness = 2.0 mm, observed thickness = 2.5 mm NG: Specified thickness = 2.0 mm, observed thickness = 2.6 mm If the thickness measured during lower panel detection is greater than this tolerance, the following warning occurs: • SVGN-254 "Low Panel Mis-detect:(Eq:%d,Ln:%d) If the thickness measured during thickness check is greater than this tolerance, the following warning occurs: • SVGN-239 Thickness error:(Eq:%d,Ln:%d)
Under thickness tolerance (mm) Default value: 2.0 mm	This item is the tolerance for the difference between the observed thickness and specified thickness values when the observed thickness value is smaller than the specified thickness. For example, when the lower thickness tolerance is 2.0 mm: OK: specified thickness = 4.0 mm, observed thickness = 2.0 mm NG: specified thickness = 4.0 mm, observed thickness = 1.9 mm If the thickness measured during lower panel detection is greater than this tolerance, the following warning occurs.: • SVGN-254 "Low Panel Mis-detect:(Eq:%d,Ln:%d) If the thickness measured during thickness check is greater than this tolerance, the following warning occurs: • SVGN-239 Thickness error:(Eq:%d,Ln:%d)
Low pnl detect dist Enb/DSB Default value: DISABLE	This item specifies whether lower panel detection distance is enabled or disabled.
Low pnl detection distance(mm) Default value: 5.0 mm	This item specifies the lower panel detection distance. By specifying this item, the robot trajectory at the upper panel detection and lower panel detection start position can be changed. Refer to Chapter "21.6 LOWER PANEL DETECTION DISTANCE CLAMP" for more information about this item.

ITEM	DESCRIPTION
Gun mechanical compensation	
Compensation Enb/Dsb Default: Disable	This item specifies whether the compensation of detection errors due to the gun mechanical unit characteristics is enabled or disabled. Note that this item can not be enabled when compensation distance calibration is incomplete.
Compensation Dist Calib Default: IMCOMP	This item indicates compensation distance calibration status. Compensation cannot be performed if calibration is not complete. Refer to Chapter 21.19 "GUN MECHANICAL COMPENSATION CALIBRATION" for the execution of compensation distance calibration.
Compensation Dist(mm) Default:0.0	This item displays compensation distance that was determined during calibration. When gun mechanical compensation is enabled, this value is applied to position of upper panel detection. This parameter is not selectable/editable on the screen.
Parameter to correct position for Xgun	
Distance correction Enb/Dsb Default value: DISABLE	This item specifies whether distance correction for X gun is enabled or disabled. This item is for X gun only. Detect pos correct dist is added to the position error correction at touchup when this item is enabled.
Detect pos correct dist(mm) Default value: 0.0mm	When the distance correction Enb/Dsb is enabled, the correction distance specified here is added to the position error correction amount at touchup.
Point touchup Setup	
Execute Thickness check Default value: ENABLE	This item specifies whether thickness check for the Point Touchup Function is enabled or disabled.
Program touchup Setup	
Execution Mode for AUTO: TOUCHUP	This item specifies execution mode for AUTO (TP disabled). TOUCHUP: Performs workpiece position detection and touchup. VERIFY: Performs workpiece position detection only.
Execution Mode for TEACH:TOUCHUP Default value: Touchup	This item specifies execution mode for TEACH (TP enabled). TOUCHUP: Performs workpiece position detection and touchup. VERIFY: Performs workpiece position detection only. MEAS OFS: Simultaneously measures offset for upper panel detection in simple search mode and performs touchup. PATH CHECK: Checks interference with peripheral devices during touchup motion. Does not perform touchup. Refer to Chapter 21.21 "SIMPLE SEARCH MODE FOR UPPER DETECTION" about Measure offset. Refer to Chapter 21.22 "PATH CHECK MODE" about Path check.
Verify mode active DO[#] Default value: 0	The Verify mode active DO is the output when Verify mode is active. The Verify mode can be active in AUTO or teach mode, and this signal is the output in both cases. To use this signal, incorporate it into the PLC and monitor it.
Max allowable position err (mm) Default value: 2.0 mm	This item is the tolerance value for the maximum allowable position error correction. If position error correction is larger than this tolerance value, touchup is canceled, and following warning occurs. • SVGN-237 Position error:(Eq:%d,Ln:%d)
Min allowable position err (mm) Default value: 0.0 mm	This item is the tolerance value for the minimum allowable position error correction. If position error correction is smaller than this tolerance value, touchup is canceled, and following warning occurs. • SVGN-237 Position error:(Eq:%d,Ln:%d)
Position error DO[#] Default value: 0	The position error DO is output as a pulse signal when the following warning occurs. The pulse output time width is 500 msec by default. To use this signal, incorporate it into the PLC and monitor it. • SVGN-237 Position error:(Eq:%d,Ln:%d) When this signal turns on, it is indicated that the calculated position error correction exceeds the allowable tolerances.

ITEM	DESCRIPTION
Thickness error DO[#] Default value: 0	The thickness error DO is outputted as a pulse signal when any of the following warnings occur. The pulse output time width is 500 msec by default. To use this signal, incorporate it into the PLC and monitor it. SVGN-254 "Low Panel Mis-detect:(Eq:%d,Ln:%d) SVGN-239 Thickness error:(Eq:%d,Ln:%d) When this signal turns on, it indicates that the thickness error exceeds the upper/lower thickness tolerance.
Detection error DO[#] Default value: 0	The detection error DO is outputted as a pulse signal when any of the warnings below occurs. The pulse output time width is 500 msec by default. To use this signal, incorporate it into the PLC and monitor it. • SVGN-240 Panel Mis-Detect(Eq:%d,Ln:%d) • SVGN-252 Panel detection was failed:%d • SVGN-260 Search motion is unsuccess When this signal turns on, it indicates that the upper panel detection has failed. Refer to chapter "21.23 TROUBLESHOOTING" for more information about SVGN-252 and SVGN-260.
Program touchup incomplt DO[#] Default value: 0	The program touchup incomplt DO is outputted when any of the following warnings occurs. • SVGN-237 Position error:(Eq:%d,Ln:%d) • SVGN-239 Thickness error:(Eq:%d,Ln:%d) • SVGN-240 Up Panel Mis-Detect:(Eq:%d,Ln:%d) • SVGN-252 Panel detection was failed: %d • SVGN-254 Low Panel Mis-detect:(Eq:%d,Ln:%d) • SVGN-260 Search motion is unsuccess. The operator should confirm the state of this signal, when the program ends. If this signal is on, it indicates that touchup is incomplete at any of the spot points in the program. This signal can also be incorporated into the PLC.
Reset DI[#] Default value: 0	If the program touchup incomplt DO is incorporated into the PLC, the operator requires a means to turn off the program touchup incomplt DO externally. An input of the Reset DI turns off the program touchup incomplt DO.
Upr pnl detection distance(mm) Default value: 5.0 mm	This item is the upper panel detection distance. This item can change the upper panel detection start position.
Maximum retry number Default value: 0	If 1 or a greater value is specified for this item, upper panel detection will automatically be retried if it fails due to the following warning. • SVGN-252 Panel detection was failed • SVGN-260 Search motion is unsuccessful. When upper panel detection is retried, the robot retries upper panel detection after it moves to the start distance (SD). Note: Refer to chapter "21.23 TROUBLESHOOTING" for more information about SVGN-252 and SVGN-260.

ITEM	DESCRIPTION
Pause mode Setup	
Det/Thk/Pos error pause Sev Default value: DISABLE	This item specifies whether the robot pauses at the end distance of the touchup motion if one of the following warnings occurs. • SVGN-237 Position error:(Eq:%d,Ln:%d) • SVGN-239 Thickness error:(Eq:%d,Ln:%d) • SVGN-240 Up Panel Mis-Detect:(Eq:%d,Ln:%d) • SVGN-252 Panel detection was failed:(Eq:%d,Ln:%d) • SVGN-254 Low Panel Mis-detect:(Eq:%d,Ln:%d) • SVGN-260 Search motion is unsuccess. If this item is DISABLED The robot does not pause. If this item has Warn severity The robot converts the following alarm into a warning and automatically pauses. • SVGN-236 [PauseMod]Det/Thk/Pos Err If this item has Alarm severity The robot pauses due to the following alarm: • SVGN-236 [PauseMod]Det/Thk/Pos Err Remove the cause of pause before restarting the program. If necessary, manually perform touchup at the end distance or use the Spot Point Touchup Function, or re-execute the spot program touchup.
SpotProgTouch_Dsb pause Sev Default value: DISABLE	This item specifies whether the robot pauses at the start distance of the touchup motion when a spot instruction with the spot program touchup disable instruction is executed. If this item is DISABLE The robot does not pause. If this item has Warn severity The robot converts the following alarm into a warning and automatically pauses. • SVGN-238 [PauseMod]SpotProgTouchDsb If this item has Alarm severity The robot pauses due to the following alarm: • SVGN-238 [PauseMod]SpotProgTouchDsb This item can be used only when TP is disabled Refer to Chapter "21.13 SPOT PROGRAM TOUCHUP DISABLE INSTRUCTION" for more information about SpotProgTouch_Dsb.
Pause mode status DO[#] Default value: 0	If the robot pauses due to Det/Thk/Pos error pause Sev or SpotProgTouch_Dsb pause Sev with Warn severity, this item is outputted as a pulse signal. The pulse output time width is 500 msec by default. To use this signal, incorporate it into the PLC and monitor it. When Det/Thk/Pos error pause Sev or SpotProgTouch_Dsb pause Sev, has Alarm severity, this signal is not outputted.
Speed of path check motion(mm/s) Default value: 20 mm/s	These items set the TCP and gun axis speed during Path check motion. This is applied to the motion near welding points. This is not applied to air-cut motion.

The following items are set per equipment. They cannot be set per gun.
- Max allowable position err
- Min allowable position err
- Position error DO
- Thickness error DO
- Detection error DO
- Program touchup incomplt DO
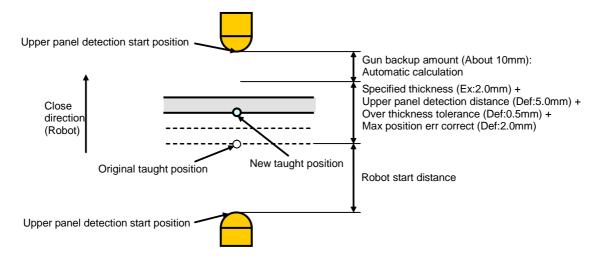
- Reset DI
- Thickness check mode
- Det/Thk/Pos error pause Sev
- SpotProgTouch_Dsb pause Sev
- Pause mode status DO

⚠ **WARNING**

The following items affect upper panel detection start position. Therefore, confirm that the gun does not interfere with any part of the workpiece or peripheral devices when it moves to the upper panel detection start position in a complex environment if a significant change is made to any of the following setting items:

- Over thickness tolerance
- Max allowable position err
- Upper panel search margin

Upper panel detection start position

Gun backup amount (About 10mm): Automatic calculation

Specified thickness (Ex:2.0mm) +
Upper panel detection distance (Def:5.0mm) +
Over thickness tolerance (Def:0.5mm) +
Max position err correct (Def:2.0mm)

Close direction (Robot)

Original taught position   New taught position

Robot start distance

Upper panel detection start position
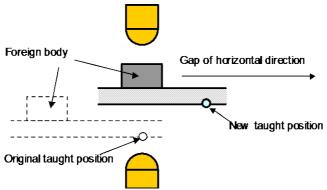
Refer to 21.5 "MAX DETECTION RANGE" for information on the max detection range.

21.5   MAX DETECTION DISTANCE RANGE (UPPER PANEL POSITION SHIFT TOLERANCE)

When executing the spot program touchup, the workpiece position may shift horizontally. In such a case, if there is a foreign body such as a nut on the upper panel, touchup may not be executed correctly or panel damage may occur during thickness check.

By setting the max detection distance range, an error (SVGN-240 Up Panel Mis-detect) can be generated when an upper panel position that exceeds the max detection distance range and spot program touchup is canceled.
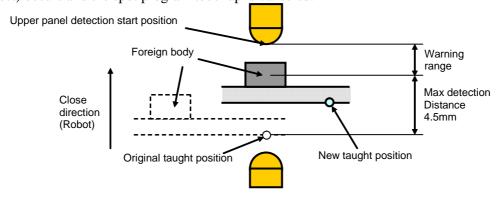
The max detection distance range is computed per the following items on the setup screen.
- Over thickness tolerance
- Max/Min allowable position err

If one of the items mentioned above changes, the following message is displayed on the TP prompt line.

Prompt message

Max detection distance = specified thickness + 2.5 mm

| 4.5mm | Specified thickness Ex) 2.0mm | Over thickness tolerance (Def:0.5mm) + Max position err correct (Def:2.0mm) |

When the above prompt message is displayed, the max detection distance is 4.5 mm. Therefore, the max detection distance is 4.5 mm toward the gun opening direction from the original taught position. If the upper panel is detected at a distance that exceeds the max detection distance, an error (SVGN-240 Up Panel Mis-detect) occurs and the spot program touchup is canceled.
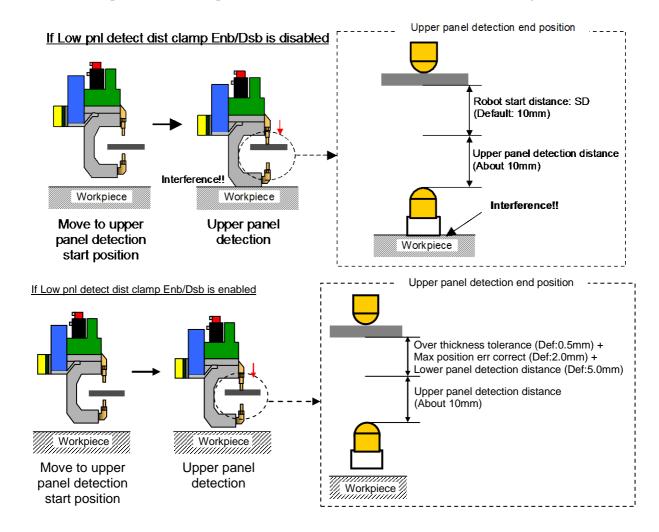
> ⚠**WARNING**
>   Max detection distance affects upper panel detection start position. Therefore, confirm that the gun does not interfere with any part of the workpiece or peripheral devices when it moves to the upper panel detection start position in a complex environment if a significant change is made to any of the following setting items.
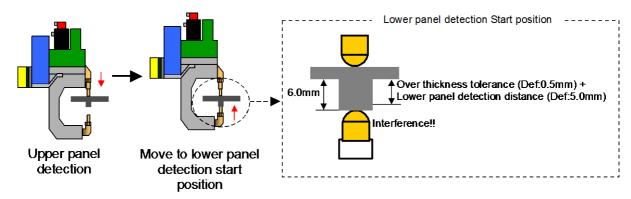
21.6   LOWER PANEL DETECTION DISTANCE

The gun moves in lower (robot open) direction by upper panel detection distance at start of upper panel detection. In a tight workspace, robot tip might interfere with a workpiece or peripheral devices. If Low pnl detect dist clamp Enb/Dsb on setup screen is set to ENABLE, the movement distance of gun can be reduced.

If Low pnl detect dist clamp Enb/Dsb is disabled

Move to upper panel detection start position

Interference!!

Workpiece

Upper panel detection

Workpiece

Upper panel detection end position

Robot start distance: SD (Default: 10mm)

Upper panel detection distance (About 10mm)

Interference!!

Workpiece

If Low pnl detect dist clamp Enb/Dsb is enabled

Move to upper panel detection start position

Workpiece

Upper panel detection

Workpiece

Upper panel detection end position

Over thickness tolerance (Def:0.5mm) + Max position err correct (Def:2.0mm) + Lower panel detection distance (Def:5.0mm)

Upper panel detection distance (About 10mm)

Workpiece

Adjust the lower panel detection distance on the setup screen to reduce the gun movement distance. However, the lower panel detection distance is also used for lower panel detection start position, as shown in the figure below. When there is a gap or foreign object under the lower panel, the gap or foreign object may be crushed when the robot starts moving to the lower panel detection start position, if a small lower panel detection distance is set. Therefore, take into consideration the size of such a gap or foreign object when specifying the lower panel detection distance.

If Low pnl detect dist Enb/Dsb is enabled

In the figure above, specify lower panel detection distance larger than 5.5 mm.

21.7 PARAMETER CALIBRATION FUNCTION

Depending on the mechanistic properties of the servogun and it's change, the spot program touchup function may incorrectly detect the workpiece (detects a different position from the actual workpiece position), and the gun axis motion or robot motion may stop before the gun touches the workpiece. In such a case, by executing parameter calibration, you can get parameters that are adapted to each servogun.

> ⚠ **CAUTION**
> Parameter calibration is a function to prevent erroneous detection that leads to stopping of the search motion before the gun touches the workpiece.

Preparations
Configure the following settings to enable parameter calibration.
1   Press the [MENU] key to display the Screen menu.
2   Press 6 SETUP.
3   Press F1 TYPE and select ServoGun.
4   On the Servogun SETUP screen, select <*DETAIL*> of General Setup.
5   On the Servogun General Setup screen, select GUN TEACH SETUP.
6   On the setup screen of spot program touchup, press the "F→" key, and then press F7 "DET CFG"
7   On the torque control setup screen, press F4 CHOICE, and set the search condition to Adaptive.

Calibration Execution
There are two way of executing parameter calibration
1.   Execute automatically during servogun autotuning.
2.   Execute from the Torque control setup screen (Adaptive).
The calibration for parameters of detection is executed automatically in ServoGun Autotuning. Refer to Chapter "2.5 SERVO GUN SETUP AND AUTOTUNING UTILITY" for more information about Autotuning.
This section describes how to execute calibration from the Torque control setup screen (Adaptive). The Torque control setup screen (Adaptive)   can be displayed by pressing F5 DETAIL on the torque control setup screen. Calibration is executed by the following procedure while the screen is displayed:
1   Enable TP.
2   Press SHIFT + F3 EXEC. The calibration motion will be executed.
During calibration motion, keep to press the [SHIFT] key.
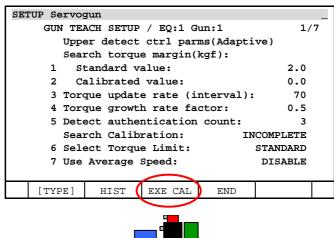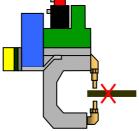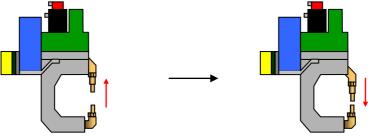
```
SETUP Servogun                                            _
        GUN TEACH SETUP / EQ:1 Gun:1              1/7
          Upper detect ctrl parms(Adaptive)
          Search torque margin(kgf):
     1    Standard value:                    2.0
     2    Calibrated value:                  0.0
     3 Torque update rate (interval):         70
     4 Torque growth rate factor:            0.5
     5 Detect authentication count:            3
          Search Calibration:         INCOMPLETE
     6 Select Torque Limit:             STANDARD
     7 Use Average Speed:                DISABLE


     [TYPE]    HIST   EXE CAL    END
```

Confirm no panel and other obstacles
between tips before start calibration.

First, the gun axis moves to start
position.

The gun axis moves to close position
by a search speed(default: 4mm/sec).

NOTE
   The parameters calculated by calibration are shared between step 1 of upper
   panel detection and lower panel detection. If you execute calibration in one of
   these, it is not necessary to perform calibration for the other. The calibrated
   parameters are applied by selecting "Adaptive."

How to apply the calibrated parameters

The search calibration field changes to "COMPLETE" after calibration is performed correctly. The
calibrated parameters can be used at this status. Change to enable as following setup.

Select Torque Limit

Setup a margin of the torque limit for gun axis during search motion. If you select "CALIB", Calibrated
value is used.

Use Averaging Speed

This item is automatically set to "ENABLE" during calibration if the controller judges that an alarm
"SVGN-274 Too low speed threshold" may occur.

ITEM	DESCRIPTION
Search torque margin(kgf) Standard value:	Search torque margin is a margin for the torque limit set during search motion. This is standard value for it.

ITEM	DESCRIPTION
Upper1 Default:2.0kgf Lower Default:3.0kgf	
Search torque margin(kgf) Calibrated value: Default:0.0kgf	This is a calibrated margin. If this value is larger than the standard value, a misdetection may have occurred. Use calibrated value.
Torque update rate (interval) Default:	This is an interval to update torque limit.
Torque growth rate factor Default:	This is a limitation imposed on the increase amount when updating the torque limit.
Detect authentication count Default:	This item delays the detection timing to ensure that the workpiece is detected.
Search Calibration	This item indicates the calibration execution status. If it is COMPLETE, the calibrated parameters can be applied.
Select Torque Limit	You can select standard or calibrated value for search torque margin.
Use Average Speed	This item specifies whether the process for averaging the gun speed during detection is enabled or disabled. If "SVGN-274 Too low speed threshold" occurs, set this item to ENABLE.

⚠**CAUTION**
   The parameters set by this function can reduce the detection sensitivity.
   Therefore, there is a risk of bending a panel, and applying the spot program
   touchup function may not be possible for some welding points on a low stiffness
   panel. Check the operation at the low stiffness welding points after enabling the
   setting.

⚠**CAUTION**
   If "Use Averaging Speed" was automatically set to ENABLE by calibration, the
   warning SVGN-279 "Averaging speed is used" is issued for every touchup
   function. This warning indicates the possibility that the calibration affects the
   detection sensitivity.
   The warning SVGN-279 is not issued if you manually enable "Use Averaging
   Speed."

⚠**CAUTION**
   The characteristics of the servogun can change as it continues to be used. If the
   misdetection becomes more likely to occur when using the servogun, re-execute
   the calibration.

21.8 PARAMETERS SETUP FOR PANEL UPPER SURFACE DETECTION AND LOWER SURFACE DETECTION

A characteristic or change of the servogun mechanism may cause panel misdetection (detection of other position than the panel position) and stoppage of the gun axis operation or robot operation before the gun reaches the panel. In such a case, misdetection can be prevented by changing the parameters for panel detection.

Parameters for panel detection can be changed on the Search Parameters Setup screen.

To display Search Parameters Setup screen, use the following procedure:

1 Press the [MENU] key to display the Screen menu.
2 Press 6 SETUP.
3 Press F1 [TYPE] key and select "Servo Gun."
4 On the SETUP Servogun screen, select <*DETAIL*> of General Setup.
5 On the servogun general setup screen, select "Gun Teach Setup."
6 On the gun teach setup screen, press the [F->] key and then F6 [SRCH PRM] key.

```
SETUP Servogun                                           _
        GUN TEACH SETUP / EQ:1 Gun:1                  1/3

          Search Parameters Setup

            Upper panel detection
              Upper detection STEP1:            TYPE1
              Upper detection STEP2:            TYPE1
            Lower panel detection              TYPE1

    [ TYPE ]    EQUIP     GUN      END    UPDATE
```

ITEM	DESCRIPTION
Upper panel detection STEP 1 Default value: 1	This item is parameters setup for upper panel detection. A gun tip touch panel two times in a search motion. This item is for first touching. When the search motion stops before the gun tip touches the panel, change the setting. Press F5 UPDATE after changing this item.
Upper panel detection STEP 2 Default value: 1	This item is parameters setup for upper panel detection. Movable tip touch panel two times in a search motion. This item is for second touching. If accuracy of touchup position is bad, change parameter type. Press F5 UPDATE after changing this item.
Lower panel detection Default value: 5	This item is lower panel detection. When the search motion stops before both tips clamp the panel, change the setting. Press F5 UPDATE after changing this item.

> ⚠**WARNING**
> Usually, the search parameters need not be changed. Change the search parameters setting only if the mis-detection occurs frequently.

> ⚠**WARNING**
> If the panel detection sensitivity is degraded due to an improper panel detection parameter setting, the panel may be significantly bent at the time of panel upper surface detection or the clearance is eliminated or foreign objects are crushed at the time of panel lower surface detection. Carefully set the panel detection parameter.

21.9 THICKNESS UPDATE SETUP

Spot Program Touchup Function can update a thickness and a position at one time. The setting concerning thickness update can be configured on thethickness update setup screen.

> ⚠ **CAUTION**
> The spot program touchup function can update the panel thicknesses only in the following cases:
> 1 Execute this function at TP enable.
> 2 Execute the gun teaching function.

To display Thickness Update Setup screen, use the following procedure:
1   Press the [MENU] key to display the Screen menu.
2   Press 6 SETUP.
3   Press F1 [TYPE] key and select "Servo Gun."
4   On the SETUP Servogun screen, select <*DETAIL*> of General Setup.
5   On theservogun general setup screen, select "Gun Teach Setup."
6   On the spot program touchup setup screen, press the [F->] key and then F9 [THK PRM] key.

```
SETUP Servogun                                    _
      GUN TEACH SETUP / EQ:1 Gun:1            1/2
         Thickness Update Setup for Touchup
         1  Program Touchup Function:   <*DETAIL*>
         2  Point Touchup Function      <*DETAIL*>


      [ TYPE ]   EQUIP    GUN
```

7.   Select the details of the program touchup function or gun teaching function.
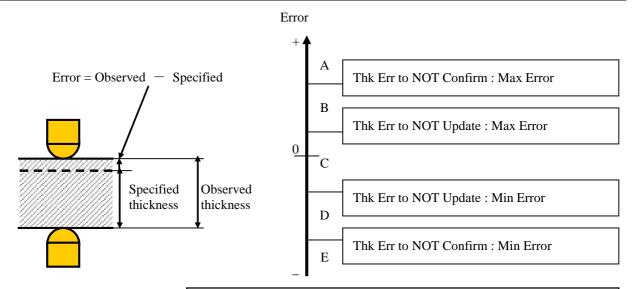
```
SETUP Servogun                          _
   GUN TEACH SETUP / EQ:1 Gun :1    1/6
   Program Touchup Function
   1 Thick Update @TEACH Enb/Dsb: ENABLE
   2 Max Thickness Valsue(mm):     10.0
     Allowable Thk Err to NOT Update
   3  Max Allowable Error(mm):      0.5
   4  Min Allowable Error(mm):     -0.5
     Allowable Thk Err to NOT Confirm
   5  Max Allowable Error(mm):      0.5
   6  Min Allowable Error(mm):     -0.5
     Error = Observed – Specified

  [ TYPE ]   EQUIP    GUN    ENABLE  DISABLE
```

```
SETUP Servogun                          _
   GUN TEACH SETUP / EQ:1 Gun :1    1/5
   Program Touchup Function
   1 Max Thickness Value(mm):       10.0
     Allowable Thk Err to NOT Update
   2  Max Allowable Error(mm):       0.5
   3  Min Allowable Error(mm):      -0.5
     Allowable Thk Err to NOT Confirm
   4  Max Allowable Error(mm):       0.5
   5  Min Allowable Error(mm):      -0.5
     Error = Observed – Specified

  [ TYPE ]   EQUIP    GUN
```

In the detail screens, following parameters are set.

ITEM	DESCRIPTION
Thick Update @TEACH Enb/Dsb:	This enables/disables the thickness update function in the execution of spot program touchup function in the Teach mode (TP enabled). ENABLE: In the spot program touchup function in the Teach mode, the thickness can be updated at the same time. DISABLE: Thickness is not updated. This item is present only on the Program Touchup Function screen.
Allowable Thk Err to NOT Update Max Thickness Value (mm) Min Thickness Value (mm)	If the thickness error falls between these values, the thickness is NOT updated. See figure below for details.
Allowable Thk Err to NOT Confirm Max Allowable Error (mm)	If the thickness error falls between these values, the thickness is updated without displaying a confirmation message.

ITEM	DESCRIPTION
Min Allowable Error (mm)	See figure below for details.

Error

+

A — Thk Err to NOT Confirm : Max Error

B — Thk Err to NOT Update : Max Error

0

C

Thk Err to NOT Update : Min Error

D

Thk Err to NOT Confirm : Min Error

E

−

Error = Observed − Specified

Specified thickness   Observed thickness

Thickness error is in A or E :Confirm to update thickness.

Thickness error is in B or D :Thickness is updated automatically.

Thickness error is in C   :Thickness is NOT updated.

⚠**CAUTION**
If Max Allowable Error for Allowable Thk Err to NOT Update is larger than Max Allowable Error for Allowable Thk Err to NOT Confirm, the processing of Allowable Thk Err to NOT Update takes precedence. Thickness is not updated if the thickness error is in that range.
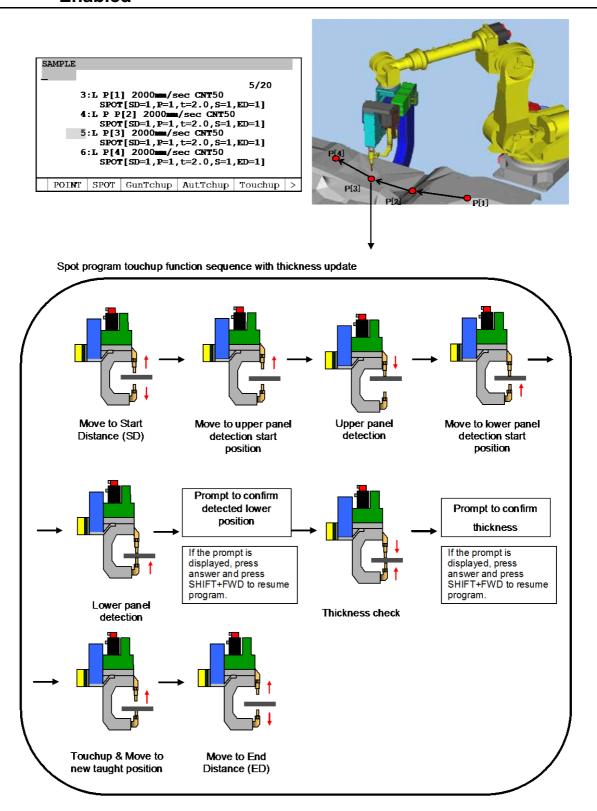
NOTE
If you set the same value to Max Allowable Error for both Allowable Thk Err to NOT Update and Allowable Thk Err to NOT Confirm and the same value to Min Allowable Error for both, the confirmation message is always displayed when thickness update is attempted, and automatic update can be disallowed. On the contrary, if you intend to have the thicknesses updated automatically, set a great Max Allowable Error and a small Min Allowable Error for Allowable Thk Err to NOT Confirm.

⚠**CAUTION**
If you set an excessively great Max Allowable Error and an excessively small Min Allowable Error for Allowable Thk Err to NOT Confirm, improper thickness measurements may not be detected because of reasons such as the climbing of the panel on another panel due to the displacement of the spot so that the thickness becomes excessively large. Configure the setting value within an appropriate range.

21.9.1   Operation Sequence When Thickness Update Function Is Enabled

```
SAMPLE
_
                                        5/20
     3:L P[1] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     4:L P P[2] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     5:L P[3] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     6:L P[4] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]

 POINT | SPOT | GunTchup | AutTchup | Touchup | >
```


Spot program touchup function sequence with thickness update

Move to Start Distance (SD)

Move to upper panel detection start position

Upper panel detection

Move to lower panel detection start position

Lower panel detection

Prompt to confirm detected lower position

If the prompt is displayed, press answer and press SHIFT+FWD to resume program.

Thickness check

Prompt to confirm thickness

If the prompt is displayed, press answer and press SHIFT+FWD to resume program.

Touchup & Move to new taught position

Move to End Distance (ED)

21.9.1.1 Prompt to confirm detected lower surface position and measured thickness

Where thicknesses measured by lower detection and thickness check meet the conditions to confirm, the prompts to confirm are displayed. When they are displayed, the program is paused. Resume program by press SHIFT+FWD after confirm the thickness and a robot tip position.
Where NOT meet the conditions, the prompts is not displayed and proceed with the sequence.

⚠ **CAUTION**
    If you do cursor movement or change display at displaying the prompts, the touchup function is aborted.

Prompt to Confirm Detected Lower Surface Position

When the error between the measured thickness in panel lower surface detection and the specified thickness exceeds the tolerance of Allowable Thk Err to NOT Confirm, a prompt as shown below is displayed.

```
SAMPLE                                    _    _    _
                                              2/3
        1: L P[1] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        2: L P[2] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        3: J P[3] 100% FINE
     [END]
     Rec Pos and Thk on this tip pos?(t=1.0)


  |      |      |        |        | YES  |  NO  |
```

When F4 YES is pressed, the position and the thickness are updated by the current values, and the next prompt as shown below is displayed.
When F5 NO is pressed, the touchup function is aborted. If you resume the program, go to next line.

⚠ **CAUTION**
    The position and thickness updated here are information as of halfway through the measurement. When selecting F4 YES in the above procedure, to obtain the correct teach position and correct thickness in which the position compensation and other adjustments are made, do not abort the touchup process.

```
SAMPLE                                    _    _    _
                                              2/3
        1: L P[1] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        2: L P[2] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=1.0,S=1,ED=1]
        3: J P[3] 100% FINE
     [END]
     SHIFT+FWD: Resume program.


  | POINT | SPOT | GunTchup | AutTchup | TOUCHUP |  |
```

Resume the program and do thickness check.

Prompt to Confirm Thickness

When the error between the measured thickness in thickness check and the specified thickness exceeds the tolerance of Allowable Thk Err to NOT Confirm, the prompt as shown below is displayed. However, if the measured thickness has already been confirmed at the prompt to confirm detected lower surface position (F4 [YES] is selected at the above conformation prompt), this prompt is not displayed provided there is no error from the thickness at the lower surface detection.

```
SAMPLE                                    _   _   _
                                              2/3
        1: L P[1] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        2: L P[2] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        3: J P[3] 100% FINE
        [END]
        Change thickness: 2.0 to 1.0?

                                    YES      NO
```

Press F4 YES, the thickness is updated and a next prompt as below is displayed.
Press F5 NO, the touchup function is aborted. If you resume the program, go to next line.

```
SAMPLE                                    _   _   _
                                              2/3
        1: L P[1] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        2: L P[2] 2000mm/sec ﾅﾒﾗｶ 50
           SPOT[SD=1,P=1,t=1.0,S=1,ED=1]
        3: J P[3] 100% FINE
        [END]
        SHIFT+FWD: Resume program.

     POINT   SPOT   GunTchup  AutTchup  TOUCHUP
```

Resume the program, move to new taught position and do touchup.

> ⚠ **CAUTION**
> To perform touchup, the robot must actually move to the taught position. In above process, if you don't resume the program, the touchup is not done.

21.10   SPOT PROGRAM TOUCHUP STATUS SCREEN

Program touchup status can be confirmed from the spot program touchup status screen.
Display the spot program touchup status screen by following the procedures below.
1   Press the [MENU] key to display the Screen menu.
2   Press [0 --NEXT--] and [4 STATUS].
3   Press F1 [TYPE] key and select "Servo Gun."
4   On the STATUS Servogun screen, select Program touchup status <*DETAIL*>.
     Spot program touchup status screen will be displayed.

The following items are shown on this screen. The lines are arranged in a reverse chronological order from the top. A maximum of 50 lines can be displayed.

```
STATUS Servogun                                                        _
        PROG TOUCHUP STAT / EQ:1 Gun:1                      1/30
        No. Program name Lin DET      THK      Pos[mm]
         1  SPOT_WELD       6   OK     OK       0.2 OK@
         2  SPOT_WELD       5   OK     OK       3.1 NG
         3  SPOT_WELD       4   OK     NG    ****** **
         4  SPOT_WELD       3   OK     OK      -0.8 OK@
         5  SPOT_WELD       2   OK     OK       0.2 OK
         6  SPOT_WELD       1   NG     **    ****** **


  [ TYPE ]    EQUIP    DETAIL    ALL_CLR    CLEAR
```

⚠ **CAUTION**
   If @symbol is placed after the touchup status, the position data has been
   modified.
   If @symbol is NOT placed, the position data has not been modified.

ITEM	DESCRIPTION
Program name	Name of program where spot program touchup was performed.
Lin	Line number of program where spot program touchup was performed.
Det	OK: Upper panel detection success NG: Upper panel detection failure **: No panel upper surface detection has been conducted. When this item is NG or **, thickness check and touchup are skipped. Refer to "Upper panel detection fails" in chapter "21.23 TROUBLESHOOTING".
Thk	OK: The error margin of the specified thickness and the observed thickness is within tolerance value. NG: The error margin of the specified thickness and the observed thickness is outside tolerance value. **: No thickness check (thickness measurement) has been performed. When this item is NG or **, touchup is skipped. Confirm the specified thickness in the pressure schedule and the under/over thickness tolerance in the setup screen.
Pos[mm]	The calculated position error correction is displayed. When this value is positive, the direction of position error correction is the robot close direction. When this value is negative, the direction of position error correction is the robot open direction. OK: The position error correction is within tolerance value. NG: The position error correction is outside tolerance value. **: No touchup amount calculation has been conducted. When this item is NG or **, touchup is skipped. Confirm max/min position err correct in the setup screen.
Position recorded status	If position was modified, then @ symbol is placed beside (to the right of) the position value. Note that position is not modified in the following cases: • if detection distance, thickness, or position error are out of tolerance • if diagnosis mode is valid • if program is write-protected

To check the details of the data, place the cursor on the desired line and press the F3 [DETAIL] key. The
detailed status screen for the corresponding data is displayed. To return to the original screen, press the F3
[RETURN] key.

```
┌─────────────────────────────────────────────────┐
│ STATUS Servogun                                 _│
│  PROG TOUCHUP STAT / EQ:1 Gun:1           1/17   │
│     1  No.:                            1         │
│     2  Program name:                             │
│                                   SPOT_WELD       │
│     3  Program line:                   6         │
│     4  Max detect dist range(mm):     4.50       │
│     5  Detection distance(mm):        2.10 OK     │
│     6  Specified thickness(mm):       2.00       │
│     7  Observed thickness(mm):        1.83 OK     │
│     8  Max allowable pos err(mm):     2.00       │
│     9  Min allowable pos err(mm):     0.00       │
│    10  Position status:            Updated       │
│    11  Distance from OldPos to NewPos:           │
│    12    Magnitude(mm):               0.20 OK     │
│    13    Direction:             Robot Close       │
│    14    Position error offset        0.00       │
│    15  Number of retry:                0         │
│    16  Date:                     2012/01/01       │
│    17  Time:                     12:00:00         │
│                                                   │
│                                                   │
│  [ TYME ]              RETURN                     │
└─────────────────────────────────────────────────┘
```

ITEM	DESCRIPTION
Program name	Name of program where spot program touchup was performed.
Program line	Line number of program where spot program touchup was performed.
Max detect dist range(mm)	This item is max detection distance range. Refer to Chapter "21.5 MAX DETECTION DISTANCE RANGE" for more information about this item.
Detection distance (mm)	This item is a result of the upper panel detection. OK: Upper panel detection success NG: Upper panel detection failure **: No panel upper surface detection has been conducted. When this item is NG or **, thickness check and touchup are skipped. Refer to "Upper panel detection fails" in chapter "21.23 TROUBLESHOOTING".
Specified thickness(mm)	This is the specified panel thickness in pressure schedule that is assigned to the spot line number.
Observed thickness(mm)	This item is the observed thickness. OK: The error margin of the specified thickness and the observed thickness is within tolerance value. NG: The error margin of the specified thickness and the observed thickness is outside tolerance value. **: No thickness check has been conducted. When this item is NG or **, touchup is skipped. Confirm the specified thickness in the pressure schedule and the under/over thickness tolerance in the setup screen.
Max allowable pos err(mm)	This is the tolerance for max position error. Check the setting screen.
Min allowable pos err (mm)	This is the tolerance for min position error. Check the setting screen.
PosStat	This items specifies whether position data was modified or not Updated: The position has been modified. The position data is taught with the detected position. NOT updated: Position has NOT been modified. The position data is left unchanged from the data as of before execution.
Magnitude (mm)	This item is the magnitude of the calculated position error correction. OK: The position error correction is within tolerance value. NG: The position error correction is outside tolerance value. **: No calculation of position error correction has been conducted. When this item is NG or **, touchup is skipped. Confirm max/min position err correct in the setup screen.
Direction	Robot Close: The direction of position error correction is the robot close direction. Robot Open: The direction of position error correction is the robot open direction.

	**: Attempted position error correction calculation
Position error offset(mm)	This item is an offset added to position error correction. Check this item via the position error offset on the setting screen or SPTCH_OFS instruction.
Number of retry	This item is number of retries for upper panel detection.
Date	This item indicates date when spot program touchup was performed.
Time	This item indicates time when spot program touchup was performed.

Data for a single line can be deleted cursor by moving cursor to desired line and pushing F5 CLEAR.
Data for all lines can be deleted by pushing F4 ALL_CLR.

> ⚠️**WARNING**
>   Deleted data cannot be restored (recovered).

Countermeasures:

If touchup fails, it is possible to identify its cause from the List and Detail screen. Causes of failure include error in tolerance value setting and detection of foreign objects. This section explains how to counter the cause. If the remedies explained in this section cannot solve the problem, there is a possibility of erroneous detection. If this is the case, refer to "21.23 TROUBLESHOOTING."

CAUSE	REMEDY

List
   Det NG
Detail
   Max detect dist. range
      < Detection distance
 	
Detected upper panel surface is out of range of allowable position.
	Max detect dist. range indicates the tolerable range of the distance between the taught point and the panel upper surface. This is calculated by following parameters.
	   Max detect dist range(mm)
	     = Specified thickness + Over thickness tolerance
	       + Max allowable position error + Detection distance margin
	
	Detection distance is a distance between weld point before touchup and detected upper panel surface. If a result is correct, this is calculated as follows.
	   Detection distance (mm)
	     = Touchup error before this function + Observed thickness
	     NOTE: The touchup error in the robot tip closing direction is positive. If a touchup error is positive, a clearance exists between the robot tip and panel at the touchup position before modification.
	
	If the result of detection is correct, confirm the settings of tolerances.
	If the result of detection is abnormally large, check whether there is any foreign object or protrusion on the weld point. If there is any problem, remove it, or move the robot along the X and Y directions to avoid it.

List
   Thk NG
Detail
   Observed thickness > Specified thickness + Over thickness tolerance
   OR
   Observed thickness < Specified thickness - Under thickness tolerance
 	
Thickness error is out of range of tolerances.
	If the measured thickness is correct, confirm that the specified thickness in the pressure schedule is properly set. If there is no problem, set a value larger than the upper thickness tolerance or a value smaller than the lower thickness tolerance to this item
	
	If the measured thickness is wrong, check whether there is any foreign object or any abnormality in panel assembly. If there is any problem, remove it or move the robot along the X and Y directions to avoid it.

CAUSE	REMEDY

List
   Pos NG
Detail
   |Position error correction|
     >Max allowable pos err
   OR
   |Position error correction|
     < Min allowable pos err
 	
Position error correction is out of range.
	Where position error correction is larger than max allowable pos err;
	   If the position error correction is correct, perform touchup using the gun teaching function or manually, or set a large value to Max allowable pos err.
	
	   If the position error correction is wrong, check whether something is wrong with the weld point.
	
	Where position error correction is smaller than min allowable pos err;
	   If the position error correction is correct, set a small value to Min allowable pos err. If it is set to 0.0 mm, detection does not fail because the correction amount is small.
	
	If a value is set to Position error offset, confirm whether the value is proper. If it is not proper, revise the value of SPTCH_OFS instruction.
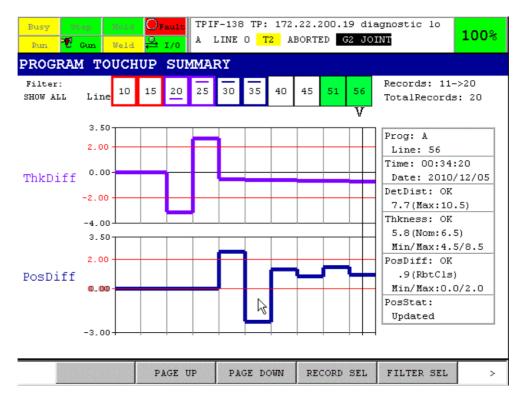
21.11 SPOT PROGRAM TOUCHUP CHART SCREEN

On the status screen, the touchup result records can be displayed as a chart.
Display the spot program touchup chart screen by following the procedures:
1   Press the [MENU] key to display the Screen menu.
2   Select [0 --NEXT-] and then [4 STATUS].
3   Press F1 [TYPE] key and select "Servo Gun."
4   On the STATUS Servogun screen, select Program touchup chart <*DETAIL*>.
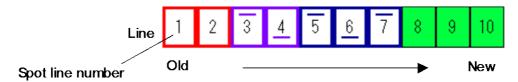
The spot program touchup chart can be used for understanding and diagnosing uniform panel displacement.

Summary:

- The screen can display up to 10 records per page.
- The record display range is indicated at the upper right corner of the screen.
- The most recent record data are displayed first when this screen is displayed.
- Records are shown in chronological order, from left to right.
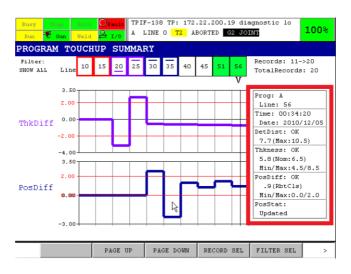
- The chart displays the measured thickness and calculated touchup amount. (Refer to (1).)
- Detailed information of the currently selected line (line with V) is displayed on the right side of the screen. (Refer to (2).)

Operation procedure:

Key	Function
F2 [Page -] /UP arrow	Displays the previous page (old record data).
F3 [Page +] /DOWN arrow	Displays the next page (present record data).
Shift + F2 [Page -] / Shift + UP arrow	Displays the first page (oldest record data).
Shift + F3 [Page +] / Shift + DOWN arrow	Displays the last page (newest record data).
F4 [selection of detail]	Selects V (line displaying detailed information).
F5 [selection of filter]	Selects filter.
F7 [evaluation function]	Configures setting of spot program touchup evaluation function.
RT arrow	Moves V (line displaying detailed information) rightward.
LF arrow	Moves V (line displaying detailed information) leftward.
Shift + RT arrow	Moves V (line displaying detailed information) to the right corner.
Shift + LF arrow	Moves V (line displaying detailed information) to the left corner.
Enter key	Additionally displays the following tolerance values: Upper thickness tolerance Lower thickness tolerance Max allowable position err. Min allowable position err.
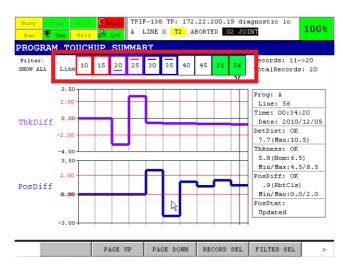
Information panel:

Template	Description / comment
Records: # -> #	This indicates the range of record data that are currently displayed.
TotalRecords	This is total of the record.
V	Currently selected record number. The detailed information of the line number selected here is displayed.
Prog: #	Name of program where spot program touchup was performed.
Line: #	Line number of program where spot program touchup was performed.
Time: #	This item indicates time when spot program touchup was performed.
Date: #	This item indicates date when spot program touchup was performed.
DetDist: #	OK: Upper panel detection success NG: Upper panel detection failure When this item is NG, thickness check and touchup are skipped. Refer to "Upper panel detection fails" in chapter "21.23 TROUBLESHOOTING".
# (Max: #)	This indicates the result of panel upper surface detection and panel upper surface detection range. Result of panel upper surface detection (Max: panel upper surface detection range) Refer to Chapter "21.5 MAX DETECTION DISTANCE RANGE" for more information about the max detection distance range.
Thickdiff: #	Thickdiff = measured thickness − specified thickness OK:: The error margin of the specified thickness and the observed thickness is within tolerance value. NG: The error margin of the specified thickness and the observed thickness is outside tolerance value. When this item is NG, touchup is skipped. Confirm the specified thickness in the pressure schedule and the under/over thickness tolerance in the setup screen.
# (Nom: #)	This indicates the measured thickness value and specified thickness value. Measured thickness (Nom: specified thickness)
Min/Max: #/#	Nominal thickness – Under thickness tolerance / Nominal thickness + Over thickness tolerance
Posdiff: #	Posdiff (touchup amount) = position after correction – position before correction OK: The position error correction is within tolerance value. NG: The position error correction is outside tolerance value. When this item is NG, touchup is skipped. Confirm max/min position err correct in the setup screen.
# (#)	This indicates the calculated touchup amount and touchup direction. Touchup amount (robot open direction/robot close direction) Robot close direction: direction in which robot moves toward panel Robot open direction: direction in which robot moves away from panel
Min/Max: #/#	Min position error correction / Max position error correction
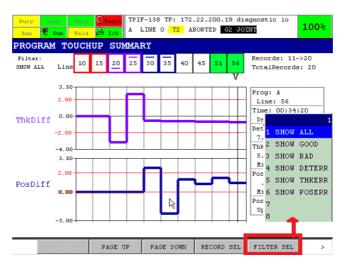
Template	Description / comment
PosStat	OK (close direction): Touch up succeeded. Touchup direction is direction in which robot tip moves toward panel. OK (open direction): Touch up succeeded. Touchup direction is direction in which robot tip moves away from panel. NG (detection result): Failed to detect panel upper surface. NG (thickness error): The error between specified thickness value and measured thickness value is the out of thickness tolerance value. NG (position error): Calculated touchup amount is out of touchup amount tolerance value. If this item is NG, touchup has not succeeded.

Symbols:
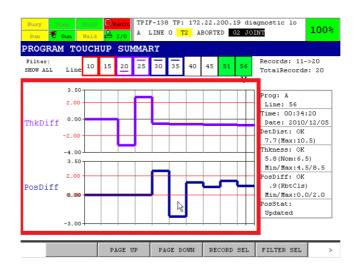
Symbol	Meaning
1 Red-framed	Failed to detect panel upper surface. Refer to "Upper panel detection fails" in chapter "21.23 TROUBLESHOOTING".
1 1 Purple -framed	The error between the specified thickness value and measured thickness value is the out of thickness value tolerance value. Line above number: The error margin of the specified thickness and the observed thickness is outside over tolerance value. Line below number: The error margin of the specified thickness and the observed thickness is outside under tolerance value.
1 1 Blue -framed	Calculated touchup amount was out of touchup amount tolerance value. Line above number: Position error correction is larger than Max position error correction. Line below number: Position error correction is smaller than Min position error correction.
1 Bright green	Successful panel detection. Position data has been corrected.
1 White	Successful panel detection. However, position data has not been corrected. The diagnosis mode or spot program touchup evaluation function is effective.

F5: FILTER SEL (data selection):
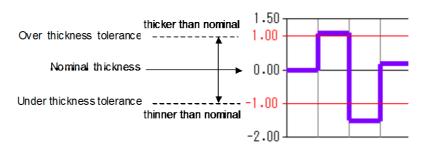
FILTER SEL	Description
SHOW ALL	Shows all the record data.
SHOW GOOD	Shows only the record data whose touchup status in the detailed information is OK.
SHOW BAD	Shows only the record data whose touchup status in the detailed information is NG.
SHOW DETERR	Shows only the record data whose detection result in the detailed information is NG.
SHOW THKERR	Shows only the record data whose thickness error in the detailed information is NG.
SHOW POSERR	Shows only the record data whose position error in the detailed information is NG.

Chart:

ThkDiff (thickness error)
Thickness error = measured thickness − specified thickness
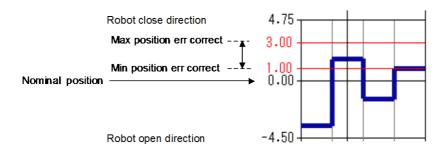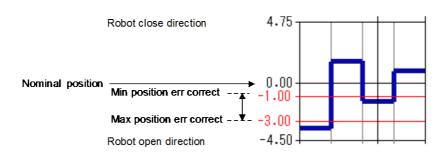
PosDiff (position criteria)
Position correction amount = Position after correction − Position before correction
- Posdiff > 0

- Posdiff < 0

Spot program touchup evaluation function (F7 [EVAL TOL])
The spot program touchup function has the diagnostic mode. The diagnostic mode is a function to measure the thickness error and position error between the previous panel and the current panel without using touchup. To use the diagnosis mode, set Min allowable position err greater than Max allowable position err in advance and set a great value to upper thickness tolerance, and then execute the spot program touchup function. To evaluate the thickness error and position error obtained in the diagnosis mode, use the spot program touchup evaluation function.
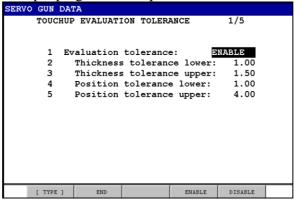
When the spot program touchup evaluation function is enabled, the following occur:
- Symbols are displayed based on the measured value and evaluation value.
- Evaluation values are displayed in pink on the chart.
- When the spot program touchup evaluation function is enabled, "EvalTol active" is displayed at the bottom of the screen.
- The detection result and touchup status in the detailed information are not displayed.
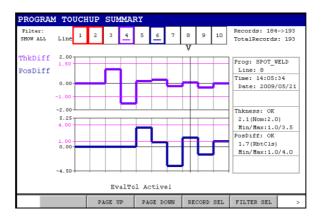
-249-

> ⚠️ **CAUTION**
> When the detection of panel upper surface fails, the thickness error and touchup in the detailed information are displayed as "**." If the measured thickness value is out of the thickness error evaluation value range, the touchup is displayed as "**."

To display the setting screen for spot program touchup evaluation function, select F7 [EVAL TOL].

```
SERVO GUN DATA
          TOUCHUP EVALUATION TOLERANCE        1/5


          1   Evaluation tolerance:      ENABLE
          2     Thickness tolerance lower:   1.00
          3     Thickness tolerance upper:   1.50
          4     Position tolerance lower:    1.00
          5     Position tolerance upper:    4.00







          [ TYPE ]      END              ENABLE    DISABLE
```

```
PROGRAM TOUCHUP SUMMARY
Filter:          1  2  3  4  5  6  7  8  9  10    Records: 184->193
SHOW ALL   Line                                  TotalRecords: 193
                                        V
ThkDiff   2.00                                   Prog: SPOT_WELD
          1.50                                      Line: 8
PosDiff                                          Time: 14:05:34
          0.00                                      Date: 2009/05/21

         -1.00

         -2.00                                   Thkness: OK
          5.25                                      2.1(Nom:2.0)
          4.00                                      Min/Max:1.0/3.5
                                                 PosDiff: OK
          1.00                                       1.7(RbtCls)
          0.00                                      Min/Max:1.0/4.0


         -4.50
                    EvalTol Active!

              PAGE UP   PAGE DOWN   RECORD SEL   FILTER SEL      >
```

Parameter	Comment
Evaluation function	Enable or disable the spot program touchup evaluation function.
Thickness error − lower limit evaluation value	Specify the evaluation value of the measured thickness value and specified thickness value when the measured thickness value is smaller than the specified thickness value. For example, if thickness tolerance lower is 0.5 mm, OK : specified thickness = 2.0 mm, measured thickness = 1.8 mm NG : specified thickness = 2.0 mm, measured thickness = 1.4 mm
Thickness error − upper limit evaluation value	Specify the evaluation value of the measured thickness value and specified thickness value when the measured thickness value is greater than the specified thickness value. For example, if thickness tolerance upper is 0.5 mm, OK : specified thickness = 2.0 mm, measured thickness = 2.3 mm NG : specified thickness = 2.0 mm, measured thickness = 2.6 mm
Touchup error − lower limit evaluation value	Specify the lower limit evaluation value of the measured touchup amount. For example, if position tolerance lower is 0.5 mm, OK : 0.5 < absolute value of position error NG : 0.5 > absolute value of position error
Touchup error − upper limit evaluation value	Specify the upper limit evaluation value of the measured touchup amount. For example, if position tolerance upper is 0.5 mm, OK : 0.5 > absolute value of position error NG : 0.5 < absolute value of position error

21.12   TOUCHUP STATUS RECORDING FUNCTION

The touchup status recording function automatically records the data (touchup status) at the time of the execution of the spot program touchup to the status recording file. The data recorded in the LS file are the following.

Parameter	Comment
No.	This is a data number. The greater this value, the newer the data.
Date	This item indicates date when spot program touchup was performed.
Gun	This is the number of the gun for which spot program touchup has been executed.
Program name	Name of program where spot program touchup was performed.
Line number	Line number of program where spot program touchup was performed.
Position ID	Position ID of program where spot program touchup was performed.
Comment	This is the comment appended to the above position ID.
Position error[mm]	This item is position error correction. When this value is positive, the direction of position error correction is the robot close direction. When this value is negative, the direction of position error correction is the robot open direction.
OK/NG/**	OK: The position error correction is within tolerance value. NG: The position error correction is outside tolerance value. **: No position error correction calculation has been conducted.
Max pos err[mm]	This item is the max position error correction tolerance value.
Detection distance[mm]	This item is a result of the upper panel detection.
OK/NG/**	OK: Upper panel detection success NG: Upper panel detection failure **: No panel upper surface detection has been conducted.
Max detect dist[mm]	This item is max detection distance range. Refer to Chapter "21.5 MAX DETECTION DISTANCE RANGE" for more information about this item.
Thickness value[mm]	This item is the observed thickness.
OK/NG/**	OK: The error margin of the specified thickness and the observed thickness is within tolerance value. NG: The error margin of the specified thickness and the observed thickness is outside tolerance value. **: No thickness check (thickness measurement) has been conducted.
Thickness error[mm]	This item is the error between the specified thickness value and the measured thickness value.
Under thick err[mm]	This item is under thickness tolerance.
Over thick err[mm]	This item is over thickness tolerance.
Nominal Thickness[mm]	This item is the specified thickness value within the pressure schedule that is assigned to the spot line number.
Min pos err[mm]	This item is the min position error correction.
Number of retries	Number of retry attempts (after failure) for this point
Point modification status	0: Point has not gone through teaching and correction. 1: Point has gone through teaching and correction.

Two LS files are prepared per equipment. The name of two LS files is the following.
- ~SGOFSET1#.LS   (#:equipment number)
- ~SGOFSET2#.LS   (#:equipment number)

These are text files, with csv format.
100 data is recorded in each LS file in the maximum.

~SGOFSET1#.LS   ~SGOFSET2#.LS

No.		No.
1		101
2		102
3		103
…		…
100		200

When the total number of data exceeds 200, ~SGOFSET2#.LS will be overwritten with ~SGOFSET1#.LS, and then the latest data will be recorded to ~SGOFSET2#.LS.

~SGOFSET1#.LS   ~SGOFSET2#.LS

No.		No.
101		201
102		
103		
…		
200		
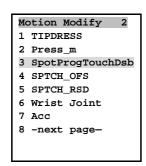
The LS files are saved to the specified recording medium through the batch save operation on the file screen.

21.13   SPOT PROGRAM TOUCHUP DISABLE INSTRUCTION

If a spot instruction is executed with program touchup mode enabled, spot program touchup will execute. However, there may be some cases where automatic touchup is undesirable. For example, in works in a complicated environment, there may be cases in which the robot or gun interferes with a portion of the panel or the surrounding device in the panel upper surface detection or cases in which spot program touchup cannot be conducted at a high accuracy due to insufficient fixing of the panel. In such a case, program touchup mode needs to be kept enabled, but it should be disabled only when a specific spot instruction is executed.
To achieve this condition, the spot touchup disabling instruction is available. If this instruction is added to a spot instruction, only when this spot instruction is executed can the program touchup mode be temporarily disabled. Note that this instruction is effective only when it is added to a spot instruction with an action sentence.
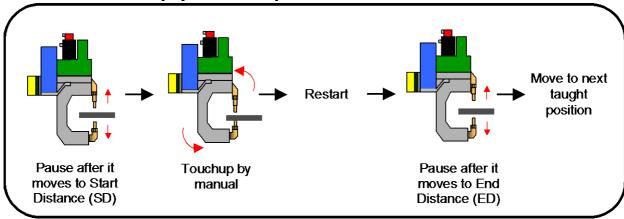
To teach the spot program touchup disable instruction, place the cursor behind the spot motion instruction and press the F4 CHOICE key to display the supplementary motion instruction menu. Select a SpotProgTouchDsb from the menu.

```
Motion Modify    2        SAMPLE                    _  _
1 TIPDRESS                                             5/6
2 Press_m                     4: L P[1] 2000mm/sec CNT50
3 SpotProgTouchDsb               SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
4 SPTCH_OFS                   5: L P[2] 2000mm/sec CNT50
5 SPTCH_RSD                      SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
6 Wrist Joint                    SpotProgTouch_Dsb
7 Acc                        6: L P[3] 2000mm/sec CNT50
8 -next page-                    SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
                             [END]
```
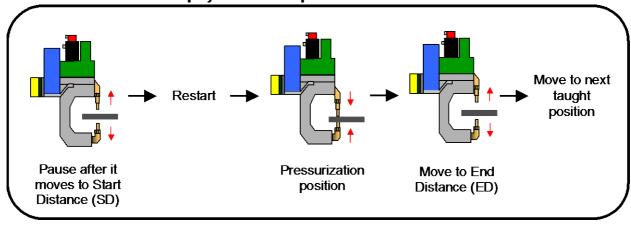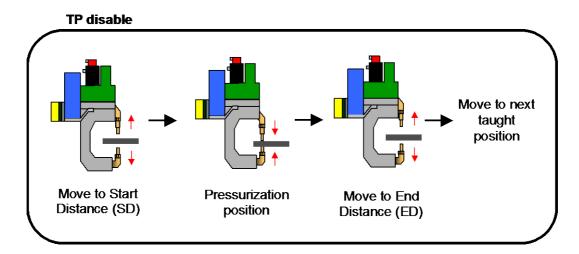
When the program above executes, the following sequence executes for line 5.

TP enable: Touchup by manual after pause

Pause after it moves to Start Distance (SD) → Touchup by manual → Restart → Pause after it moves to End Distance (ED) → Move to next taught position

TP enable: Not touchup by manual after pause

Pause after it moves to Start Distance (SD) → Restart → Pressurization position → Move to End Distance (ED) → Move to next taught position

TP disable

Move to Start Distance (SD)   Pressurization position   Move to End Distance (ED)   Move to next taught position

When this instruction is executed with the TP enabled, robot pauses at start distance. Perform touchup if necessary, manually.

When this instruction is executed with the TP disabled, robot does not pause at the start distance. However, when SpotProgTouch_Dsb pause Sev on setup screen is specified as alarm, robot pauses at the start distance. Do the touchup if necessary by manual.

Moreover, when the robot temporarily stops, the prompt message "Paused by Spot Prog Touch Dsb" indicating that this instruction has been executed is displayed on the screen for about one second.

⚠ **CAUTION**
- Spot program touchup disable should only be attached to spot instructions. Do not attach it to other application instructions.
- Spot program touchup disable instruction is useful only when program touchup mode is enabled.
- Add spot program touchup disable instruction to end of spot instruction.

21.14 SPTCH_OFS INSTRUCTION

In touchup, the offset amount that is specified in the touchup offset on the setting screen is inevitably added to the touchup amount. If SPTCH_OFS instruction is appended to a spot instruction, only when this spot instruction is executed can the touchup offset be temporarily changed with the value specified by this instruction.

To teach SPTCH_OFS instruction, place the cursor behind the spot motion instruction and press the F4 CHOICE key to display the supplementary motion instruction menu. Select a SPTCH_OFS from the menu. SPTCH_OFS can use the following two methods.
- Direct specification: A numerical value is directly specified.
- Indirect specification: The value of register [i] is set.

The input range of SPTCH_OFS is -2.0mm <= SPTCH_OFS <= 2.0mm.

```
Motion Modify   2        SAMPLE                           _  _
1 TIPDRESS                                                 5/6
2 Press_m                     4: L P[1] 2000mm/sec CNT50
3 SpotProgTouchDsb               SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
4 SPTCH_OFS                   5: L P[2] 2000mm/sec CNT50
5 SPTCH_RSD                      SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
6 Wrist Joint                    SPTCH_OFS = -1.1mm
7 Acc                         6: L P[3] 2000mm/sec CNT50
8 -next page-                    SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
                              [END]
```

When the above program is executed, in the 5th line, an offset amount of −1.1 mm is added to the touchup amount. In other lines, the offset specified by position error offset in setup screen is added to position error correction.

> ⚠ **CAUTION**
> The SPTCH_OFS instruction works only when program touchup mode is enabled.

21.15   SPTCH_RSD INSTRUCTION

When Low pnl detect dist Enb/Dsb on setup screen is enabled, lower panel detection distance on setup screen is used for the movement distance in the lower direction of gun at the upper panel detection. If SPTCH_RSD instruction is added to the spot instruction, only when this spot instruction is executed can the panel lower surface detection distance function be temporarily enabled or can the panel lower surface detection distance be changed with the value specified by this instruction.
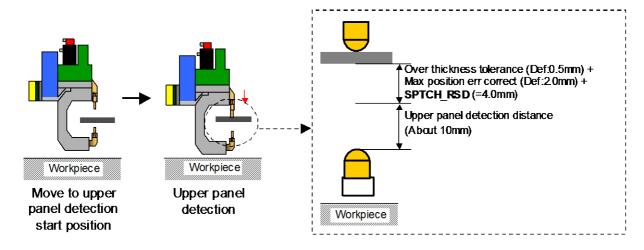
To teach SPTCH_RSD instruction, place the cursor behind the spot motion instruction and press the F4 CHOICE key to display the supplementary motion instruction menu. Select a SPTCH_RSD from the menu. SPTCH_RSD can use the following two methods.
- Direct specification: A numerical value is directly specified.
- Indirect specification: The value of register [i] is set.
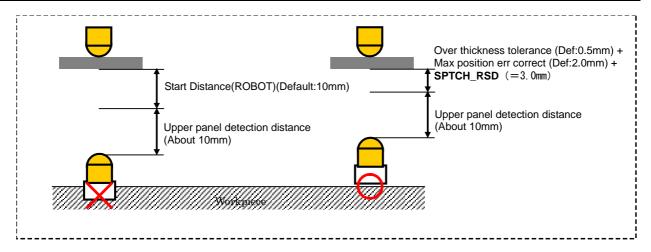
The input range of SPTCH_RSD is 0.0 mm <= SPTCH_RSD <= 20.0 mm.

```
Motion Modify   2        SAMPLE                              _  _
1 TIPDRESS                                                   5/6
2 Press_m                      4: L P[1] 2000mm/sec CNT50
3 SpotProgTouchDsb                SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
4 SPTCH_OFS                    5: L P[2] 2000mm/sec CNT50
5 SPTCH_RSD                       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
6 Wrist Joint                     SPTCH_RSD = 4.0mm
7 Acc                          6: L P[3] 2000mm/sec CNT50
8 -next page-                     SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
                              [END]
```

When the above program is executed, the gun movement amount in panel upper surface detection specified in the 5th line is as follows:

When a weld point does not allow a sufficient detection distance in the robot tip opening direction, this instruction prevents the servo gun from colliding with a surrounding device during detection motion.

Over thickness tolerance (Def:0.5mm) +
Max position err correct (Def:2.0mm) +
SPTCH_RSD (=3.0mm)

Upper panel detection distance
(About 10mm)

Start Distance(ROBOT)(Default:10mm)

Upper panel detection distance
(About 10mm)

Workpiece
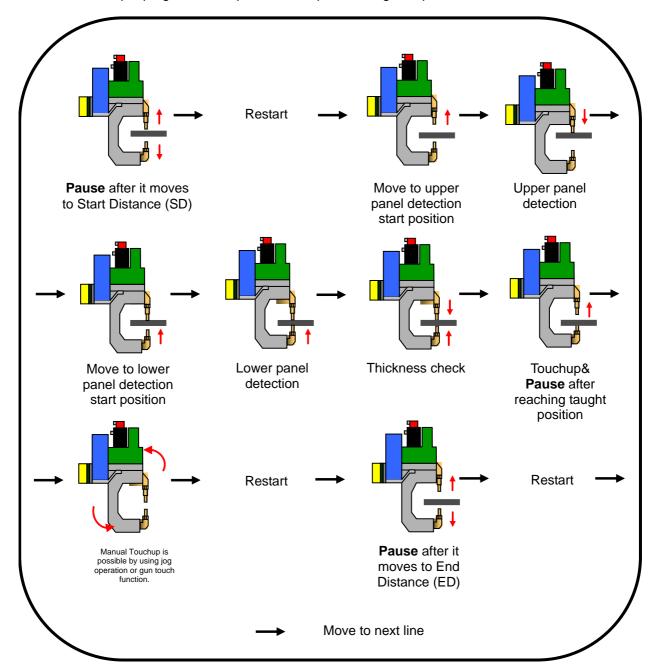
⚠ **CAUTION**
    SPTCH_RSD instruction is effective only when the program touchup mode is
    enabled.

21.16   SINGLE STEP MODE

When spot program touchup is executed with single step enabled, the following sequence executes.

Spot program touchup function sequence: Single step mode

Pause after it moves to Start Distance (SD)

Restart

Move to upper panel detection start position

Upper panel detection

Move to lower panel detection start position

Lower panel detection

Thickness check

Touchup&
Pause after reaching taught position

Manual Touchup is possible by using jog operation or gun touch function.

Restart

Pause after it moves to End Distance (ED)

Restart

Move to next line

If a spot program touchup is executed with the single step enabled, the sequence inevitably performs a temporary stop at the start position (SD), position after correction, and end position (ED). Perform touchup as necessary using the jog operation or gun teaching function. In the program touchup mode, the above action is executed regardless of the enable/disable setting of "Pressure Motion" and "Stop @ Taught Pos" for "Servo Gun Motion in Single Step."

21.17 OTHER SPECIFICATIONS

Backward Discharge (BWD)

Spot program touchup does not execute at BWD execution. Therefore, the robot and gun do the same motion as motion of BWD execution of the spot instruction.

Pause

If a temporary stop is executed during panel upper surface detection, the operation resumes by moving again to the panel upper surface detection start position and then starting the panel upper surface detection. If a temporary stop is executed during panel lower surface detection, the operation resumes by moving again to the panel lower surface detection start position (location where gun tip is positioned on the panel upper surface) and then continues the panel lower surface detection.

Jog

The robot restarts spot program touchup from the start distance at next restart when the robot and the gun are jogged while spot program touchup is being executed.

Touchup

If touchup is performed using the manual/gun teaching function during execution of spot program touchup, the spot program touchup is canceled halfway. At the next restart, the robot resumes operation from the end position.

In addition, during execution of spot program touchup, the gun teaching function is disabled until the robot reaches the position after correction. After the robot has reached the position as of after correction, the gun touch function is enabled.

Resumption from other line

If the robot is temporarily stopped by pressing the hold key or by other means during the execution of spot program touchup and then program is restarted from a line different from the line where temporary stop was executed, the spot program touchup is canceled halfway. If the next spot instruction is executed, however, a spot program touchup is executed.

Dual gun

When the dual gun is assigned, the gun to execute touchup operation is determined based on the presence/absence of welding condition that is specified in the spot instruction. In the standard stetting, gun A performs teaching and touchup actions unless the welding conditions for gun B are not set. The following parameter specifies the gun to execute teaching and touchup.
$SGSYSTCH.$DGIDXSELOPT
1: Always use gun A for teaching and touchup.
2: Always use gun B for teaching and touchup.
3: Use gun A for teaching and touchup unless the welding conditions for gun B are set (standard setting).
When S = (1,1) or S = (1,0), gun A is used for teaching and touchup.
When S = (0,1), gun B is used for teaching and touchup.
In addition, in standard setting, the teaching position (recorded opening amount) of the gun that does not perform teaching and touchup is same as that of the gun that has performed teaching and touchup.
$SGSYSTCH.$DGPOSRECOPT
0×1 = ON: The teaching positions for both guns are the same (standard setting).
Others: The teaching position of the gun that does not perform teaching and touchup is the current open distance.

21.18   SPOT POINT TOUCHUP FUNCTION

21.18.1   Function overview
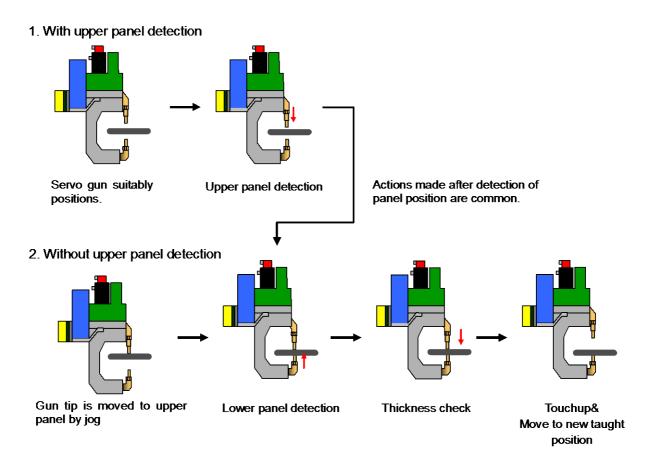
The gun teaching function supports the following teaching methods in addition to the conventional manual teaching method through jog operation.

1.   Gun teach touchup with automatic search

By this method, the panel position is detected by the automatic search, and the robot automatic teaching is performed based on the detected panel position.

2.   Gun teach touchup without automatic search

By this method, after the gun tip is positioned to the panel upper surface by jogging operation, automatic robot teaching is performed based on the position of the gun tip.

To use this function, the following option is required.

Servogun option	A05B-2***-J643

On 7DC1 software, this function for Standard Setting user that order A05B-2***-R651 needs the following option:

Servo gun setup package	A05B-2***-J979

> ⚠ **WARNING**
> The touchup accuracy depends on the servo gun structure and panel clamping condition.
> The gun teaching function may not be performed with a high accuracy in the following cases:
> - When a large size X gun or gun with a great friction resistance at the driving part is used
> - When a panel is not sufficiently fixed, largely deflected by a small force, or changes position
> - When an equalizing mechanism or a floating mechanism is equipped on the gun and the gun operates when the tip makes contact with a panel

> ⚠ **CAUTION**
> PR[90] is the default position register for robot motion during the spot program touchup motion sequence. Don't use this PR for another purpose. The register number of this PR can be changed on the setup screen (Refer to Chapter "21.4 SPOT PROGRAM TOUCHUP FUNCTION SETUP".).

21.18.2 Preparation before teaching

To use the gun teaching function, the following works must be completed.
- Autotuning
- Pressure calibration
- Setting the tool coordinate system
- Tip wear standard
- Enabling of press motion (even when execution of thickness check in the gun teach setting is disabled, press motion can be executed even when it is disabled.)

The following works must be conducted before executing the gun teaching function.
- Tip wear measurement
- Thickness check calibration

Thickness check calibration can also be executed from TP program. Please refer to Chapter "21.20 THICKNESS CHECK CALIBRATION".
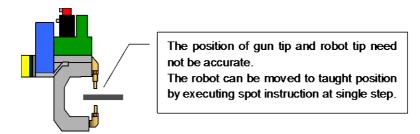
> ⚠ **CAUTION**
> To use this function, the TCP for gun mastering and robot tip must be in a correct condition.
> Be sure to measure the tip wear, and make the wear amount on the gun tip and robot tip appropriate.
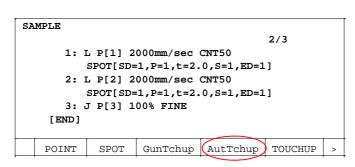
21.18.3 Operating Procedure for Gun Teaching with Automatic Search Function
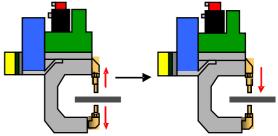
To perform gun teaching with an automatic search function, follow the procedures below:

1   Move the robot to a suitable position near a teaching target welding point.

The position of gun tip and robot tip need not be accurate.
The robot can be moved to taught position by executing spot instruction at single step.

2   Move the cursor to the spot instruction that requires position correction (add a spot instruction to the TP program, if no spot instructions exist). The position at this time need not be accurate.

3   Press the [SHIFT] key & F4"AutTchup" to start the upper panel detection. In the following operations, the robot and the servo gun work. **Perform the following operation while pressing the [SHIFT] key.**

```
SAMPLE
                                2/3
     1: L P[1] 2000mm/sec CNT50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     2: L P[2] 2000mm/sec CNT50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     3: J P[3] 100% FINE
   [END]

   POINT  |  SPOT  | GunTchup | AutTchup | TOUCHUP |  >
```
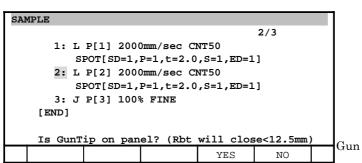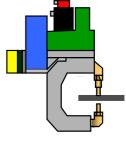

First, the robot and the gun axis move away from the panel. Second, the gun axis moves. Third, the robot moves for search.

⚠ **WARNING**
   During gun teaching, the servo gun and robot move at a low constant speed regardless of the override.

---

4.   The gun tip stops at the detected position after detecting upper panel. And, the following prompt is displayed.

```
SAMPLE
                                2/3
     1: L P[1] 2000mm/sec CNT50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     2: L P[2] 2000mm/sec CNT50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     3: J P[3] 100% FINE
   [END]

   Is GunTip on panel? (Rbt will close<12.5mm)
                          |      | YES  | NO   |
```


Gun tip stops on upper panel.
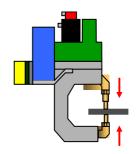
> ⚠️**CAUTION**
> The movement amount of the robot shown in the prompt message is the maximum movement amount of the robot action for positioning the robot tip to the panel lower surface position in the next procedure. This corresponds to the distance between the robot tip and the panel lower surface.
> When there is a foreign object on the panel lower surface or the panel thickness or shape differs from the assumption, the robot stops moving before the end of the distance.

Press F4"YES" when there is no problem with the position of the gun tip. Go to procedure 5.
Press F5"NO" when there is any problem with the position of the gun tip. Teaching operation is canceled.
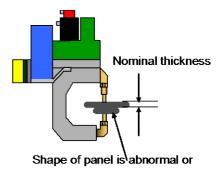
5. The robot operates so that the robot tip is positioned at the panel lower surface.

```
SAMPLE
                                    2/3
    1: L P[1] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    2: L P[2] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    3: J P[3] 100% FINE
   [END]

      Closing both tips…
```

The gun and robot operate so that the both tips clamp the panel.

In this procedure, the thickness is measured in a simple manner when the panel is clamped by both tips. If the error between the measured thickness and the specified thickness exceeds Allowable Thk Err to NOT Confirm as a result of the simplified measurement, a prompt as shown below is displayed. When the thickness error is smaller than that, the prompt is not displayed. Go to procedure 6.
Refer to Chapter 21.9 "THICKNESS UPDATE SETUP" for more information on this.

```
SAMPLE
                                    2/3
    1: L P[1] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    2: L P[2] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    3: J P[3] 100% FINE
   [END]

      Check thickness on this robot tip pos?
                              YES     NO
```

Nominal thickness

Shape of panel is abnormal or there is obstacle on the lower panel

Confirm that the robot tip is correctly positioned on the panel lower surface.
To continue teaching, press F4"YES." Go to procedure 6, and conduct thickness measurement and touchup with reference to the current robot tip position.
Press F5"NO" when you do not want to continue spot point touchup. Spot point touchup is canceled.

> ⚠️**CAUTION**
> If the error between the measured thickness and specified thickness exceeds the Allowable Thk Err to NOT Confirm as a result of the simplified measurement, a prompt as shown above is displayed to prompt you to confirm the search result. Refer to Chapter 21.9 "THICKNESS UPDATE SETUP" for more information about this.
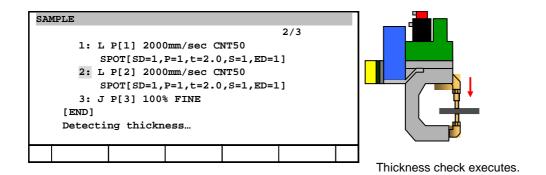
> ⚠️**CAUTION**
> The robot tip moves to the panel lower surface based on the specified thickness when "Execute Thickness check" on the setup screen is disabled. If the specified thickness is thicker than the actual thickness, a clearance will be made between the robot tip and the panel lower surface.

6.   Measure the thickness by clamping the panel.

> ⚠️**CAUTION**
> This step does not execute when "Execute Thickness check" is disabled on the setup screen. Go to procedure 8.

```
SAMPLE
                                    2/3
     1: L P[1] 2000mm/sec CNT50
        SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     2: L P[2] 2000mm/sec CNT50
        SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     3: J P[3] 100% FINE
     [END]
     Detecting thickness…

```

Thickness check executes.

If the result of thickness measurement is equal to or smaller than the Allowable Thk Err to NOT Confirm, go to procedure 7.
If the result of thickness measurement is greater than the Allowable Thk Err to NOT Confirm, the prompt as shown below is displayed.
Refer to Chapter 21.9 "THICKNESS UPDATE SETUP" for more information on this.

```
SAMPLE                                  _   _  _
                                    2/3
     1: L P[1] 2000mm/sec CNT50
        SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     2: L P[2] 2000mm/sec CNT50
        SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     3: J P[3] 100% FINE
     [END]
     Update thickness: 2.0 to 1.0?

                              YES    NO
```
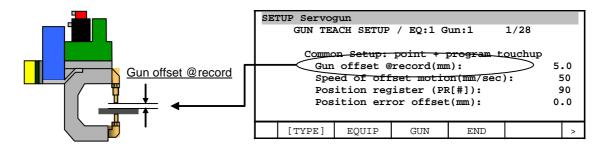
Press F4 YES, the thickness is updated and the touchup process is continued.
Press F5 NO, it is not update and the touchup process is continued. Then the prompt for confirming touchup as shown below is displayed.

```
SAMPLE                                    _  _  _
                                            2/3
      1: L P[1] 2000mm/sec ﾅﾒﾗｶ 50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
      2: L P[2] 2000mm/sec ﾅﾒﾗｶ 50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
      3: J P[3] 100% ｲﾁｷﾞﾒ
      [END]
      Record this position?

                              YES      NO
```

Press F4 [Yes] if the teaching operation can be continued. Then go to procedure 7.
Press F5 [No] if you do not intend to continue the teaching operation. The teaching operation is canceled.

7.   The robot and the servo gun move to the taught position.
     The servo gun moves away from the upper surface position of the measured thickness by the specified distance.


```
SETUP Servogun
   GUN TEACH SETUP / EQ:1 Gun:1      1/28

   Common Setup: point + program touchup
     Gun offset @record(mm):              5.0
     Speed of offset motion(mm/sec):       50
     Position register (PR[#]):            90
     Position error offset(mm):           0.0

    [TYPE]  EQUIP   GUN    END          >
```

⚠ **CAUTION**
  If "Execute Thickness check" is set to DISABLE, the servogun moves away from the upper surface position of the specified thickness by the specified distance.

⚠ **CAUTION**
  If Tip Wear Comp is set to ENABLE, the robot teaching position is compensated by the robot tip wear amount. The teaching position will be the position for new tip (robot tip wear amount = 0 mm).

When the movement to taught position is completed, following warning SVGN-183 is displayed.

SVGN-183 Program Name/Program Line/Correct value/Thickness

```
SVGN-183  SAMPLE/ 2 / 0.5 / 2.0
SAMPLE
                                         2/3
      1: L P[1] 2000mm/sec CNT50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
      2: L P[2] 2000mm/sec CNT50
         SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
      3: J P[3] 100% FINE
      [END]

      Position has been recorded to P[3].
    POINT   SPOT   GunTchup  AutTchup  TOUCHUP  >
```

SVGN-183 displays the information of correction result by gun teaching (program name/program line/corrected value/thickness).
In this example, the teaching position of spot instruction in the second line in SAMPLE.TP was corrected by 0.5 mm, and the result of thickness check was 2.0 mm.
The position and the thickness are updated based on above results. However, if the thickness error is equal to or smaller than the Allowable Thk Err to NOT Confirm or you answered NO at the prompt for thickness update confirmation in procedure 6, the thickness is not updated and only touchup is executed. Refer to Chapter "21.9 THICKNESS UPDATE SETUP" for more information about this.
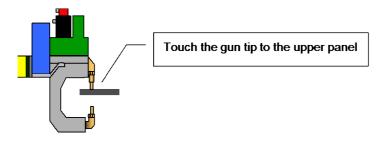
⚠ **CAUTION**
The corrected value displayed on SVGN-183 is the difference in the robot tip moving direction between the previous position data and the revised position data. When the robot tip moving direction is the Z direction, the revision amounts in X and Y directions are not displayed.
When this corrected value is positive, it means that the position has been revised in the direction in which the robot tip moves toward the panel. On the contrary, when this value is negative, it means that the position has been revised in the direction in which the robot tip moves away from the panel.

21.18.4 Operating Procedures for Gun Teaching without Automatic Search

To use the gun teaching function without automatic search, follow the procedures below:
1.   Move the robot, and position the gun tip so that it makes contact with the panel upper surface.

Touch the gun tip to the upper panel

2.   Move the cursor to the spot instruction that requires correction.
     If there is no spot instruction in the program, add a spot instruction. The position at this time need not be accurate.
3.   Pressing SHIFT + F3"GunTchup" displays the following prompt.

```
SAMPLE                                      _   _  _
                                                 2/3
        1: L P[1] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        2: L P[2] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        3: J P[3] 100% FINE
     [END]


     Is GunTip on panel? (Rbt will close<12.5mm)
```

				YES	NO	

⚠️**CAUTION**

The robot movement amount displayed in the prompt is the maximum robot movement amount in positioning of robot tip to the panel lower surface in the next step. It corresponds to the distance between the robot tip and the panel lower surface.
When there is a foreign object on the panel lower surface or its thickness or shape differs from the assumption, the robot stops moving.

Press F4"YES" if the gun tip is correctly positioned on the panel upper surface. The robot moves so that the robot tip is positioned on the panel lower surface. **In the following operations, the robot and the servo gun operate. Keep pressing the [SHIFT] key.**
Press F5"NO" when there is a problem concerning the position of the gun tip. Spot point touchup is canceled.
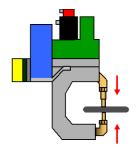
```
SAMPLE
                                      2/3
    1: L P[1] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    2: L P[2] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    3: J P[3] 100% FINE
   [END]

    Closing both tips…

```
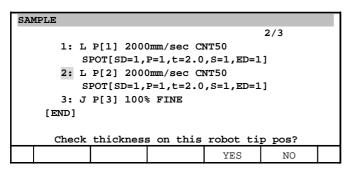
Gun and robot move so that both tips clamp the panel.
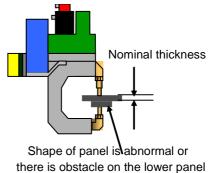
⚠️**WARNING**

During gun teaching, the servo gun and robot move at a low constant speed regardless of the override.

In this procedure, the thickness is measured in a simple manner when the panel is clamped by both tips. If the error between the measured thickness and the specified thickness exceeds the Allowable Thk Err to NOT Confirm as a result of the simplified measurement, a prompt as shown below is displayed. When the thickness error is smaller than the Allowable Thk Err to NOT Confirm, the prompt is not displayed. Go to procedure 4.
Refer to Chapter 21.9 "THICKNESS UPDATE SETUP" for more information about this.

```
SAMPLE
                                      2/3
    1: L P[1] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    2: L P[2] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    3: J P[3] 100% FINE
   [END]

    Check thickness on this robot tip pos?
                              YES     NO
```

Nominal thickness

Shape of panel is abnormal or there is obstacle on the lower panel

Confirm that the robot tip is correctly positioned on the panel lower surface.
To continue teaching operation, press F4 "YES." Go to procedure 4 and conduct thickness measurement and touchup with reference to the current robot tip position.
Press F5"NO" when you do not want to continue spot point touchup. Spot point touchup is canceled.

> ⚠️ **CAUTION**
> If the error between the measured thickness and the specified thickness exceeds the Allowable Thk Err to NOT Confirm as a result of the simplified measurement, a prompt as shown above is displayed to prompt you to confirm the search result. Refer to Chapter 21.9 "THICKNESS UPDATE SETUP" for more information about this.
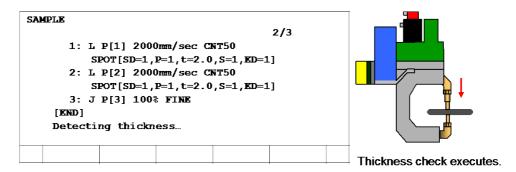
> ⚠️ **CAUTION**
> When "Execute Thickness check" on the setup screen is set to DISABLE, the robot tip moves to the lower surface position of the specified thickness.
> When the specified thickness is thicker than the actual thickness, a clearance will be made between the robot tip and the actual panel lower surface.

4.   Measure the thickness by clamping the panel.

> ⚠️ **CAUTION**
> This step is not executed when "Execute Thickness check" on the setup screen is DISABLE. Go to procedure 5.

Thickness check executes.
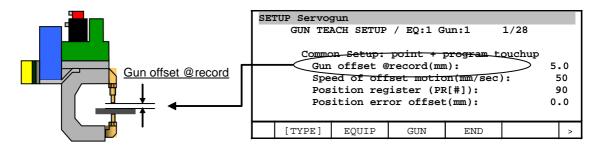
If result of thickness check is shorter than allowable thickness error to not confirm, go to procedure 5.
If result of thickness check is longer than it, a prompt as below is displayed.
Refer to Chapter "21.9 THICKNESS UPDATE SETUP" for more information about this.

Press F4 YES, the thickness is updated and the touchup process is continued.
Press F5 NO, it is not update and the touchup process is continued. And a prompt as below is displayed.

```
SAMPLE                                    _  _  _
                                          2/3
        1: L P[1] 2000mm/sec ナメラカ 50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        2: L P[2] 2000mm/sec ナメラカ 50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        3: J P[3] 100% イチギメ
       [END]
       Record this position?


|      |      |      |      | YES  |  NO  |
```

To continue the teaching operation in this condition, press F4 YES. Go to procedure 5.
If you do not intend to continue the teaching operation, press F5 NO. The teaching operation will be canceled.

5.   The robot and the servo gun move to the taught position.
     The servo gun moves away from the upper surface position of the measured thickness by the specified distance.

```
SETUP Servogun
    GUN TEACH SETUP / EQ:1 Gun:1      1/28

    Common Setup: point + program touchup
      Gun offset @record(mm):             5.0
      Speed of offset motion(mm/sec):      50
      Position register (PR[#]):           90
      Position error offset(mm):          0.0

|  [TYPE]  | EQUIP | GUN | END |  |  >  |
```

Gun offset @record
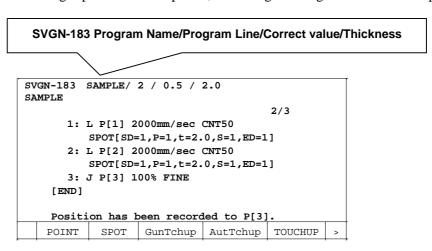
⚠ **CAUTION**
When "Execute Thickness check" on the setup screen is set to DISABLE, the servo gun moves away from the upper surface position of the specified thickness that is set in the pressure schedule by the specified distance.

⚠ **CAUTION**
If Tip Wear Comp is set to ENABLE, the robot teaching position is compensated by the robot tip wear amount. The teaching position will be the position for new tip (robot tip wear amount = 0 mm).

When the movement to taught position is completed, following warning SVGN-183 is displayed.

SVGN-183 Program Name/Program Line/Correct value/Thickness

```
SVGN-183  SAMPLE/ 2 / 0.5 / 2.0
SAMPLE
                                     2/3
     1: L P[1] 2000mm/sec CNT50
        SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     2: L P[2] 2000mm/sec CNT50
        SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
     3: J P[3] 100% FINE
    [END]

    Position has been recorded to P[3].
|  POINT  | SPOT | GunTchup | AutTchup | TOUCHUP | > |
```

SVGN-183 provides the result(Program name/ Program Line /Corrected value / Thickness) of the touchup operation. In this example, the teaching position of spot instruction in the second line in SAMPLE.TP was corrected by 0.5 mm, and the result of thickness check was 2.0 mm.
The position and the thickness are updated based on above results. However, where the thickness error is shorter than the allowable thickness error to not update or you answered NO at the prompt to confirm the thickness in procedure 4, the thickness is not updated. In this case, the position is updated. Refer to Chapter "21.9 THICKNESS UPDATE SETUP" for more information about this.

⚠ **CAUTION**

The corrected value displayed on SVGN-183 is the difference in the robot tip moving direction between the previous position data and the revised position data. When the robot tip moving direction is Z direction, the revision amounts in X and Y directions are not displayed.
When the corrected value is positive, it means that the position has been revised in the direction in which the robot tip moves toward the panel. When this value is negative, it means that the position has been revised in the direction in which the robot tip moves away from the panel.

21.18.5 Operation Suspension/Cancelation

Spot point touchup is canceled at the following times:
- When a HOLD stop, emergency stop, or alarm stop occurs during operation
- When the [SHIFT] key is released
- When the screen display switches to another screen during operation

```
SAMPLE                                      _   _   _
                                                 2/3
        1: L P[1] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        2: L P[2] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        3: J P[3] 100% FINE
       [END]
       Return to start position?


                               YES      NO
```

If F4"YES" is pressed, robot and gun return to their position prior to spot point touchup.
If F5"NO" is pressed, robot and gun stay at current position (position at touchup cancellation).

⚠ **CAUTION**
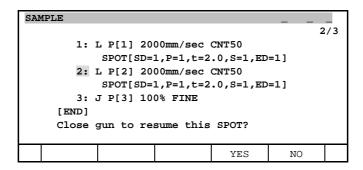
Once the operation is temporarily stopped, a series of actions of the gun teaching function must be restarted from the first operation.

⚠ **WARNING**
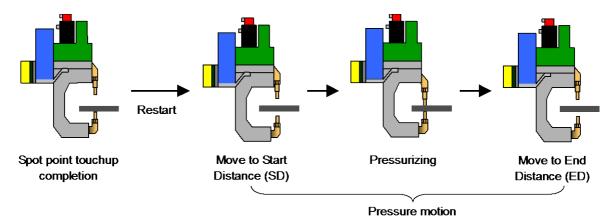
When the teaching by the gun teaching function is stopped halfway, the robot and gun axis are stopped at positions different from the teaching points in the program. To resume execution of the program, perform backward movement and then forward movement in the program.

21.18.6 Re-pressing Motion after Gun Teaching
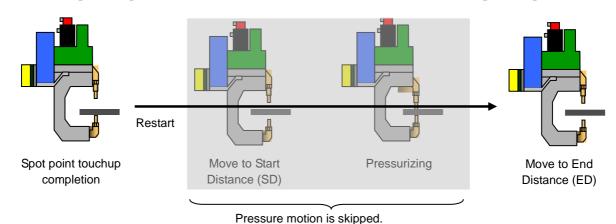
If a spot instruction being executed in single step or the like is revised using this function, the press motion can be skipped at the resumption of the taught and corrected spot instruction.

```
SAMPLE                                          _  _  _
                                                   2/3
        1: L P[1] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        2: L P[2] 2000mm/sec CNT50
           SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
        3: J P[3] 100% FINE
     [END]
     Close gun to resume this SPOT?

                                    YES       NO
```

If F4 "YES" is pressed, the press motion is executed as is conventionally done at the resumption of taught and corrected spot instruction.

| Spot point touchup completion | Move to Start Distance (SD) | Pressurizing | Move to End Distance (ED) |

Pressure motion

If F5"NO" is pressed, pressure motion does not execute at next restart after touchup is completes.

| Spot point touchup completion | Move to Start Distance (SD) | Pressurizing | Move to End Distance (ED) |

Pressure motion is skipped.

⚠️**CAUTION**
Even when F5 "NO" is pressed, the press motion is not skipped in the following cases:
- When the cursor is moved to another line, and another spot instruction is executed
- When backward movement is executed, and then this spot instruction is re-executed
- When the program is aborted
- When power is cycled

21.19   GUN MECHANICAL COMPENSATION CALIBRATION

Overview

If touchup has been executed using the spot touchup function or gun teaching function, depending on the characteristics of the gun mechanism part as shown below, a uniform detection error may occur, leading to change of tje tendency of touchup result.
- Strength of gun arm
- Friction resistance of gun driving part
- Disparity between instructed open distance and actual open distance in X gun.

The gun mechanical compensation function compensates the uniform detection error that occurs due to the characteristics of the gun mechanism part as shown above.
Before using the gun mechanical compensation function, it is necessary to calibrate the compensation distance on a gun basis in advance.

Calibration of compensation distance is performed with calibration plate and calibration utility program. When calibration has been executed, an action equivalent to the spot program touchup function is executed on the fixture for calibration.

⚠️**WARNING**
In the following cases, it may not be possible to appropriately conduct compensation distance calibration and exhibit the compensation effect.
- When a gun with a small gun arm rigidity, such as large X gun and C gun with offset structure, is used
- When a gun with a large friction resistance at the gun driving part is used
- When a gun with more than the required accuracy in the gun driving part is used
- When a gun is equipped with an equalization function or a floating function and the gun operates when the tip makes contact with the panel

NOTE
To perform this calibration, the spot program touchup function (A05B-25**-R725) must be installed.

Preparation
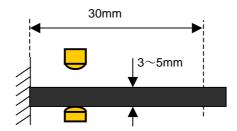
A calibration plate is required for mechanical compensation calibration. Calibration plate should meet the following specifications.

Material: Steel
Thickness: About 3~5 mm.

Calibration plate is fixed to firm pedestal. Perform calibration near the fixed end, no more than 30 mm from fixed end.
As a guide for rigidity, the deformation amount must be 2 mm or less at 200 N.

NOTE
The most important characteristic required of fixture is rigidity. If the fixture is deflected, it is not possible to obtain a compensation distance at a high accuracy.

NOTE
With an X gun, the disparity between the actual open distance and the instructed open distance depends on the open distance of the gun. In general, as the open distance increases, the error increases exponentially.
In this case, if the fixture is thicker than necessary, the open distance during calibration (based on calibration fixture) and the open distance used in actual teaching and touchup (based on actual welding panel) differ from each other, disabling proper application of compensation distance.

NOTE
If the fixture for calibration is thick for the actual welding panel, the calibration accuracy can be increased by shortening the robot tip distance, which is one of arguments of the KAREL program for gun mechanism characteristic compensation calibration (SGKTCHCL.PC) explained later.
I.E. Thickness + Start distance(SD) of robot tip (at actual welding) = Thickness + Robot tip distance (at calibration)
Compare the conditions of a representative welding point and the calibration conditions. If the relationship between them follows the above or is close to it, the calibration accuracy will be high.
However, we recommend that you secure the robot tip distance in the calibration conditions of 1 mm or more.
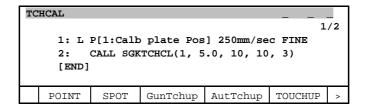
NOTE
If a measurement fixture to be used for tip wear measurement satisfies the above conditions, it can be used as the fixture for calibration.

Execution method
1. Set up the servo gun (gun zero mastering, automatic adjustment, pressure adjustment, thickness check calibration), and make the spot touchup function and gun teaching function usable.
2. Create a TP program for calibration as shown below, and perform teaching so as to execute the operation instruction and KAREL program SGKTCHCL.PC.

```
TCHCAL                                    _   _   _
                                            1/2
    1: L P[1:Calb plate Pos] 250mm/sec FINE
    2:    CALL SGKTCHCL(1, 5.0, 10, 10, 3)
    [END]


   POINT    SPOT   GunTchup  AutTchup  TOUCHUP   >
```
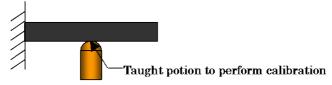
> ⚠ **CAUTION**
> As the motion instruction immediately before the call of SGKTCHCL, be sure to insert **positioning**.

3. Teach the position as of before execution of KAREL program ([1] in the above program) manually and accurately so that the robot tip makes contact with the lower surface of the fixture for calibration with zero clearance.
    At the same time, this teaching position must satisfy the condition that a deflection of 2 mm or less is produced when a load about 200 N is applied. The point should be preferably closer to the fixture supporting point.

Taught potion to perform calibration

4. Assign the gun number, thickness, tip open distance, and the number of calibrations to the arguments of the KAREL program.

    CALL SGKTCHCL (Gun number, Thickness, Gun tip opening, Robot tip opening, Calibration time)

> **NOTE**
> Specify thickness as accurately as possible.

> ⚠ **CAUTION**
> In a calibration operation, as with the normal spot touchup, the gun tip and the robot tip move away from each other up to the specified distance. Specify the open distance that does not cause interference with the surrounding device.

> **NOTE**
> The number of calibrations can be "1" in normal cases. If it is set to "2" or greater, the calibration is performed for the set number of times, and the average value of the calibrations is applied as the final calibration result of compensation distance.

5. **Enable the spot program touchup mode via TEST CYCLE screen or cell interface signal.**
    Confirm the following system status.
    - Reset all alarm, and turn off HOLD.
    - Disable single step and machine lock.
    - Enable gun stroke.
6. Execute the TP program for calibration. For the number of times equivalent to the number of calibrations, the robot performs gun teaching.

> **NOTE**
> If the program is stopped during calibration operation, the calibration finishes without being resumed. When the number of calibrations is set, execution of the next calibration operation starts.

7. When calibration finishes successfully, the following warning message is posted (the values are examples):
   SVGN-265 Mech Comp Calib. succeeded.
   SVGN-266 Comp Dist: -0.2 mm (3/3)
   SVGN-265 indicates calibration finishes successfully.
   SVGN-266 is posted together SVGN-265 as cause code. SVGN-266 shows compensation distance determined during calibration. The value in () shows the number of successes/number of executed calibrations. In the above example, SVGN-266 shows that specified 3 times calibration is successful at all , the calibration result decided –0.2mm(average of 3 times) of compensation distance.

   The calibration result can be checked on the GUN TEACH SETUP screen.
   When calibration is complete, gun mechanical compensation can be enabled.

```
SETUP Servogun
    GUN TEACH SETUP / EQ:1 Gun:1      10/28
    Gun mechanical compensation:
      Compensation Enb/Dsb:       DISABLE
      Compensation Dist Calib:    COMPETE
      Compensation Dist (mm):       -0.2


    [TYPE]   EQUIP    GUN    ENABLE  DISABLE  >
```

Alarm for gun mechanical compensation calibration.
The following alarms can occur for gun mechanical compensation calibration. Solve the problem by referring to the causes and remedies of the corresponding alarm.

SVGN-267 Mech Comp Calib. failed
[Cause]
This message indicates that the calibration of gun mechanism characteristic compensation did not properly finish and the compensation distance was not calculated.
[Remedy]
SVGN-268 or another alarm is also displayed as the cause code. Check the contents of the cause code and take measures.
Additionally, check whether there is any other alarm on the alarm list screen.

SVGN-268 << Message is displayed >>
[Cause]
Any of the following the causes of SVGN-267 is displayed as an alarm message.
Invalid gun number: Gun number is not correctly specified.
Invalid thickness: Thickness is not correctly specified.
Invalid Gun Open Distance: Specification of open distance on the gun tip side is not correct.
Invalid Robot Open Distance: Specification of open distance on the robot tip side is not correct.
Invalid Num of Calib: Specification of number of calibrations is not correct.
ALL Calib. NOT SUCCESS: An alarm has occurred in the course of calibration and no calibration operation was completed normally.
Check system status: The condition is not such that calibration can be executed. The following are possible causes.
- The alarm state of the system or HOLD state is not canceled.
- The machine is in single-step state or machine lock state.

- Press motion is disabled.
- Spot touchup is disabled.

[Remedy]

Take remedy on a message basis.

Invalid gun number: Correctly specify the gun number.

Invalid thickness: Correctly specify the thickness.

Invalid Gun Open Distance: Correctly specify the open distance on the gun tip side.

Invalid Robot Open Distance: Correctly specify the open distance on the robot tip side.

Invalid Num of Calib: Correctly specify the number of calibrations.

ALL Calib. NOT SUCCESS: Check the alarm list screen, and identify the alarm that occurred during calibration.

Check system status: Perform setup so that calibration can be executed.

- Reset all alarm, and/or turn off HOLD.
- Disable single step and/or machine lock.
- Enable gun stroke (mode)
- Enable program touchup mode.

SVGN-269 Spot program touchup disabled

[Cause]

Program touchup mode is disabled during calibration

[Remedy]

Enable program touchup mode.

21.20   THICKNESS CHECK CALIBRATION

Overview
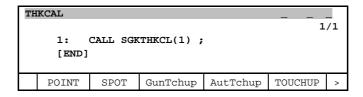
To perform teaching/touchup at a high accuracy using the spot touchup function and gun teaching function, the wear measurement and thickness check calibration need to have been already property conducted.

Conduct wear measurement in the same manner as that in normal production before executing spot touchup function and gun teaching function.

Updating the thickness check calibration along with wear measurement value after measuring wear allows thickness measurement to be accurately performed. Thickness check calibration can be executed on the Gun Setup screen as with normal gun setup. This section explains, however, the method of executing thickness check calibration from a TP program.

Execution method

1   Create an appropriate TP program to instruct to execute the KAREL program SGKTHKCL.PC.
2   Correctly specify the gun number to the argument.

```
THKCAL                                              _   _  _
                                                        1/1
     1:   CALL SGKTHKCL(1) ;
     [END]


 |    POINT   |   SPOT   | GunTchup | AutTchup | TOUCHUP | > |
```

> ⚠ **CAUTION**
> Confirm the following items before executing thickness check calibration.
> - Make sure that the gun mastering position is correct. (Error in mastering may lead to an error in thickness check.)
> - Complete wear measurement in advance.
> - Calibration cannot be executed if the machine is in the single-step state, press motion is disabled, and machine lock is on.
> - Execute the override at 100%.

3   Execute the TP program. Gun will open and close several times to perform the calibration.
4   When thickness check calibration is completed, following warning SVGN-191 is displayed.
    SVGN-191 Thickness Check Calib Updated.

> ⚠ **CAUTION**
> If thickness check calibration fails or is interrupted, the following alarm is displayed:
> SVGN-192 Thickness Check Calib Not Updated.
> At this time, the data of thickness check calibration is automatically restored to the original status.

> ⚠ **CAUTION**
> If thickness check calibration fails, the following causes are expected.
> - Cause: Master position for the gun axis is not correct.
>   Remedy: Retry the tip wear detection.
> - Cause: Tip wear amount exceeds maximum tip wear amount.
>   Remedy: Replace new tip, and retry the tip wear detection.
> - Cause: Gun does not close completely during thickness check calibration.
>   Remedy: Confirm master position for the gun axis. If master position for the gun axis is correct, tip contacting position is mis-detected because friction in gun mechanism increases. Do the action similar to the appendix "G.1.1 Gun does not close completely with pressure motion".

> ⚠ **CAUTION**
> If thickness check calibration is resumed after it failed or is suspended, then it is retried from the beginning. At this time, the following warning is displayed.
> **SVGN-306 Thickness Check Calib retrying...**
> Program does not go to the next step until thickness calibration succeeds.

⚠**CAUTION**

You can perform thickness check calibration immediately after wear detection if you execute SGKTHKCL in the wear detection program, as shown in the following sample program.

During normal production, thickness check calibration does not need to be performed after wear detection. Therefore, you can update thickness check calibration only when executing the spot program touchup function by teaching, using the touchup status signal, as shown below.

```
TW_UPD01
 18:   !Param2: New tips: 1, used tips:0
 19:   !CALL TWUPDAT(1, 0)
 20:   CALL TW_UPDAT(1,R[30:Tip Change])
 21:   IF DO[5:PrgTchStatEQ1] = ON,
          CALL SGKTHKCL(1)
 [END]

 ___|  POINT  |  SPOT  | GunTchup | AutTchup | TOUCHUP | > |
```

21.21 SIMPLE SEARCH MODE FOR UPPER DETECTION

Overview

Simple search mode can be provided a short cycle time of touchup by simplified search motion.

> **NOTE**
> This function might not maintain accuracy due to a change in the gun or dot condition (stiffness of workpiece and jig) as workpiece deflection is corrected by a constant value.

> **NOTE**
> Simple search mode for Upper detection is supported since 7DC2 software.

Preparation

Enable the Simple search mode of the spot program touchup function, using the following procedure:
1   Press the [MENU] key to display the Screen menu.
2   Press 6 SETUP.
3   Press F1 TYPE and select Servo Gun. The Servo Gun Setup screen will be displayed.
4   In the Servo Gun Setup screen, select <*DETAIL*> of General Setup.
5   In the Servo Gun General Setup screen, select Gun Teach Setup.
6   Enable Simple search mode for upper detection.

```
SETUP Servo gun
       GUN TEACH SETUP/EQ:1 GUN:1          5/30

    Common Setup: point + program touchup
       Gun offset @record(mm):          5.0
       Speed of offset motion(mm/sec): 50
       Position register(PR[#]):         90
       Position error offset(mm):       0.0
       Upper det simple search mode:ENABLE


    [TYPE]   EQUIP    GUN    ENABLE   DISABLE   >
```

In Simple search mode, FANUC recommends using "Non-Adaptive2" as the detection condition for stable detection. Follow the steps below to change the setting.
1   In the Gun teach setup screen, press the F→ key and F7 DET CFG.
2   In the Torque Control Setup screen, press F4 CHOICE and set "Non-Adaptive2" for the detection condition.

21.21.1 UPDET_OFS instruction

In the Simple search mode, workpiece deflection is not detected during detection. Therefore, the workpiece is slightly bended at the detected point. By adding the UPDET_OFS instruction to the spot instruction, you can correct workpiece deflection at touchup in the Simple search mode.

```
 Motion Modify 2          SAMPLE
1 TIPDRESS                                             1/2
2 Press_m                       1:L  P[1] 2000mm/sec CNT50
3 SpotProgTouchDsb               :  SPOT[SD=1,P=1,T=1.0,S=1,ED=1]
4 SPTCH_OFS                      :  UPDET_OFS=3.0mm
5 SPTCH_RSD                  [END]
6 UPDET_OFS
7 Wrist Joint
8 --next page--              Enter value
                                  DIRECT   INDIRECT   [CHOICE]      >
```
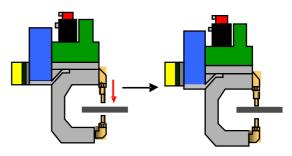
In addition to manually entering an offset value, the UPDETOFS instruction function allows offset values to be measured and corrected as described below.

21.21.1.1 Method to enter an offset value at the same time as gun teach
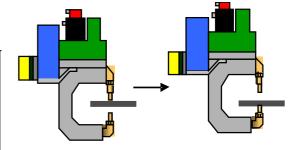
In this function, a panel deflection is measured by using Spot point touchup function with upper panel detection. This function uses the original search motion even if Simple search mode is enabled. A procedure for this function is the same as Spot point touchup.

Set the cursor on the SPOT instruction to which you want to add the UPDET_OFS instruction or the SPOT instruction that you want to correct. Press the [F→] key; then, while pressing the [SHIFT] key, press F7 "MEAS OFS" to start workpiece position detection and the addition and correction of the UPDET_OFS instruction. **In the following operations, the robot and the servo gun work. Keep pressing the [SHIFT] key while performing the operations**.

```
SAMPLE
                                    2/3
    1: L P[1] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    2: L P[2] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    3: J P[3] 100% FINE
    [END]

   [INST]   MEAS OFS        MEAS   [EDCMD]   >
```


Gun teach is normally executed and stops at the position where the gun tip comes into contact with the workpiece upper surface.

```
SAMPLE
                                    2/3
    1: L P[1] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    2: L P[2] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
    3: J P[3] 100% FINE
    [END]

   Is GunTip on panel? (Rbt will close<15.0)
                                YES    NO
```


Confirm the gun tip is on the workpiece upper surface.
Pressing F4 "YES" adds or correct the offset and then teaching and touching-up continues.
Pressing F5 "NO" sets the offset to 0.0 mm and teaching and touching-up are aborted. Enter the offset value manually.

```
SAMPLE
                                    2/3
    1: L P[1] 2000mm/sec CNT50
       スポット[SD=1,P=1,t=2.0,S=1,ED=1]
    2: L P[2] 2000mm/sec CNT50
       SPOT[SD=1,P=1,t=2.0,S=1,ED=1]
       UPDET_OFS=3.0mm
    3: J P[3] 100% FINE
    [END]

   [INST   MEAS OFS        MEAS THK  [EDCMD]  >
```
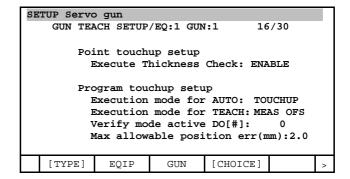
21.21.1.2 Method to enter an offset value at the same time as spot program touchup

In this function, a panel deflection is measured by using Spot program touchup function. This function uses the original search motion even if Simple search mode is enabled. A procedure for this function is the same as Spot program touchup.

Enable the Measure offset mode of the spot program touchup function using the following procedure:

1   Press the [MENU] key to display the Screen menu.
2   Press 6 SETUP.
3   Press F1 TYPE and select Servo Gun.
4   In the Servo Gun Setup screen, select <*DETAIL*> of General Setup. The General Setup screen will be displayed.
5   In the Servo Gun General Setup screen, select Gun Teach Setup.
6   Move the cursor on Execution mode for TEACH and press F4 [CHOICE]. Select MEAS OFS.
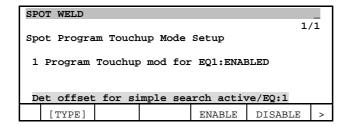
```
                    1
 1 TOUCHUP
 2 VERIFY
 3 MEAS OFS
 4 PATH CHECK
```

```
SETUP Servo gun
   GUN TEACH SETUP/EQ:1 GUN:1        16/30

           Point touchup setup
             Execute Thickness Check: ENABLE

           Program touchup setup
             Execution mode for AUTO:  TOUCHUP
             Execution mode for TEACH: MEAS OFS
             Verify mode active DO[#]:     0
             Max allowable position err(mm):2.0


      [TYPE]    EQIP    GUN   [CHOICE]       >
```

> **NOTE**
>   This function can be used at TP enable.

Enable Spot program touchup function.
7   Select 2 TEST CYCLE from the Screen menu.
8   Press F1 TYPE and select Spot Prog Touch. Spot Program Touchup Mode Setup screen will be displayed.
9   Press F4 ENABLED. Measure offset mode is enabled.

```
SPOT WELD                                _
                                        1/1
Spot Program Touchup Mode Setup

 1 Program Touchup mod for EQ1:ENABLED


 Det offset for simple search active/EQ:1
    [TYPE]                ENABLE  DISABLE  >
```

The offset is measured and added or updated by executing the program. When the SPOT instruction not added UPDET_OFS instruction is taught, a following message is displayed for confirming. This message is not displayed at the SPOT instruction added UPDET_OFS. This message is displayed after the touchup is done.

```
┌─────────────────────────────────────────────┐
│ SPOT                                          │
│                                          2/3  │
│        1: L P[1] 2000mm/sec CNT50             │
│            SPOT[SD=1,P=1,t=2.0,S=1,ED=1]      │
│        2: L P[2] 2000mm/sec CNT50             │
│            SPOT[SD=1,P=1,t=1.0,S=1,ED=1]      │
│        3: J P[3] 100% FINE                    │
│        [END]                                  │
│                                               │
│        UPDET_OFS=3.0mm:Update upper det offset? │
├────┬─────┬─────┬─────┬──────┬─────┬────┤
│    │     │     │     │ YES  │ NO  │    │
└────┴─────┴─────┴─────┴──────┴─────┴────┘
```

If press F4 YES, measured offset is set to UPDET_OFS.
If press F5 NO, UPDET_OFS=0.0 mm is set. Enter the offset value manually or retry measure offset.

```
┌─────────────────────────────────────────────┐
│ SPOT                                          │
│                                          2/3  │
│        1: L P[1] 2000mm/sec CNT50             │
│            SPOT[SD=1,P=1,t=2.0,S=1,ED=1]      │
│        2: L P[2] 2000mm/sec CNT50             │
│            SPOT[SD=1,P=1,t=1.0,S=1,ED=1]      │
│            UPDET_OFS=3.0mm                     │
│        3: J P[3] 100% FINE                    │
│        [END]                                  │
│                                               │
│        SHIFT+FWD:Resume program.              │
├────┬───────┬──────┬─────────┬─────────┬─────────┬────┤
│    │ POINT │ SPOT │ GunTchup│ AutTchup│ TOUCHUP │ >  │
└────┴───────┴──────┴─────────┴─────────┴─────────┴────┘
```

Resume program and continue to measure offset.

21.22 PATH CHECK MODE

Overview

The operation of the spot program touchup function is different from that of normal spot welding. For this reason, the gun may collide with peripheral equipment. The gun may also collide with the workpiece before the detection motion starts depending on the setting.
In this function, the gun moves in the range that it moves around while touchup is performed and to the position where the search motion starts in order. You can confirm settings for spot program touchup function before execute touchup.

NOTE
   The gun may come in contact with the workpiece or peripheral equipment. Ensure that the gun in operation is carefully observed and that its operation can be stopped immediately while executing the function.
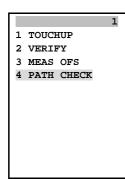
NOTE
   Path check mode is supported since 7DC2 software.
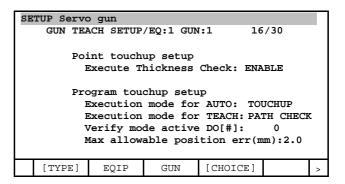
Preparation

Follow the steps below to enable the path check mode of the spot program touchup function:
1   Press the [MENU] key to display the Screen menu.
2   Press 6 SETUP.
3   Press F1 TYPE and select Servo Gun.
4   In the Servo Gun Setup screen, select <*DETAIL*> in General Setup.
5   In the Servo Gun General Setup screen, select Gun Teach Setup.
6   Move the cursor on Execution mode for TEACH and press F4 [CHOICE]. Select PATH CHECK.
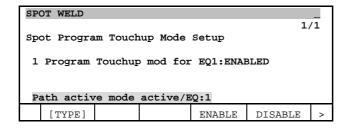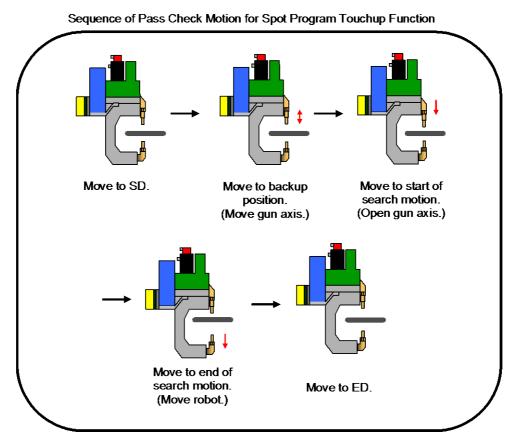
```
                      1     SETUP Servo gun
1 TOUCHUP                      GUN TEACH SETUP/EQ:1 GUN:1      16/30
2 VERIFY
3 MEAS OFS                        Point touchup setup
4 PATH CHECK                        Execute Thickness Check: ENABLE

                                   Program touchup setup
                                     Execution mode for AUTO:  TOUCHUP
                                     Execution mode for TEACH: PATH CHECK
                                     Verify mode active DO[#]:     0
                                     Max allowable position err(mm):2.0

                                [TYPE]   EQIP    GUN   [CHOICE]        >
```

NOTE
   This function can be used at TP enable.

Enable spot program touchup function.
7   Select 2 TEST CYCLE from the Screen menu.
8   Press F1 TYPE and select Spot Prog Touch. Spot Program Touchup Mode Setup screen will be displayed
9   Press F4 ENABLED. Path check mode is enabled.

```
SPOT WELD                               _
                                      1/1
Spot Program Touchup Mode Setup

 1 Program Touchup mod for EQ1:ENABLED


 Path active mode active/EQ:1
   [TYPE]              ENABLE  DISABLE  >
```

Path Check Motion

In the path check mode, the gun moves around the characteristic points, including the moving range that it moves while the spot program touchup function is in operation and the position where the search motion starts in order. The following shows the characteristic points.

Sequence of Pass Check Motion for Spot Program Touchup Function

Move to SD.

Move to backup position.
(Move gun axis.)

Move to start of search motion.
(Open gun axis.)

Move to end of search motion.
(Move robot.)

Move to ED.

Points to be Checked and Remedy for Path Check Motion

If the gun is unable to operate properly because it comes in contact with peripheral equipment or the workpiece at the following check points, then touchup cannot be performed. If this is the case, adjust each setting so that the function can be executed properly.

Points to be Checked	Remedy
Gun stroke limit occurs before moving to backup position for upper panel detection.	Although the detection motion start at the position closer to the workpiece than the normal position, no remedy is needed if the gun tip does not come in contact with the workpiece at the detection motion start position. If it is not so, then set a smaller value for Max allowable position error and/or Overthickness tolerance to move the gun tip toward the workpiece or add the SPTCH_RSD instruction to move the robot tip toward the workpiece. If this problem occurs with all points, then you may use Low pnl detect dist, instead of the SPTCH_RSD instruction.
Movable gun arm collides jig or others at backup position for upper panel detection.	Set a smaller value for the Max allowable position error and/or Overthickness tolerance to move the gun tip toward the workpiece.
Robot tip collides panel surface at backup position for upper panel detection.	This problem might occur when Low pnl detect dist is enabled or the SPTCH_RSD instruction has been added. Set a larger value for the Max allowable position error to move the gun tip away from the workpiece.
Gun tip collides panel surface at start of search motion.	Set a larger value for the Max allowable position error and/or Overthickness tolerance to move the gun tip away from the workpiece.
Fixed gun arm collides jig or others at end of search motion.	Set a smaller value for the Max allowable position error or add the SPTCH_RSD instruction to move the gun tip toward the workpiece. If this problem occurs with all points, then you may use Low pnl detect dist, instead of the SPTCH_RSD instruction.

After making corrections, execute path check motion again to check that operations at points with problems are normal and that no other points are affected.

> **NOTE**
> Don't set Max allowable position error lower margin than assumed position error. and don't set Overthickness tolerance lower margin than assumed thickness error.

21.23 TROUBLESHOOTING

If spot program touchup does not operate as expected, then check information found in this chapter. In addition, if an alarm is generated, then refer to Chapter "21.24 ALARMS." This chapter describes the corresponding search motions. Refer to items that match the actual operation of the robot.

> ⚠ **If you cannot identify the symptom by performing troubleshooting:**
>
> • Execute the servo gun pre-conditioning operation (repeated opening and closing of the gun and pressurization) for approximately 30 s.

> ⚠ **If performing troubleshooting does not solve the problem:**
>
> If you cannot solve the problem by performing troubleshooting, take the following measures:
> 1. Obtain the diagnostic data for such a problem. For the procedure to collect diagnostic data, refer to the end of this chapter.
> 2. Contact a FANUC technical representative.

<u>Upper Panel Detection Step 1</u>
1. The gun collided with the workpiece.
[Cause]
Because the teach error was larger than the "Max allowable position error," the gun collided with the workpiece on the way to the upper workpiece detection start position.
[Remedy]
Enter a value larger than the maximum value for the expected teach correction amount for "Max allowable position error" in the spot program touchup setup screen. The upper workpiece detection start position will be changed to a position at which the gun is open wider. Refer to Chapter "21.4 SPOT PROGRAM TOCHUP SETUP SCREEN" for more information about upper panel detection start position. However, increasing open distance also increases search (and touchup) time. FANUC recommends that the "Max allowable position error" be set appropriately according to the expected usage method.

2. The gun axis motion stops before the gun touches the workpiece during upper panel detection.
[Cause]
It is considered that the workpiece was erroneously detected (a non-workpiece position was detected) due to a characteristic or change in the servo gun-driven mechanism, causing the gun axis operation to stop before the gun comes in contact with the workpiece.
[Remedy]
You can prevent erroneous detection by changing the parameters for upper panel detection step 1. For information on how to change the detection parameters, refer to Chapter "21.8 SEARCH PARAMETERS SETUP."

3. The workpiece bents during upper panel detection motion.

[Cause]
The stiffness of the workpiece may be insufficient. A rough indication of insufficient workpiece stiffness is a workpiece deflection that is more than 3 mm during search motion.

[Remedy]
For a point with low workpiece stiffness, the spot program touchup function cannot be used. For points with low workpiece stiffness, disable the spot program touchup function and then correct the position manually. For information on how to disable the spot program touchup function, refer to Chapter "21.13 SPOT PROGRAM TOUCHUP DISABLE INSTRUCTION."

<u>Upper Panel Detection Step 2</u>
4. The position detected by upper panel detection is not correct: Part 1
The positions detected by upper panel detection vary (Check the position of the gun tip at the lower panel detection start position).

[Cause]
The detection positions may vary when guns with the following characteristics are used:
*   A gun with a large frictional force
*   A gun with a small gear ratio (as a guide, a gun with the gun tip travel distance per motor rotation is 10 mm or less).

[Remedy]
You can improve the detection accuracy by changing the detection parameters for upper panel detection step   2.
For information on how to change detection parameters, refer to Chapter "21.8 SEARCH PARAMETERS SETUP."

5. The position detected by upper panel detection is not correct: Part 2
<u>All the positions</u> detected by upper panel detection shifted to a direction for a certain amount (Check the position of the gun tip at the lower panel detection start position).

[Cause]
All detected positions may shift to a direction for a certain amount due to gun-specific characteristics, such as flexible and long gun arms.

[Remedy]
Detection accuracy can be improved by gun mechanical compensation. For information on how to use gun mechanical compensation, refer to Chapter "21.19 GUN MECHANICAL COMPENSATION CALIBRATION."

6. The position detected by upper panel detection is not correct: Part 3
Specific positions detected by upper panel detection shifts to a direction for a certain amount (Check the position of the gun tip at the lower panel detection start position).

[Cause]
Detected positions for specific positions may shift for a certain amount due to workpiece stiffness and gun characteristics.

[Remedy]
You can correct the detected position for each point by adding the SPTCH_OFS instruction to the spot instruction. Refer to Chapter "21.14 SPTCH_OFS INSTRUCTION" for more information about SPTCH_OFS instruction.

7. Upper panel detection fails.

[Cause]
The following alarms might have been generated.
*   SVGN-240 Upper panel detection error.

- SVGN-248 Panel not detected.
- SVGN-252 Panel detection was failed.
- SVGN-260 Search motion is unsuccess.

[Remedy]

Consider and take the following actions:

- If SVGN-240 is generated, then refer to the cause and remedy for SVGN-240 described in Chapter "21.24 ALARMS."
- If SVGN-248 is generated, then refer to the cause and remedy for SVGN-248 described in Chapter "21.24 ALARMS." If the search motion stopped before the gun tip comes in contact with the workpiece, then refer to Troubleshooting 2.
- If SVGN-252 is generated, then refer to the cause and remedy for SVGN-252 described in Chapter "21.24 ALARMS."
- If SVGN-260 is generated, then refer to the cause and remedy for SVGN-260 described in Chapter "21.24 ALARMS."

8. Peripheral equipment interferes with robot/gun during spot program touchup motion.

[Cause]

Robot moves a short distance during upper panel detection step 2. Interference with peripheral equipment can occur if clearance between gun/robot arm and external equipment is less than 10 mm.

[Remedy]

If the robot open distance is insufficient at the start distance (SD) position, then check for any interference. As a result of the check, if the robot tip interferes with peripheral equipment, then add the SPTCH_RSD instruction to the spot instruction. This will move the robot tip position toward the position, preventing interference. Refer to Chapter "21.15 SPTCH_RSD INSTRUCTION" for more information about SPTCH_RSD instruction.

If the interference cannot be prevented by the above remedy, then the spot program touchup function cannot be used at that point. Disable the spot program touchup function for the point and then correct the position manually. For information on how to disable the spot program touchup function, refer to Chapter "21.13 SPOT PROGRAM TOUCHUP DISABLE INSTRUCTION."

Lower Panel Detection

9. Lower panel detection stops before robot tip contact lower panel surface

[Cause]

It is considered that when the lower workpiece surface was erroneously detected (a non-lower workpiece surface position was detected) due to a characteristic or change in the servo gun-driven mechanism, robot tip stops operation before it comes into contact with the lower workpiece surface.

[Remedy]

You can prevent erroneous detection by changing the lower panel detection parameters. For information on how to change the detection parameters, refer to Chapter "21.8 SEARCH PARAMETERS SETUP."

10. Lower panel detection crushes a gap.

[Cause]

Due to low gap stiffness, it is crushed when measuring thickness.

[Remedy]

According to the specification, soft gaps are crushed during lower panel detection.

A gap must have a certain stiffness to be detected in lower panel detection. A rough indication of gaps that can be detected in lower panel detection is a gap that resists when a pressure of 200 N is applied.

After searching

11. Touchup position is not correct.

[Cause]

When the workpiece is not stiff enough, touchup accuracy cannot be guaranteed. A rough indication of insufficient stiffness is a workpiece deformation of more than 3 mm during search motion.

[Remedy]

Spot program touchup cannot be applied at this point. Disable this function at this point, and touchup manually. For information on how to disable the spot program touchup function, refer to Chapter "21.13 SPOT PROGRAM TOUCHUP DISABLE INSTRUCTION." Note: if the deformation amount is small and the strength of panel is sufficient, refer to Troubleshooting items 4,5,6.

Diagnostic data acquisition procedure

Acquire diagnostic data per the following procedures.
1. Install memory device.
2. Select the memory device for diagnosis data.
   - $SGSYSTCH.$OUT_DEVICE = 0: Memory card
   - $SGSYSTCH.$OUT_DEVICE = 1: USB memory device
3. Change the system variable as follows. Diagnostic data acquisition becomes effective.
   - $SGSYSTCH.$LOG_FLAG=TRUE
   - $SGSYSTCH.$RSCHLOG_ENB=TRUE
   - $SYSDEBUG=50
4. Power OFF/ON.
5. Execute spot program touchup and reproduce the problem.
6. The diagnostic data for the problem are saved in the specified memory media. The preserved diagnostic data is the following.
   - tchalog_acdet_chart.dt
   - tchalog_acdet_data.dt
   - tchalog_acdet_lines.dt
   - tchalog_acdet_result.dt
   - tchalog_acdet_detect.dt
   - tchalog_acdet_ofst.dt
   - tchalog_acdet_posns.dt
   - rsrch_upperdet.dt
   - rsrch_accudet.dt
   - rsrch_lowerdet.dt
7. Pass the diagnostic data to FANUC technical representative.
8. Change the system variable as follows. Diagnostic data acquisition becomes invalid.
   - $SGSYSTCH.$LOG_FLAG=FALSE
   - $SGSYSTCH.$RSCHLOG_ENB=FALSE
   - $SYSDEBUG=0
9. Power OFF/ON.

21.24 ALARMS

This chapter describes the alarms related to the program touchup function and the point touchup function.

SVGN-175   Position not recorded
[Cause]
GunTouchup (F3) or AutoTouchup (F4) was executed but touchup did not occur. This alarm only indicates that touchup was unsuccessful, and the cause is described under SVGN-176. Note: SVGN-175 is not posted during program touchup.
[Remedy]
Check the description for SVGN-176. Note that you can hide this alarm by setting $SGSYSTCH..$PTNOTRECALM = FALSE.

SVGN-176   %s
[Cause]
"The cause of SVGN-175."
[Remedy]
With reference to this alarm, remove the cause of SVGN-175.
Also, display the History Alarm screen to confirm whether any other alarms are occurring.

SVGN-183   %s,%s,%s,%s
[Cause]
The point touchup function has taught a new position. This alarm is provided to notify information and does not notify an occurrence of error. Note: SVGN-183 is not posted during program touchup.
[Remedy]
This alarm provides four pieces of information regarding teach position correction (P1, P2, P3, P4).
P1: Program name of the point to be corrected.
P2: Program line number of the point to be corrected.
P3: The touchup amount is the difference between the new teach position and the old teach position.
P4: Thickness measured during thickness check. If thickness check is disabled, then the specified thickness (value in pressure schedule) is displayed.

SVGN-184   Point touchup request cancelled.
[Cause]
Another screen was selected or the [SHIFT] key + FWD key were pressed when point touchup is being executed.
[Remedy]
Execute the point touchup function again. Do not move to another screen while operating the fucntion.

SVGN-190   Open operation before search clamped.
[Cause]
The gun could not be opened to the search motion start position due to the position exceeding the stroke limit. The gun open position is clamped by the stroke limit.
Note: The search motion start position is different depending on the touchup method:
if point touchup: open distance = initial pos + search prep dist
Program touchup function: open distance = specified thickness + thickness tolerance + allowable position error + search prep dist
There is no problem even if the open distance is clamped unless the gun tip does not touch the workpiece before the search starts. However, if the gun tip comes in contact with the workpiece before the search starts, then workpiece detection cannot be performed properly.
[Remedy]
When performing the point touchup function, close the gun slightly before starting search teach.

When performing the program touchup function, reduce one of the following values: upper panel detection distance, max allowable position error, and over thickness tolerance.
Also, confirm that the open side stroke limit, gun tip distance condition, and set thickness are appropriate. Change them to appropriate values, if necessary.

SVGN-191   Thickness Check Calib Updated.
[Cause]
Thickness check calibration was successful.
[Remedy]
There is no need to take action.

SVGN-192   Thickness Check Calib Not Updated.
[Cause]
Thickness check calibration failed or aborted. Thickness check calibration data will automatically be restored to the condition prior to executing the calibration (before update).
[Remedy]
Thickness check calibration related alarms may have been generated. Check the History Alarm screen to see if such alarms have been generated. If thickness check calibration-related alarms have been generated, then remove the cause and execute the calibration again.

SVGN-236   [PauseMod]Det/Thk/Pos Err :Eq%d
[Cause]
Program execution paused because position and/or thickness is out of tolerance. This pause occurs when DET/THK/POS error pause severity is set to warn or alarm, and one more of the following conditions exist:
* SVGN-237 Position error:(Eq:%d,Ln:%d)
* SVGN-239 Thickness error:(Eq:%d,Ln:%d)
* SVGN-240 Up Panel Mis-Detect:(Eq:%d,Ln:%d)
* SVGN-252 Panel detection was failed:(Eq:%d,Ln:%d)
* SVGN-254 Low Panel Mis-detect:(Eq:%d,Ln:%d)
* SVGN-260 Search motion is unsuccess.
[Remedy]
Set Det/Thk/Pos error pause Sev in the gun teach setup screen to DISABLE if you do not want robot to pause when the alarms above occur.

SVGN-237   Position error:(Eq:%d,Ln:%d)
[Cause]
The error (teach correction amount) between the detected workpiece position and the original teach position is greater than the maximum allowable position error or less than the minimum allowable position error.
[Remedy]
Take the following actions.
1. Confirm that the tip wear amount has correctly been measured. Re-execute the tip wear measurement when the tip wear amount is incorrect.
If this problem persists after taking the above actions, confirm that:
1. Max allowable Pos error (on gun teach setup screen) is large enough.
2. Min allowable Pos error (on gun teach setup screen) is small enough.
If the correction amount is smaller than the minimum allowable position error or greater than the maximum allowable position error, then teach correction is not performed. Use the following method to ensure that the teach correction amount is within the allowable values.
1. Teach the correct position manually or using the point touchup function.
2. Change the maximum/minimum allowable position errors to set sufficient allowable values.
If the position correction amount is too large for teaching at the initial stage, then FANUC recommends using point touchup for the correction.
If this problem still persists after taking the above actions, take the following actions.

1. Confirm the position error offset in the spot program touchup setup screen. This alarm is likely to be generated immediately after the position error offset has been changed.
2. Confirm the parameter to correct position for Xgun in the spot program touchup setup screen. This alarm is likely to be generated immediately after the parameter to correct the Xgun teach position has been changed.

If this problem persists after taking the all actions, perform the following actions:

1. Obtain the diagnostic data for the problem. For the procedure to obtain diagnostic data, refer to Chapter "21.23 TROUBLESHOOTING" in the R-30iB CONTROLLER Servo Gun OPERATOR'S MANUAL (B-83264EN).
2. Contact a FANUC technical representative.

SVGN-238   [PauseMod]SpotProgTouchDsb:Eq%d

[Cause]

The robot pauses at the start position of the touchup motion if SpotProgTouch_Dsb pause Sev in the gun teach setup screen is set to warn or alarm and a spot instruction with TCH_DSB from spot instruction is executed.

[Remedy]

If you do not want robot to pause, either:

a. set SpotProgTouch_Dsb pause Sev in the gun teach setup screen to DISABLE OR
b. remove TCH_DSB from spot instruction

SVGN-239   Thickness error:(Eq:%d,Ln:%d)

[Cause]

Measured thickness is out of tolerance. Note: SVGN-242 Act thick:x.x, Nom thick: y.y is posted as cause code for SVGN-239.

[Remedy]

Take the following actions:

1. Confirm that the error between the panel thickness and the measured thickness is not too large.
2. Check the specified thickness in the pressure schedule.
3. Check the Overthickness and Underthickness tolerance values on the spot program touchup screen.

SVGN-240   Up Panel Mis-detect:(Eq:%d,Ln:%d)

[Cause]

Upper panel detection distance is larger (gun more open) than max detect distance. where: max detect distance = pos.err.max + thk.nom + thk.err.max This alarm occurs only during program touchup (not point touchup).

[Remedy]

Confirm and take the following actions:

1. Confirm that no obstruction exists on the upper panel surface.
2. Confirm that the panel is correctly installed.
3. Confirm that the master position for the gun axis is correct.
4. Confirm that the tip wear amount is correctly measured. If the tip wear amount is incorrect, then re-execute the tip wear measurement and perform the thickness check calibration again.

If the problem still persists, confirm the following:

1. nominal thickness in pressure schedule is correct.
2. OverThickness tolerance (on gun teach setup screen) is large enough.

If there is no problem with the above items, then confirm that:

1. Max allowable Pos error (on gun teach setup screen) is large enough.

If the above items are applicable, then use the following method to ensure that the teach correction amount is within the allowable value.

1. Teach correct positions manually or by using the point touchup function.
2. Change the maximum/minimum allowable position errors to set sufficient allowable values.

If the position correction amount is too large for teaching at the initial stage, then FANUC recommends using point touchup for the correction.

1. Obtain the diagnostic data for the problem. For the procedure to obtain diagnostic data, refer to Chapter "21.23 TROUBLESHOOTING" in the R-30iB CONTROLLER Servo Gun OPERATOR'S MANUAL (B-83264EN).
2. Contact a FANUC technical representative.

SVGN-241   ActPosErr:%smm > MaxPosErr:%smm

[Cause]

This alarm is additional information to "SVGN-237 Position error:(Eq:%d,Ln:%d)." The calculated position correction amount is greater than the Max allowable Pos error.

[Remedy]

Refer to the cause and remedy for SVGN-237.

SVGN-242   Act thick:%smm Nom thick:%smm

[Cause]

This alarm is additional information to "SVGN-239 Thickness error:(Eq:%d,Ln:%d)" or "SVGN-254 Low Panel Mis-detect:(Eq:%d,Ln:%d)" This alarm indicates the measured thickness by spot program touchup and the specified thickness in the pressure schedule.

[Remedy]

Refer to the cause and remedy for SVGN-239.
Refer to the cause and remedy for SVGN-254.

SVGN-243   ActDetDis:%smm MaxDetDis:%smm

[Cause]

This alarm is additional information to "SVGN-240 Up Panel Mis-detect:(Eq:%d,Ln:%d)." This alarm indicates the upper workpiece detection result and upper workpiece detection range.

[Remedy]

Refer to the cause and remedy for SVGN-240.

SVGN-244   Retry thickness check calibration

[Cause]

Thickness check calibration is incomplete or has not been updated.

[Remedy]

Execute thickness check calibration again.

SVGN-245   Gun not open to undeflect pos

[Cause]

The gun could not travel to the open position after the end of the detection motion.

[Remedy]

Check the alarm displayed along with this alarm and take the remedy for that alarm.

SVGN-246   Machine lock required for pnlsim

[Cause]

Panel simulation is enabled, but machine lock is disabled on robot group or gun group. Machine lock must be ENABLED on both robot group and gun group, when panel simulation is enabled.

[Remedy]

Disable panel simulation($SGSYSTCH.$SIM_PNL_ENB=FALSE) or ENABLE machine lock on robot group and gun group.

SVGN-247   Concurrent multiarm touchup unsupported.
[Cause]
Spot program touchup cannot be performed on multiple robots at the same time in a system controlling multiple robots.
[Remedy]
Before performing spot program touchup, complete spot program touchup that is being performed by other robots.

SVGN-248   Panel not detected.
[Cause]
Upper or lower panel search ended, but panel was not detected. I.E. gun never met search condition, during search. The following conditions can cause this problem:
1.   Panel installation error
2.   Excessive gun sliding friction
3.   Excessive detection margin
[Remedy]
Take the following actions:
1.   Make sure that the panel is correctly installed.
2.   Execute servo gun pre-conditioning operation (repeated opening and closing and pressurization).
3.   Decrease the detection margin.
If problem persists, contact a FANUC Robotics technical representative.

SVGN-249   Panel detection was failed.
[Cause]
The detection condition was not established; thus, the upper panel position was not detected. This alarm may occur if the panel or gun is too soft.
[Remedy]
Retry touchup.

SVGN-250   Spot program touchup enabled !
[Cause]
The TP program started (or resumed) when the spot program touchup function is enabled with execution mode = TOUCHUP. In the touchup mode, points are searched and teach correction is executed. This alarm is only for recording of information.
[Remedy]
If verify (not touchup) mode is desired, change execution mode via Touchup setup screen:
a.   if tp is disabled, set Execution mode for AUTO = VERIFY mode,
b.   if tp is enabled, set Execution mode for TEACH = VERIFY mode,
If normal spot (not touchup or verify) operation is desired, disable program touchup via:
a.   DIN, if tp is disable.
b.   Touchup mode setup screen, if tp is enable.

SVGN-251   ActPosErr:%smm < MinPosErr:%smm
[Cause]
The correction amount (teach correction amount) resulted in less than the MinPosError (Min allowable position err). This message is the output used to compare the correction amount and the minimum allowable position error when SVGN-237 occurs. Note that min pos error is used in conjunction with max pos error to control when points are touched up. Points are only touched up if position error is >= min pos error and <= max pos error. Min pos error tolerance identifies when position change is small and/or insignificant.
[Remedy]
If position error is acceptable, decrease min pos error and execute touchup again. Set min pos error = 0.0, to disable min pos error check completely.

SVGN-252   Panel detection was failed.

[Cause]
Upper panel detection failed. The integer parameter ()identifies the failure type:
type1: gun tip did not contact panel during search motion (internal condition to terminate search was not met).
type2: The position could not be calculated. The workpiece may be too soft.

[Remedy]
Confirm that:
Type1: Confirm that the workpiece is caught at the search start position. If the point is out of position, then manually correct it or move to the position near the point by jogging and correct it using the point touchup function.
Type2: Confirm the workpiece stiffness. A rough indication of workpiece stiffness is a workpiece deflection that does not exceed 3 mm during the search motion.

SVGN-254   Low Panel Mis-detect:(Eq:%d,Ln:%d)

[Cause]
The error between the measured thickness and the specified thickness was out of the allowable thickness error. Check the spot program touchup screen.

[Remedy]
Take the following actions:
1.   Confirm that there is no excessive unevenness on the panel surface.
2.   Confirm that the error between the panel thickness and the measured thickness is not too large.
3.   Check the specified thickness in the pressure schedule.

SVGN-255   Search motion is unsuccess.

[Cause]
Detection data for the second upper panel search is invalid.

[Remedy]
Retry spot program touchup. Confirm that gun tip contacts panel at upper panel detection. If this problem persists after taking the above actions, perform the following actions:
1.   Acquire the diagnostic data. See the procedure for diagnostic data collection at Troubleshooting section.
2.   Contact a FANUC technical representative.

SVGN-256   Invalid parameter in SPTCH_XXX

[Cause]
The value specified for the SPTCH_OFS or SPTCH_RSD by an indirect (register) specification was out of range.
Note: SPTCH_OFS is added to the spot instruction to correct the detected teach position. For the setting, a correction amount is assigned. SPTCH_RSD is added to the spot instruction to specify the offset distance for the robot tip.

[Remedy]
Check the content of the register used for the SPTCH_OFS instruction or the SPTCH_RSD instruction. The specifiable ranges are listed below:
1.   SPTCH_OFS: >= −2.0 mm and <= 2.0 mm
2.   SPTCH_RSD: >= 0.0 mm and <= 20.0 mm

SVGN-257   Invalid register number.
[Cause]
Register specified for SPTCH_OFS or SPTCH_RSD is invalid.
[Remedy]
Check the register number used for the SPTCH_OFS or SPTCH_RSD instruction:
min: 1
max: posreg max (position registers item, on program limits setup screen)

SVGN-258   SPOT prog touchup retry:(Num:%d).
[Cause]
Retry the spot program touchup function started.
[Remedy]
There is no need to take action. If you do not want to retry the spot program touchup function, then you can disable the retry option in the spot program touchup setup screen.

SVGN-259   Retry number > Max retry number.
[Cause]
The spot program touchup function was retried more than the maximum retry count.
[Remedy]
Confirm the stiffness of the workpiece. A rough indication of workpiece stiffness is a workpiece deflection that does not exceed 3 mm during the search motion.
If this problem persists after taking the above actions, perform the following actions:
1.   Obtain the diagnostic data for the problem. For the procedure to obtain diagnostic data, refer to the Troubleshooting section.
2.   Contact a FANUC technical representative.

SVGN-260   Search motion is unsuccess.
[Cause]
Upper panel detection failed. The motion may have stopped before the gun tip touched the panel.
[Remedy]
Retry spot program touchup.
If this problem persists after taking the above actions, then perform the following actions:
1.   Obtain the diagnostic data for the problem. For the procedure to obtain diagnostic data, refer to the Troubleshooting section.
2.   Contact a FANUC technical representative.

SVGN-261   Gun abnormal disturbance detected.
[Cause]
The servo gun torque command was not a normal value. This gun mechanical section may have an error.
[Remedy]
Examine the servo gun motion and confirm if there is any error or aging deterioration (out of grease) in the motor or actuator. If any gun issue is resolved, then retry the touchup function.

SVGN-262   Gun abnormal disturbance detected.
[Cause]
The servo gun torque command was not a normal value. This gun mechanical section may have an error.
[Remedy]
Examine the servo gun motion and confirm if there is any error or aging deterioration (out of grease) in the motor or actuator. If any gun issue is resolved, then retry the touchup function.

SVGN-263   Variation in gun disturbance is excessive.

[Cause]

The servo gun torque command was not a normal value. This gun mechanical section may have an error.

[Remedy]

Examine the servo gun motion and confirm if there is any error or aging deterioration (out of grease) in the motor or actuator. If any gun issue is resolved, then retry the touchup function.

SVGN-264   Variation in gun disturbance is excessive.

[Cause]

The gun mechanical section may have some issues.

[Remedy]

If the search motion fails, then check the gun. If you want to complete work detection, then set $SGGUN#.$TEACH.$ESEV4LGVARY = 0 and disable the alarm.

SVGN-265   Mech Comp Calib. succeeded

[Cause]

Calibration of the gun mechanical compensation was completed successfully. The compensation distance can be used for the point touchup function and the spot touchup program.

[Remedy]

There is no need to take action. The detailed results are displayed in SVGN-266.

SVGN-266   Comp dist:%s mm(%s)

[Cause]

This is the result of the calibration of the compensation distance in the gun mechanical compensation. Value in () means Num of Successful calibration/Specified Num of calibrations.

[Remedy]

There is no need to take action.

SVGN-267   Mech Comp Calib. failed

[Cause]

Mechanical calibration for point/program touchup function failed.

Compensation distance could not be found.

[Remedy]

SVGN-268 or other alarm as cause code is posted together. Confirm cause code, then solve it. Also, confirm other alarm in alarm list screen.

SVGN-268   <A message is displayed>

[Cause]

One of the following alarm messages indicating the causes of SVGN-267 is displayed:

Invalid gun number: The specified gun number is invalid.

Invalid thickness: The specified thickness is invalid.

Invalid Gun Open Distance: The specified gun tip open distance is invalid.

Invalid Robot Open Distance: The specified robot tip open distance is invalid.

Invalid Num of Calib: The specified calibration count is invalid.

ALL Calib. NOT SUCCESS: An alarm occurred during calibration and the calibration motion could never be completed successfully.

Check system status: Calibration cannot be executed. The following are the possible causes:

- The system alarm status or hold status has not been released.
- Single step or machine lock is enabled.
- Pressurization is disabled.
- Spot touchup is disabled.

[Remedy]

Take action for each message:

Invalid gun number: Specify the correct gun number.

Invalid thickness: Specify the correct thickness.

Invalid Gun Open Distance: Specify the correct gun tip open distance.

Invalid Robot Open Distance: Specify the correct robot tip open distance.

Invalid Num of Calib: Specify the correct calibration count.

ALL Calib. NOT SUCCESS: Check the alarm list screen and identify the alarm occurred during calibration.

Check system status: Perform the following so that calibration can be performed.

- Release the system alarm status or hold status.
- Disable single step or machine lock.
- Enable pressurization.
- Enable spot touchup.

SVGN-269   Spot program touchup disabled

〔**Cause**〕

Spot touchup was disabled while calibration was being performed.

〔**Remedy**〕

Enable spot touchup.

SVGN-270   Too large torque limit. (Upper)

[Cause]

Gun tip contacted upper panel surface before search motion started. Torque limit became unexpectedly-large during upper panel detection step1.

[Remedy]

Confirm that distance of gun panel contact is not larger than search start distance. Retry spot program touchup. If gun tip contacts upper panel surface before search start distance, confirm that:

1.   no obstruction exists between gun tip and panel.

If the above item is OK, confirm that:

1.   nominal thickness in pressure schedule is correct.

2.   OverThickness tolerance (on gun teach setup screen) is large enough.

If the above items are OK, confirm that:

1.   Max allowable Pos error (on gun teach setup screen) is large enough.

If the above item is applicable, then use the following method to ensure that the teach correction amount is within the allowable value.

1.   Touch up correct position using jog or point touchup (not program touchup).

2.   Increase maximum allowable position error on gun teach setup screen.

If this problem persists after taking the above actions, perform the following actions:

1.   Acquire diagnostic data. See the procedure for diagnostic data collection at Troubleshooting section.

2.   Contact a FANUC technical representative.

SVGN-271   Too large torque limit.(Lower)

[Cause]

Robot tip contacted lower panel surface before search motion started. Torque limit became unexpectedly-large during lower panel detection.

[Remedy]

Confirm that distance of panel contact is not larger than search start distance. If robot tip contacts lower panel surface before search start distance, increase start distance(SD) for robot tip and/or lower panel detection distance. Refer to Chapter "21.6 LOWER PANEL DETECTION DISTANCE CLAMP" or "21.15 SPTCH_RSD INSTRUCTION" for more information about the lower panel detection distance.

Avoid any foreign object while teaching.

Retry spot program touchup.

If this problem persists after taking the above actions, perform the following actions:

1. Acquire diagnostic data. See the procedure for diagnostic data collection at Troubleshooting section.
2. Contact a FANUC technical representative.

SVGN-272   Lower Det start pos error.
[Cause]
Open distance of a gun axis was too short at start position of lower panel detection.
[Remedy]
Confirm that robot tip has enough clearance from panel surface at start position. If distance between robot tip and panel is too short, increase start distance(SD) for robot tip and/or lower panel detection distance. Refer to Chapter "21.6 LOWER PANEL DETECTION DISTANCE CLAMP" or "21.15 SPTCH_RSD INSTRUCTION" for more information about the lower panel detection distance Retry spot program touchup. Retry spot program touchup. If this problem persists after taking the above actions, perform the following actions:
1. Acquire the diagnostic data. See the procedure for diagnostic data collection at Troubleshooting section.
2. Contact a FANUC technical representative.

SVGN-273   Det was irregular stop. R:%d, P:%d
[Cause]
A gun tip was contacted an upper panel surface on a free running section before search motion.
[Remedy]
R:1 means that error occurred during upper panel detection. Confirm that gun tip has enough clearance from upper panel surface at start position. If distance between the tip and the panel is too short, confirm that:
1. No obstruction exists between gun tip and panel.
If the above item is OK, confirm that:
1. nominal thickness in pressure schedule is correct.
2. OverThickness tolerance (on gun teach setup screen) is large enough.
If the above items are OK, confirm that:
1. Max allowable Pos error (on gun teach setup screen) is large enough.
If the above item is NG, the position error is made less than maximum allowable position error in the following ways.
1. Touch up correct position using jog or point touchup (not program touchup).
2. Increase maximum allowable position error on gun teach setup screen.
R:3 means that error occurred during lower panel detection. Confirm that robot tip has enough clearance from panel surface at start position and that there is no obstacle between the panel and the robot tip at start position. If distance between the tip and the panel is too short, increase start distance(SD) for robot tip and/or lower panel detection distance. Refer to Chapter "21.6 LOWER PANEL DETECTION DISTANCE CLAMP" or "21.15 SPTCH_RSD INSTRUCTION" in R-30*i*B CONTROLLER Servo Gun Function OPERATOR'S MANUAL (B-83264EN) for Servo Gun Function for more information about the lower panel detection distance.
Retry spot program touchup.
If this problem persists after taking the above actions, perform the following actions:
1. Acquire the diagnostic data. See the procedure for diagnostic data collection at Chapter "21.23 Troubleshooting" in R-30*i*B CONTROLLER Servo Gun Function OPERATOR'S MANUAL (B-83264EN) for Servo Gun Function.
2. Contact a FANUC technical representative.
Note: This alarm is posted when the time to execute phases2,3 take longer than anticipated, during upper1 detection and lower detection.
R indicates the search motion being performed.
R:1 and R:2 indicate that this alarm occurred during upper panel detection step 1 and lower panel detection, respectively.
P indicates a phase in the motion. P:2 and P:3 indicate that this alarm occurred in the acceleration phase and the state quantity acquisition phase, respectively.

SVGN-274   Too low speed threshold.
[Cause]

Threshold to detect panel contact became unexpectedly-low.

Two causes are expected as follows.

1.   Gun tip is contacted to panel before start search motion.
2.   Speed of gun axis is not stable during search motion.

[Remedy]

1.   If gun tip contacted panel surface at start position, increase start distance(SD) for gun tip.

      If robot tip contacted lower panel surface at start position, increase start distance(SD) for robot tip and/or lower panel detection distance.

      Refer to Chapter "21.6 LOWER PANEL DETECTION DISTANCE CLAMP" or "21.15 SPTCH_RSD INSTRUCTION" for more information about the lower panel detection distance. Retry spot program touchup.
2.   Suppress variation in axis speed at search motion by turning on Use Averaging Speed in Parameter Calibration Setup.

      Refer to Chapter "21.7 Parameter Calibration Setup" for more information about the Use Averaging Speed.

If this problem persists after taking the above actions, perform the following actions:

1.   Acquire the diagnostic data. See the procedure for diagnostic data collection at Troubleshooting section.
2.   Contact a FANUC technical representative.

SVGN-275   Search starts@:%smm(%s desired).
[Cause]

Search start distance was clamped due to gun open limit. SVGN-275 is posted as cause code for SVGN-190.

Actual search start distance is displayed, along with desired (unclamped) search start distance.

[Remedy]

See SVGN-190.

SVGN-276   Search mode was not selected.
[Cause]

Touchup function cannot be executed because search mode was not selected.

[Remedy]

Set $SGSYSTCH.$ACCUDET_ENB=TRUE, and restart spot program touchup function.

SVGN-278   Averaging speed is enabled.
[Cause]

The axis speed is unstable during the search motion. An error detection measure has automatically been enabled.

[Remedy]

If the gun has no abnormality, then no action is necessary.

SVGN-279   Averaging speed is used.
[Cause]

The axis is unstable during the search motion. The error detection measure has automatically been executed.

[Remedy]

If the gun has no abnormality, there is no remedy. Turn Use averaging speed ON manually if you want to disable this message.

SVGN-306   Thickness Check Calib retrying...
[Cause]

Retrying thickness check calibration.

[Remedy]

This is a notification message. There is no need to take action.

SVGN-340   Prog:%s is write protected.
[Cause]

Spot program touchup function could not modify program position, because file is write-protected.

[Remedy]

Disable write protection.

SVGN-341   Spot program touchup pending.
[Cause]

Spot program touchup has been enabled with execution mode = TOUCHUP mode during spot instruction execution, so spot program touchup will not start until next spot. The following sequence can lead to this condition/message:

1. Start program with spot program touchup disabled
2. Pause program during execution of spot instruction
3. Enable spot program touchup (in TOUCHUP mode)
4. Resume (continue) program

[Remedy]

Note: This is a notification message. There is no need to take action. In order to execute program touchup immediately, either execute shift backward (to restart spot) or abort program.

SVGN-342   Spot program verification enabled !
[Cause]

The spot program touchup function is executed in the diagnosis mode, instead of performing normal spot motion.

[Remedy]

This is a notification message. There is no need to take action.

If you need to execute the spot program touchup function in touchup mode, then follow the steps below to disable the diagnosis mode in the spot program touchup setup screen:

1.   If TP is disabled, then set Execution mode for AUTO = TOUCHUP mode.
2.   If TP is enabled, then set Execution mode for TEACH = TOUCHUP mode.

If you want to execute the normal spot instruction, then disable the spot program touchup function:

1.   If TP is disabled, then turn OFF the enable signal for the spot program touchup function.
2.   If TP is enabled, then disable the spot program touchup function in the TEST CYCLE screen.

SVGN-343   Spot program diag mode stand-by
[Cause]

The spot program touchup function has been enabled while executing the spot instruction. In this case, the spot program touchup function is enabled by the following spot instruction:

1.   Start program with spot program touchup disabled
2.   Pause program during execution of spot instruction
3.   Enable spot program touchup (in VERIFY mode)
4.   Resume (continue) program

[Remedy]

This is a notification message. There is no need to take action.

To enable the spot program touchup function from the line being executed, either execute BWD to go back to the spot start position or abort the program and execute the function again.

SVGN-344   Torque limit calibration incomplete.
[Cause]
The point touchup function was executed with the detection condition "Non-Adaptive2," but torque limit calibration has not been completed.
[Remedy]
Complete the torque limit calibration for the upper and lower panel detection parameters or change the search condition to Adaptive.

SVGN-385   Prg tch mode switch err
[Cause]
Spot program touchup mode had become ENABLE immediately before spot instruction is executed.
[Remedy]
Make the spot program touchup mode ENABLE earlier.
Make this mode ENABLE before the program to touch up is executed.
If you call the target program from the main program, then ENABLE the mode before the CALL instruction.

22   SERVO TIP DRESSER CONTROL

22.1   OVERVIEW

This function will directly provide control of the tip dressing operation by building the servo motor of FANUC into the tip dresser.

This function is optional (not standard).

Servo Tip Dresser Control	A05B-2***-R708

> ⚠ **CAUTION**
> Use Brake Number except No. 1 with brake unit if dresser uses motor that integrates brake.

22.2   SERVO TIP DRESSER AXIS SETUP
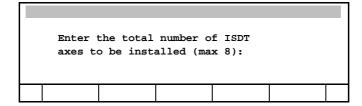
Setup of Servo Tip Dresser axis is required in order to use this function. You can setup Servo Tip Dresser axes in MAINTENANCE screen at controlled start status. Servo Tip Dresser axes are set as the axes of motion group 0.

Procedure
1   Perform a controlled start.
2   Press the [MENU] key and select "9.MAINTENANCE." The following screen will be displayed.

```
ROBOT MAINTENANCE
                                        1/10
     Setup Robot System Variables

     Group   Robot Library/Option   Ext Axes
        1    R-2000iB/165F               0
        2    Servo Gun Axes              0
        0    Basic Positioner            0


    [TYPE]   ORD NO   AUTO   MANUAL
```
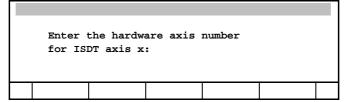
3   Move the cursor to "Basic Process Axis" and press F4 "MANUAL."
4   The following screen will be displayed. Input the number of Servo Tip Dresser axes here. Input 1 if you use one Servo Tip Dresser. Input 2 if you use two Servo Tip Dresser.

```
     Enter the total number of ISDT
     axes to be installed (max 8):
```
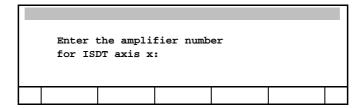
5   Enter FSSB line with which the Servo Tip Dresser axes is connected.

-301-

```
┌─────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓       │
│                                               │
│    Enter the FSSB number (from 1,2,3 or 5)    │
│    on which ISDT axis x is installed:         │
│                                               │
│                                               │
├──────┬──────┬──────┬──────┬──────┬──────┬─────┤
│      │      │      │      │      │      │     │
└──────┴──────┴──────┴──────┴──────┴──────┴─────┘
```
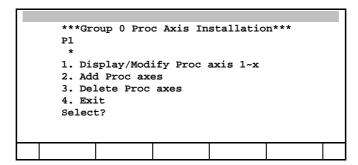
6   Type the axis number in the whole system to be assigned to the servo tip dresser axis. For example, in the case of R-2000*i*B + servo gun axis (single-gun) + servo tip dresser axis, the servo tip dresser axis in the 0th group starts from the 8th axis because the R-2000*i*B in the 1st group is a 6-axis robot and servo gun is a 1-axis gun.

```
┌─────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓       │
│                                               │
│    Enter the hardware axis number             │
│    for ISDT axis x:                           │
│                                               │
│                                               │
├──────┬──────┬──────┬──────┬──────┬──────┬─────┤
│      │      │      │      │      │      │     │
└──────┴──────┴──────┴──────┴──────┴──────┴─────┘
```

7   Enter the servo amplifier number to which the servo tip dresser axis is connected.

```
┌─────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓       │
│                                               │
│    Enter the amplifier number                 │
│    for ISDT axis x:                           │
│                                               │
│                                               │
├──────┬──────┬──────┬──────┬──────┬──────┬─────┤
│      │      │      │      │      │      │     │
└──────┴──────┴──────┴──────┴──────┴──────┴─────┘
```

8   The following screen will be displayed.

```
┌─────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓       │
│    ***Group 0 Proc Axis Installation***       │
│    P1                                         │
│     *                                         │
│    1. Display/Modify Proc axis 1~x            │
│    2. Add Proc axes                           │
│    3. Delete Proc axes                        │
│    4. Exit                                    │
│    Select?                                    │
│                                               │
├──────┬──────┬──────┬──────┬──────┬──────┬─────┤
│      │      │      │      │      │      │     │
└──────┴──────┴──────┴──────┴──────┴──────┴─────┘
```

9   To add Servo Tip Dresser axes, choose "2. Add Proc axes." To delete Servo Tip Dresser axes, choose "3. Delete Proc axis" and press the [ENTER] key.

10   If "2. Add Proc axes" is chosen, the following screen will be displayed. Enter the axis number that you want to add.
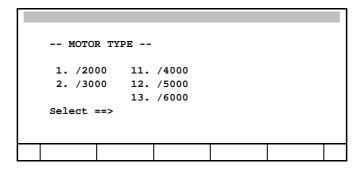
```
┌─────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓       │
│                                               │
│    Add Proc axex                              │
│    Enter axis to add (1~x)?                   │
│                                               │
│                                               │
├──────┬──────┬──────┬──────┬──────┬──────┬─────┤
│      │      │      │      │      │      │     │
└──────┴──────┴──────┴──────┴──────┴──────┴─────┘
```

11   Select the Motor type used for the Servo Tip Dresser axis on the screen.

```
  -- MOTOR SIZE (alpha iS) --

 60. aiS2     64. aiS22
 61. aiS4     65. aiS30
 62. aiS8     66. aiS40
 63. aiS12
  0. Next Page
Select ==>
```

12   Select Motor Type on the screen.

```
  -- MOTOR TYPE --

 1. /2000    11. /4000
 2. /3000    12. /5000
             13. /6000
Select ==>
```

13   Select Current Limit for the amplifier on the screen.

```
  -- CURRENT LIMIT FOR AMPLIFIER--

 2.    4A  10.   20A
 5.   40A  12.  160A
 7.   80A

 Select ==>
```
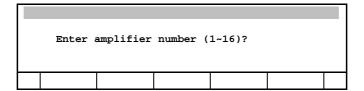
14   Select Current Limit for the motor on the screen.

```
  -- CURRENT LIMIT FOR MOTOR --

 2.    4A  10.   20A
 5.   40A  12.  160A
 7.   80A

 Select ==>
```
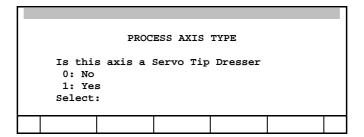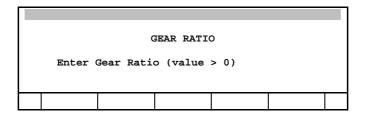
15   Enter the servo amplifier number to which the servo tip dresser axis is connected.

```
┌──────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓           │
│                                            │
│      Enter amplifier number (1~16)?        │
│                                            │
│                                            │
├────┬─────┬─────┬─────┬─────┬─────┬────┤
│    │     │     │     │     │     │    │
└────┴─────┴─────┴─────┴─────┴─────┴────┘
```

16   Enter "1: Yes," to indicate the motor just selected is for the Servo Tip Dresser.

```
┌──────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓           │
│                                            │
│             PROCESS AXIS TYPE              │
│                                            │
│     Is this axis a Servo Tip Dresser       │
│      0: No                                 │
│      1: Yes                                │
│     Select:                                │
│                                            │
├────┬─────┬─────┬─────┬─────┬─────┬────┤
│    │     │     │     │     │     │    │
└────┴─────┴─────┴─────┴─────┴─────┴────┘
```

17   Enter Gear Ratio. The gear ratio is the number of motor revolutions required to spin the cutting blade 1 full revolution.

```
┌──────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓           │
│                                            │
│                GEAR RATIO                  │
│                                            │
│      Enter Gear Ratio (value > 0)          │
│                                            │
│                                            │
├────┬─────┬─────┬─────┬─────┬─────┬────┤
│    │     │     │     │     │     │    │
└────┴─────┴─────┴─────┴─────┴─────┴────┘
```

18   Set the maximum speed of the axis. "1: Default Speed" is the speed achieved by the cutting blade if the motor is spinning at 100% maximum speed. Set this value based on the dresser mechanism.

```
┌──────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓           │
│                                            │
│          MAX JOINT SPEED SETTING           │
│                                            │
│     Current Speed =    0.000(rpm)          │
│     Default Speed = 600.000(rpm)           │
│      (Calculated with Max motor Speed)     │
│                                            │
│     Enter(1:Default, 2:Change, 3:No Change)?│
│                                            │
├────┬─────┬─────┬─────┬─────┬─────┬────┤
│    │     │     │     │     │     │    │
└────┴─────┴─────┴─────┴─────┴─────┴────┘
```
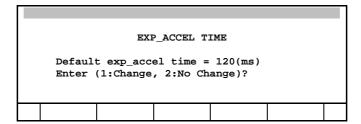
19   Select the rotation direction of the cutter against the motor. If the forward direction of the motor and the rotation direction of the cutter are matched, set "1:TRUE." If they are not matched, select "2:FALSE."
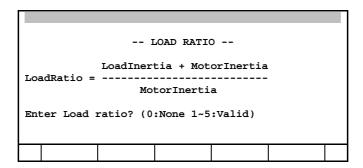
```
┌──────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓           │
│                                            │
│              MAX DIRECTION                 │
│                                            │
│     Proc_axs 1 Motion Sing = TURE          │
│     Enter (1:TURE, 2:FALSE)?               │
│                                            │
│                                            │
├────┬─────┬─────┬─────┬─────┬─────┬────┤
│    │     │     │     │     │     │    │
└────┴─────┴─────┴─────┴─────┴─────┴────┘
```
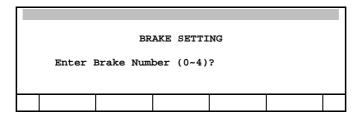
20 Enter exponential acceleration time. If you want to change the value, choose "1: Change," then enter the new value. If you do not want to change the value, select "2: No Change." The default value is 40 to 120 ms.

```
┌──────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓            │
│                                                │
│              EXP_ACCEL TIME                    │
│                                                │
│       Default exp_accel time = 120(ms)         │
│       Enter (1:Change, 2:No Change)?           │
│                                                │
│                                                │
├─────┬─────┬─────┬─────┬─────┬─────┬─────┬──────┤
│     │     │     │     │     │     │     │      │
└─────┴─────┴─────┴─────┴─────┴─────┴─────┴──────┘
```

21 This value is the ratio of the rotor axis converted total load inertia to the inertia. The valid range of Load Ratio is 1 < inertia ratio < 5. If you don't want to set this value, enter "0." Consult with tip dress manufacturer to determine the appropriate setting.

```
┌──────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓            │
│                                                │
│             -- LOAD RATIO --                   │
│                                                │
│           LoadInertia + MotorInertia           │
│ LoadRatio = ------------------------           │
│                   MotorInertia                 │
│                                                │
│ Enter Load ratio? (0:None 1~5:Valid)           │
│                                                │
├─────┬─────┬─────┬─────┬─────┬─────┬─────┬──────┤
│     │     │     │     │     │     │     │      │
└─────┴─────┴─────┴─────┴─────┴─────┴─────┴──────┘
```

22 Enter Brake Number. Use the Brake number, except 1 for the brake used for the servo tip dresser axis.

```
┌──────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓            │
│                                                │
│              BRAKE SETTING                     │
│                                                │
│        Enter Brake Number (0~4)?               │
│                                                │
│                                                │
├─────┬─────┬─────┬─────┬─────┬─────┬─────┬──────┤
│     │     │     │     │     │     │     │      │
└─────┴─────┴─────┴─────┴─────┴─────┴─────┴──────┘
```

23 Come back to the screen of step 8.

```
┌──────────────────────────────────────────────┐
│ ▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓            │
│     ***Group 0 Proc Axis Installation***       │
│     P1                                         │
│      I                                         │
│     1. Display/Modify Proc axis 1~x            │
│     2. Add Proc axes                           │
│     3. Delete Proc axes                        │
│     4. Exit                                    │
│     Select?                                    │
│                                                │
├─────┬─────┬─────┬─────┬─────┬─────┬─────┬──────┤
│     │     │     │     │     │     │     │      │
└─────┴─────┴─────┴─────┴─────┴─────┴─────┴──────┘
```

- To display/modify the Servo Tip Dresser axis setting, choose "1: Display/Modify Proc axis 1~x."
- To add the next Servo Tip Dresser axis, choose "2:Add Proc axis," then start the procedure from step 9.
- To delete the Servo Tip Dresser axis, choose "3:Delete Proc Axis."
- To finish Servo Tip Dresser axis setup, choose "4:Exit."

22.3   TIPDRESS INSTRUCTION

The TIPDRESS instruction is used to press the tip.
The instruction allows you to perform pressure motion, pressurize for the dress time or for the number of cutter revolutions, and then open a servo gun.

Instruction format

Stand Alone format:
        1:    TIPDRESS [SD = m, P = n, t = j, TD = i, ED = m]

        m: Distance schedule numbers (1–99)
        n: Pressure schedule number (1–9)
        i: Tip dress schedule number* (0–2)
        j: Thickness of dresser (mm)
              *Tip dress schedule can be set on the Tip dress setup menu.

Motion Option format:
        1: L P[1] 2000 mm/sec FINE TIPDRESS [SD = m, P = n, t = j, TD = i, ED = m]
- Pressurize the gun using the specified start distance, pressure schedule number, and tip thickness.
- Turn on the blow-off valve signal when it is assigned on the TIPDRESS SETUP screen.
- Once pressure is achieved, do one of the following according to the dressing completion type:
    1. If end of dress type in the dress schedule is TIME, then hold pressure for the time specified in the schedule assigned in the Tip Dress (TD=) field.
    2. If end of dress type in the dress schedule is REVS, then hold pressure for the number of cutter head revolutions specified in the schedule assigned in the Tip Dress (TD=) field.
    3. For 7DF1 (V9.10P) and later, if end of dress type in the dress schedule is WldCntrl, then hold pressure until the weld controller end of weld signal is received.
- Once the tip dressing is complete, open the tip according to the open tip distance and turn off the blow-off valve signal.
- Increment the cutter count and guns tip dress count on the TIPDRESS SETUP screen.
- The TIPDRESS instruction can be executed with both the Motion Option and single command. For the case of the Motion Option command, both gun and robot tips move during the pressurization sequence.
- When you execute TIPDRESS instruction in single step mode, servo tip dresser does not drive.

NOTE:
It is not possible to use the Tip Dress command on multiple guns simultaneously. In the case of a dual gun application, ensure at least one tip dress schedule parameter is set to 0 in the Tip Dress instruction.

22.4   TIP DRESS SETUP MENU

Display the TIPDRESS SETUP menu, using the procedure below:
1   Press the [MENU] key. Select "6 SETUP."
2   Press F1 "TYPE" to select "9. Tip Dress."

The following screen will be displayed.

```
┌────────────────────────────────────────────────────┐
│ TIP DRESS                                            │
│                                              1/29    │
│                                                      │
│   - Dresser #:1                                      │
│      Current # of cuts:                        0     │
│      Max # of cuts:                            0     │
│      Max Cuts alarm Sev:               FAULT         │
│      Blow Off Valve:              DO[    0]           │
│      Fault output:                DO[    0]           │
│      Alert output:                DO[    0]           │
│      Fault/Alert Reset:           DI[    0]           │
│      Max Free Torque:                          0     │
│      Max Free Torqe Sev:               FAULT         │
│      Last Dress # of REVS:                           │
│        Contact to Force:                     0.0     │
│        Force to End of Dress:                0.0     │
│        Dress End to Gun Open:                0.0     │
│                                                      │
│   - Gun #:1                                          │
│      Dresser number for gun:                   1     │
│      Current # of dresses:                     0     │
│      Max # of dresses:                         0     │
│      Max dress alarm Sev:              FAULT         │
│                                                      │
│   - Sched #: 1                                       │
│      Step #1:                                        │
│       Duration (ms):                           1     │
│       Speed (rpm):                             0     │
│       Rotation:                          POS         │
│       Torque Max increase %:                   0     │
│       Torque Min increase %:                   0     │
│       Max/Min  alarm Sev:              FAULT         │
│       End of Dress Method:              TIME         │
│       Comment:                                       │
│       -----------------------------------            │
│      Step #2:                                        │
│       Duration (ms):                           0     │
│       Speed (rpm):                             0     │
│       Rotation:                          POS         │
│       -----------------------------------            │
│      Step #3:                                        │
│       Duration (ms):                           0     │
│       Speed (rpm):                             0     │
│       Rotation:                          POS         │
│       -----------------------------------            │
│                                                      │
│  ┌──────────┬───────┬──────────┬────┬─────┬────┐     │
│  │ [TYPE]   │ CHART │ SUM_CHAR │    │     │    │     │
└────────────────────────────────────────────────────┘
```

The SETUP menu is broken up into 3 sections.

- Dresser info

ITEM	DESCRIPTION
Dresser # Default: 1	A dresser number of the currently displayed dresser information. Dresser information can be set for each dresser. If multiple dressers exist in a system, change the system variable $sgtdcfg.$num_dresrs to the number of the dressers. The maximum number of dressers is 8. If $sgtdcfg.$num_dresr is changed, a CTRL start must be performed.
Current number of cuts Default: 0	This item counts the number of dressings performed. This item is incremented automatically after each successful dress. You can reset this count on this screen by cursoring to the item and setting it to 0, or programmatically by setting $sgtdset[Dresser_num].$cut_count.
Max # of cuts Default: 0	Specify the maximum cuts for the cutter blade to perform. When current cuts are greater than max cuts, then the system will post a Fault or Warning depending on the Max cuts alarm sev. Setting. • SPOT-075 Max cutter counts exceeded.
Max Cuts Alarm Sev. Default: FAULT	Specify the following severity of the alarm as a Fault or Warning. • SPOT-075 Max cutter counts exceeded.

ITEM	DESCRIPTION
Blow off Valve Default: 0	This is the output only for the dressing time when dress is being executed. Use this to control the blow-off valve when a dress is being performed.
Fault output Default: 0	This is theoutput when there is a TIPDRESS error.
Alert output Default: 0	This is the index of the DOUT that will turn on when there is a TIPDRESS error, and the severity has been configured as a Warning.
Fault/Alert Reset Default: 0	The reset input can turn off Fault output and Alert output
Send Schedule to WC Default: FALSE	This item is used to control the dressing time with a weld timer. To display this item, set $sgtdcfg.$dsp_wschd = TRUE. If this item is enabled and a TIPDRESS instruction is executed, a weld schedule specified in the tipdress schedule will be sent to a weld timer, and gun pressurization will continue until a weld complete signal from the weld timer is received. In software series 7DF1 (V9.10P) or later, if Send Schedule to WC is enabled, the dressing time control and dress chart are controlled regardless of the end of the dress type and the dressing time is controlled by the weld machine.
Max Free Torque Default: 0	This item is the maximum torque required to spin the motor at the specified dressing speed with no load applied by the gun tips. If the torque when the gun is not touched exceeds the value specified here, the following fault or warning is posted depending on the Max Free Torqe Sev setting. • SPOT-081 Max free torque exceeded. Excessive free torque can be an indication the dresser has a fault. Inspect the dresser, etc. This item is disabled when it is set to 0. To set this item, refer to the torque in "Dress Result Monitor Function" and FREE_TORQ in "Dress Summary Log File and Chart" in the next chapter.
Max Free Torqe Sev Default: FAULT	Specify the following alarm severity, which can be a Fault or Warning. • SPOT-081 Max free torque exceeded.
Last Dress # of REVS	The following 3 items will report the number of cutter revolution during the last dress.
Contact to Force	This is the number of revolutions of the cutter head from the time the servo gun contacts the cutter head until force is achieved.
Force to End of Dress	This is the number of revolutions of the cutter head from the time force is achieved with the servo gun until the end of the dress is detected.
Dress End to Gun Open	This is the number of revolutions of the cutter head from the time the dress ends until the servo gun releases the cutter head.

• Gun info

ITEM	DESCRIPTION
Gun # Default: 1	A gun number of the currently displayed gun information. The gun information can be set for each gun.
Dresser number for gun Default: 1	This maps a dresser to the gun. Specify the number of the dresser used for this gun.
Current # of dresses Default: 0	This item counts the number of TIPDRESS instructions executed. It is incremented automatically after each successful dress. You can reset this count on this screen by cursoring to the item and setting it to 0, or programmatically by setting $sggun#.$setup.$dress_cnt.
Max number of dresses Default: 0	Specify the maximum number of tip dressing. When the current dresses are greater than the max dresses, the following fault or warning is posted depending on the Max dress alarm severity setting. • SPOT-076 Max tip dresses on Gun #%d exceeded.
Max Dress Alarm Sev Default: FAULT	Specify the following alarm severity, which can be a Fault or Warning. • SPOT-076 Max tip dresses on Gun #%d exceeded.

• Schedule info

ITEM	DESCRIPTION
Sched # Default: 1	The tip dress schedule number of the currently displayed tip dress schedule information. There are 2 schedules by default. To increase the number of schedules, set $sgtdcfg.$num_sched, and then perform a CTRL start.
Step #	A maximum 3 steps can be provided as a dress schedule. It is 1 step by default. If 3 steps are used, the following dress is possible. To increase the number of steps, change the system variable $sgtdcfg.$numstepsdsp.
Duration (ms) OR # of REVS Default: 0	When the end of dress type is TIME: Set a dressing time (ms) for this item. Once a specified pressure is achieved, pressurization is performed for the dressing time being set here. When the end of dress type is # of REVS: Set the number of cutter revolutions for this item. Once a specified pressure is achieved, pressurization is performed for the number of cutter revolutions being set here.
Speed (rpm) Default: 0	This is the cutter speed (rpm) for Step #1.
Rotation Default: POS	This is the direction of the rotation of the cutter. Positive is the polishing direction.
Torque Max increase% Default: 0	Specify the upper limit of torque increase allowed during Step #1. If the torque exceeds the "free torque + maximum torque increase" during Step #1, the following fault or warning is posted depending on Max/Min alarm Sev. • SPOT-078 Tdress max Torque exceeded. To set this item, refer to the torque in "Dress Result Monitor Function" and MAX_TORQ in "Dress Summary Log File and Chart" in the next chapter.
Torque Min increase % Default: 0	Specify the lower limit of torque increase allowed during Step #1. If the torque does not reach the "free torque + minimum torque increase" during Step #1, the following fault or warning is posted depending on Max/Min alarm Sev. • SPOT-077 Tdress min Torque not acheived. To set this item, refer to the torque in "Dress Result Monitor Function" and MIN_TORQ in "Dress Summary Log File and Chart" in the next chapter.
Max/Min Alarm Severity Default: FAULT	Specify the following alarm severity for this item, which can be a Fault or Warning. • SPOT-078 Tdress max Torque exceeded. • SPOT-077 Tdress min Torque not acheived.
End of Dress Method Default: TIME	When the end of dress type is TIME: Once the specified pressure is reached, pressurization is performed for dressing time. When the end of dress type is REVS: Once the specified pressure is reached, pressurization is performed for the number of revolutions. When the end of dress type is WldCntrl: Once the specified pressure is reached, pressurization is performed until a weld complete signal is received. This function is available in software series 7DF1 (V9.10P) or later. Send Schedule to WC must be enabled to use the weld controller option. Multiple step dresses are not supported when using weld controller option.
Weld Schedule Default: 1	This item is used to control dressing time with a weld timer. To display this item, set $sgtdcfg.$dsp_wschd = TRUE. If the above-mentioned Send Schedule to WC is enabled and a TIPDRESS instruction is executed, a weld schedule specified here will be sent to a weld timer, and gun pressurization will continue until a weld complete signal from the weld timer is received. Specify the weld schedule for dressing (no conducting) for this weld schedule.
Comment	Allows you to associate a comment with this tip dress schedule.

> ⚠ **CAUTION**
> When push depth is set to a value greater than the default and TIPDRESS is
> executed with a low override, the pressurizing time might become longer than the
> specified dressing time. It is recommended to change the push depth to 5 mm
> when you want to avoid this. The push depth can be changed by the system
> variable $sgsch#[pressure schedule number].$pushing_depth. A default value of
> the push depth is 10 mm.
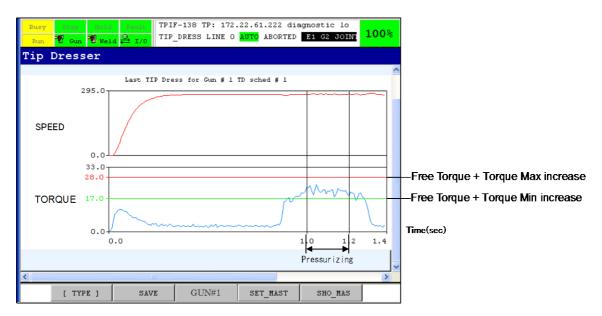
22.5   OTHER FUNCTIONS

22.5.1   Dress Result Monitor Function

You can get a graphical display of the speed and torque of the last dress performed by the tip dresser.
Display the Last Dress/Master Dress Chart, using the procedure below:
1   Press the [MENU] key. Select "6 SETUP."
2   Press F1"TYPE" to display the pull-up menu.
     Select "9 Tip Dress."
3   Press F2"CHART."

The following screen will be displayed.

ITEM	DESCRIPTION
SPEED Unit: rpm	This is a speed variance of the cutter head from the start of TIPDRESS instruction to the end.
TORQUE Unit: %	This is a free torque variance from the start of TIPDRESS instruction to the end. Use this as a guideline when setting the free, max, and min torque in the tip dress setup screen.

Operation

ITEM	DESCRIPTION
F2 SAVE	This chart is saved as a text file in the CSV format named TDLOG#.CSV (# is gun number) to the external device.
F3 GUN#	This changes the gun number.
F4 SET_MAST	This can be used to save the current chart as the "Master Chart" which can be recalled at any time by pressing the SHO_MAST button.
F5 SHO_MAST / SHOW_LA	Use this button to toggle between showing the results from the last dress done and the master dress.
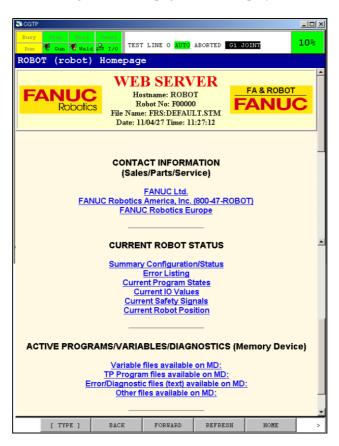
> ⚠ **CAUTION**
> When power supply is turned off, the last dress result is lost. Press F2 "SAVE" if
> you want to save the last dress result as a text file in the CSV format to an external
> device.

22.5.2   Dress Summary Log File and Chart
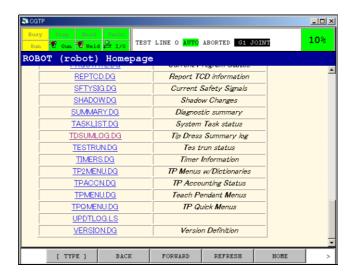
For each dress that occurs, a record is written to the summary log. The name of summary log is TDSUMLOG.DG.

Display the summary log, using the procedure below:
1   Press the [MENU] key.
2   Select "0 --NEXT--," "8. BROWSER."
3   Press F5"HOME." The following robot homepage will be displayed.
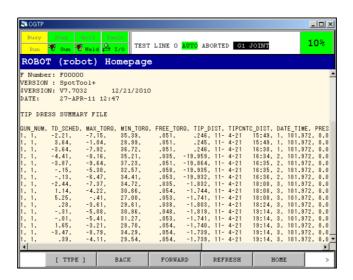
4   Move the cursor to "Error/Diagnostic files (text) available on MD," and press the [ENTER] key. The following screen is displayed.

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5   Move the cursor to "TDSUMLOG.DG," and press the [ENTER] key.

The following summary log will be displayed.

ITEM	DESCRIPTION
GUN_NUM	This is gun number.
TD_SCHED	This is the tip dress schedule number specified with the TIPDRESS instruction.
MAX_TORQ Unit: %	This is the max torque increase to the torque with no loads applied to the gun during Step #1. Use this as a guideline when setting the max torque increase in the tip dress setup screen.
MIN_TORQ Unit: %	This is min torque increase to the torque with no loads applied to the gun during Step #1. Use this as a guideline when setting the min torque increase in the tip dress setup screen.
FREE_TORQ Unit: %	This is motor torque with no loads applied to the gun. Use this as a guideline when setting the free torque in the tip dress setup screen.
TIP_DIST Unit: mm	This is distance the servo gun tips (mm) moved forward from the time tip pressure was achieved until dress is done. To use this item, gun mastering before dressing must be in a proper state.
TIPCNTC_DIST Unit: mm	This is position of servo gun tips (mm) when the dresser motor torque increased enough to determine the servo gun tips were in contact with the cutter blades. To use this item, gun mastering before dressing must be in a proper state.
DATE_TIME	This is the time/date when the TIPDRESS instruction was executed.
PRESS_SCHED	This is pressure schedule number in TIPDRESS instruction.
PRESS_VAL (kgf)	This is the pressure of the pressure schedule number specified in TIPDRESS instruction.

ITEM	DESCRIPTION
TOTAL_TIP_WEAR Unit: mm	This is current total servo gun tip wear.
END_TORQ	This is not being used now.
TOTAL_REVS	This is the number of revolutions of the cutter head from the time force is achieved with the servo gun until the end of the dress is detected.

Summary log will hold the max. 130 dresses.
Summary log can be saved to an external device by backing up in the file screen.
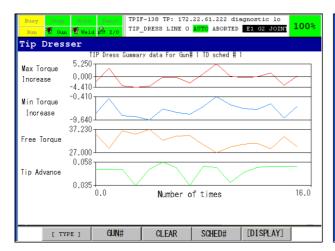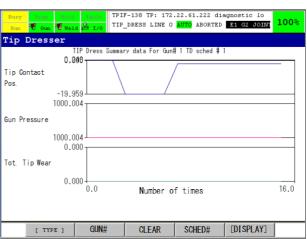
Information obtained from the summary log can be displayed as a chart.
Display the chart menu, using the procedure below:
1   Press the [MENU] key. Select "6. SETUP."
2   Press F1"TYPE" to display the pull-up menu.
       Select "9 Tip Dress."
3   Press F3"SUM_CHAR."

The following screen will be displayed.

ITEM	DESCRIPTION
Max Torque Increase Unit: %	This is a chart of MAX_TORQ in summary log file.
Min Torque Increase Unit: %	This is a chart of MIN_TORQ in summary log file.
Free Torque Unit: %	This is a chart of FREE_TORQ in summary log file.
Tip Advance Unit: mm	This is a chart of TIP_DIST in summary log file.
Tip Contact Pos. Unit: mm	This is a chart of TIPCNTC_DIST in summary log file.
Gun Pressure Unit: kgf	This is a chart of PRESS_VAL in summary log file.
Tot. Tip Wear Unit: mm	This is a chart of TOTAL_TIP_WEAR in summary log file.
End Torque	This is not being used now.

Operation

ITEM	DESCRIPTION
F2 GUN#	This changes the gun number.
F3 CLEAR	This deletes contents of summary log file.
F4 SCHED#	This changes the tip dress schedule.
F5 [DISPLAY]	This can be used to toggle on/off each display items.

22.5.3 Servo Tip Dresser Drive Program

The following KAREL program to drive tip dress servo motor is prepared beforehand.

TURNDRES (Dresser number, Cutter head speed [rpm], Driving time [ms])
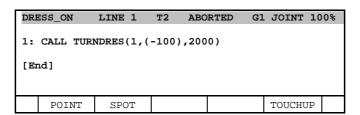
This KAREL program can drive tip dress servo motor without the execution of the TIPDRESS instruction.

Step

1   Make a suitable TP program. Call TURNDRES.PC in the TP program.
2   Specify dresser number, cutter head speed and driving time to the argument.

```
DRESS_ON      LINE 1    T2    ABORTED    G1 JOINT 100%

1: CALL TURNDRES(1,100,2000)

[End]


      POINT   SPOT                        TOUCHUP
```

3   Execute the TP program. Tip dress servo motor drives according to the specified argument.
4   Specify a negative value as follows for a cutter head speed if you want to make the tip dress servo motor reverse-driven.

```
DRESS_ON      LINE 1    T2    ABORTED    G1 JOINT 100%

1: CALL TURNDRES(1,(-100),2000)

[End]


      POINT   SPOT                        TOUCHUP
```

22.6 ALARM

Refer to OPERATOR'S MANUAL (Alarm Code List) (B-83284EN-1).

23 WELDTIP INSPECTION
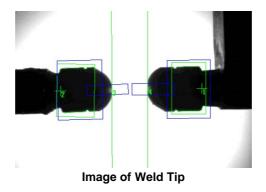
23.1 OVERVIEW

The Weld Tip Inspection is designed to visually inspect and error proof the condition of spot welding tips. This function requires Weld Tip Inspection (A05B-2500-J847)

- Verification of tip figure during replacement
- Verification of successful Tip Dress Operation
- Measure Gun and Robot tip wear to determine if threshold is exceeded
- Adjust welding tip gap from tip wear
- Check Alignment of weld tip angles
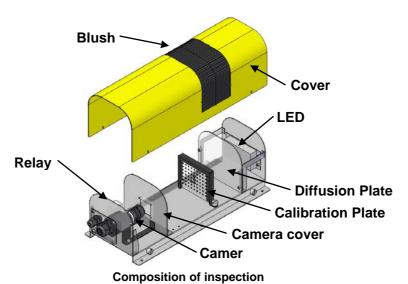
23.1.1 WeldTip Vision Model

*i*RVision camera takes and saves the figure of new tip. Weldtip inspection compares the figure of tip at the inspection with that of new tip.

Image of Weld Tip
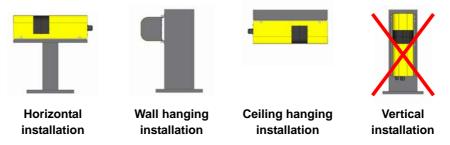
23.1.2 Composition of Tip Inspection

Inspection box is composed as following. Camera and LED light are located. Move robot into the station's view position. Robot moves accurately every times and it leads correct inspection.

Composition of inspection

⚠️**CAUTION**
- The direction of the installation is only for the horizontal or wall hanging. Please do not set it up in the vertical direction for dustproof. (Following chart)
- Please clean the camera cover and diffusion plate in the main body periodically.
- Please down the power supply immediately when water splashes. Then take off the main body cover, and wipe moisture in the main body off.
- Please do not step the body.
- Please light the LED only during inspection of the tip.

| **Horizontal installation** | **Wall hanging installation** | **Ceiling hanging installation** | **Vertical installation** |

23.1.3   Related Function

*i*RVision

*i*RVision is a visual sensor system designed to provide robot guidance and error proofing capabilities by inspecting a workpiece using cameras. It can perform workpiece position detection and figure inspection. This function performs tip inspection using some *i*RVision functions. For the full details on the setup and use of *i*RVision, please refer to the *i*RVision Addendum and *i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN).

23.2   HARDWARE SETUP

It explains the setup method of weld tip inspection (A05B-1409-B101) as follows.

NOTE
The specifications below indicate the hardware specifications for the R-30*i*B.
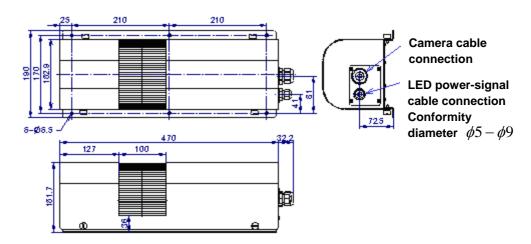
23.2.1   Inspection Box

Specifications

Item		description
Tip inspection	The main function	Weld tip inspection, shank relative angle inspection Cutting amount check of tip
	Method	Picture processing by *i*RVison
	Camera, Lens, LED	Built-in
	LED power supply	DC24V supply necessity, it is possible to turn it on and off by relay (built-in).
	Size	470 x 190 x 152（refer to the overall dimensions）
	Mass	4.2kg
Sensor control part	Picture processing	R-30*i*B main board
	Number of pixels	512 x 480
	Operational environment	PC (it can be detached except teaching)
	Image display	iPendant (or PC connected with Ethernet)
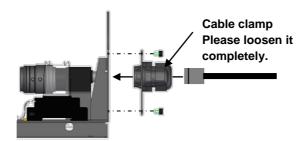
Overall dimensions
Installation dimensions

Camera cable
connection

LED power-signal
cable connection
Conformity
diameter $\phi 5 - \phi 9$
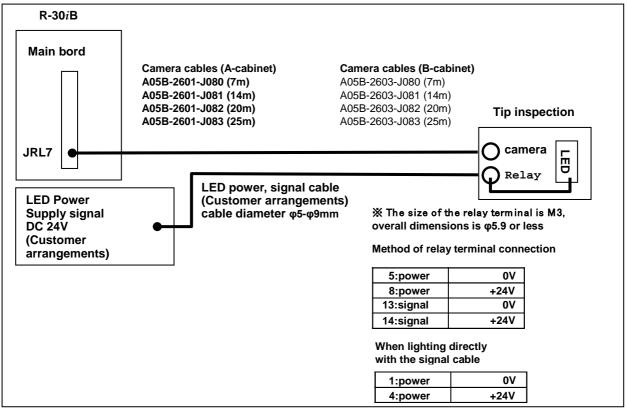
23.2.2   Routing Method of Main Body Connection Cables（Camera, LED）

Please do the connection and detaching the camera cable after turning off robot controller's power supply without fail. There is a possibility that the hardware or the robot controller breaks down when the cable is connected or detached at power supply ON.
Please loosen the cable clamp completely and detach the plate in the back when you connect the camera cable.
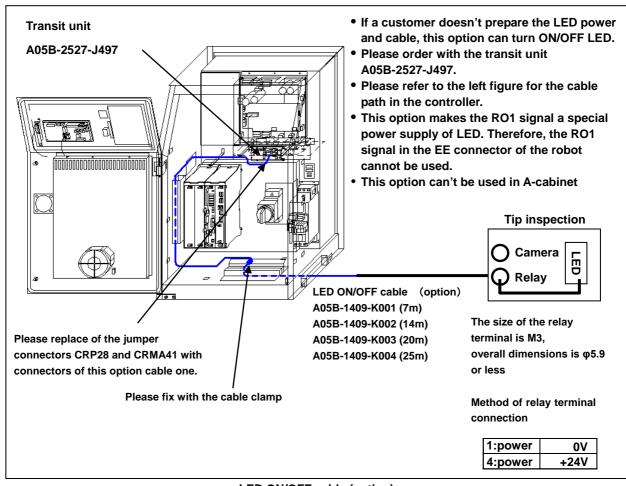
Cable clamp
Please loosen it
completely.

Method of camera cable connection

R-30iB

Main bord

JRL7

Camera cables (A-cabinet)
A05B-2601-J080 (7m)
A05B-2601-J081 (14m)
A05B-2601-J082 (20m)
A05B-2601-J083 (25m)

Camera cables (B-cabinet)
A05B-2603-J080 (7m)
A05B-2603-J081 (14m)
A05B-2603-J082 (20m)
A05B-2603-J083 (25m)

Tip inspection

camera

Relay

LED

**LED Power
Supply signal
DC 24V
(Customer
arrangements)**

**LED power, signal cable
(Customer arrangements)
cable diameter φ5-φ9mm**

※ The size of the relay terminal is M3,
overall dimensions is φ5.9 or less

Method of relay terminal connection

5:power	0V
8:power	+24V
13:signal	0V
14:signal	+24V

**When lighting directly
with the signal cable**

1:power	0V
4:power	+24V

Connection of camera and LED

Transit unit

A05B-2527-J497

- **If a customer doesn't prepare the LED power
  and cable, this option can turn ON/OFF LED.**
- **Please order with the transit unit
  A05B-2527-J497.**
- **Please refer to the left figure for the cable
  path in the controller.**
- **This option makes the RO1 signal a special
  power supply of LED. Therefore, the RO1
  signal in the EE connector of the robot
  cannot be used.**
- **This option can't be used in A-cabinet**

Tip inspection

Camera

Relay

LED

**Please replace of the jumper
connectors CRP28 and CRMA41 with
connectors of this option cable one.**

Please fix with the cable clamp

LED ON/OFF cable （option）
A05B-1409-K001 (7m)
A05B-1409-K002 (14m)
A05B-1409-K003 (20m)
A05B-1409-K004 (25m)

**The size of the relay
terminal is M3,
overall dimensions is φ5.9
or less**

**Method of relay terminal
connection**

1:power	0V
4:power	+24V

LED ON/OFF cable (option)

23.2.3   Installation of Calibration Plate

Please install Calibration plate (A05B-1409-J901) horizontally with main body. And confirm whether the bulge of under Plate is accurately in a square hole of main body. And tightens a bolt. Because the lock washer is broken Please do not pull the bolt forcibly. Please take care not to place the cable.

Please confirm whether the bulge of Plate is in a square hole of main body. Please do not place the cable.

Please do not pull the bolt forcibly.

Installation of Calibration Plate
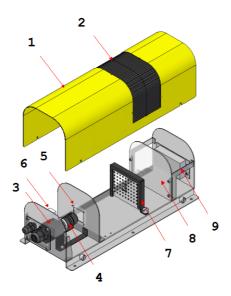
23.2.4   Periodic Maintenance

Please clean up when you can confirm dirt to the surface of lens, camera cover, and diffusion plate. Please exchange the parts when dirt can't be washed or there is a crack in parts.
Please clean up it according to the following procedures.
1.   Please blow off the dirt of parts in a clean dry air.
2.   Please wipe the parts by lens cleaning paper that soaked alcohol until dirt is washed off. If the dirt is not washed, please exchange the parts.

23.2.5   Spare Parts List

Overall dimensions

Specification/name

	Specification	Name	Quantity
1	A290-7409-X002	Main body cover	1
2	A290-7409-X004	Blushes	4
3	A97L-0218-0683/XC56	Camera	1
4	A97L-0218-0774	Lens	1
5	A290-7409-X006	Camera cover	1
6	A58L-0001-0015/ADC24	Relay (contact part)	1
7	A05B-1409-J901	Calibration jig (option)	1
8	A290-7409-X007	Diffusion plate	1
9	A290-7409-V001	LED unit	1

23.3   CREATING VISION DATA

23.3.1   Basic Screens of *i*RVision

You can set up *i*RVision by vision setup screen by pressing [MENU] on iPendant and selecting [8.iRVision], or using a PC connected to the robot controller over an Ethernet network. Following is the procedure by using PC connected to the robot. For details, see Section A, "TEACHING FROM PC" in "*i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)".

To setup by iPendant, see Section 3.1, "VISION SETUP" in "*i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)".

Procedure

- **Vision Setup**
Performs *i*RVision setup and testing.
For details, see Section 3.1, "VISION SEUTP" in "*i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)".

-    **Vision Log**

Displays the execution log of *i*RVision.

For details, see Section 3.3, "VISION LOG" in "*i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)".

-    **Vision Runtime**

Displays the run-time monitor of *i*RVision.

For details, see Section 3.2, "VISION RUN-TIME" in "*i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)".

23.3.2   Vision Setup

This is the Main Setup Page for performing *i*RVision setup and testing.

For details, see Section 3.1, "VISION SEUTP" in "*i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)".

23.3.3   Camera Setup

Default camera data "**WTICAM_TMPL**" is installed for this function. Use this setting for the following vision setup.

To reset or add vision data for camera setup, please refer to Section 4, "CAMERA" in "*i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)".

23.3.4   Camera Calibration

Default camera data **"WTICAL_TMPL"** is installed for this function. Perform the calibration of the vision data according to your inspection station; it will set the coordinate axes on the calibration plate surface, and tip measurement will be performed correctly. Use this vision data for the following vision setup.

Procedure

1.   Complete the setup of the inspection station.
2.   Attach the calibration plate to the inspection station.
3.   Perform camera calibration with either of following procedures.
       (a)   **With iRVision Setup Screen in robot controller:**
              (i)   Select **" WTICAL_TMPL "** from vision data list of camera calibration and Camera Calibration setup window appears.
              (ii)   Click [**Find**] button at lower right hand of the screen.
              (iii) The calibration result is displayed. Click the [**OK**] button.

4.   Take off the calibration grid.

23.3.5   Process Setup

Attach a new tip and create a vision process. Weld tip inspection is performed when the created vision process is executed from the TP program, as described in the following.

The list of vision processes is displayed when you open the vision data list screen.

Using the following four vision processes as reference, set up and teach your vision processes.

Process Name	Contents
WTINEW_TMPL	Inspects new tip figure.

Process Name	Contents
WTIDRESS_TMPL	Inspects the dressed tip figure.
WTIWEAR_TMPL	Inspects the tip length and wear.
WTIMATREM_TMPL	Inspects the tip dress amount

23.3.5.1   New tip figure inspection

Create a vision process.
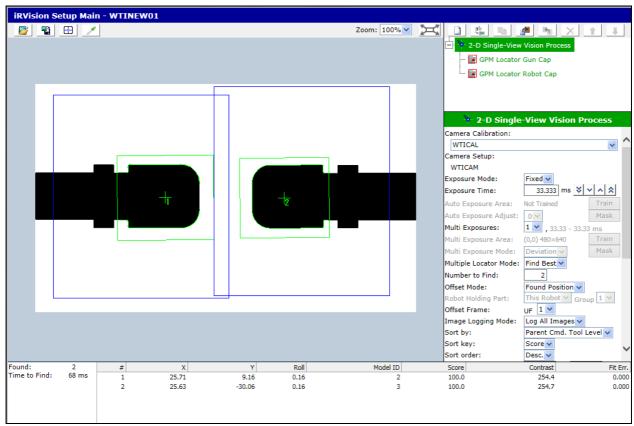
Procedure
1.   Set new weld tip to spot welding gun.
2.   Move the spot welding gun to the inspection position. Bring the weld tip end in front of the camera on the calibration plate surface.
3.   Teach the inspection position to the TP program.

> **NOTE**
>   Make sure that the positions of the spot welding gun and inspection station during inspection are the same every time.
>   Accurate inspection can be performed by taking an image of the welding tip on the calibration grid plane.

4.   Turn on LED.
5.   Click **[WTINEW_TMPL]** on the list of vision processes.

Vision process setup window
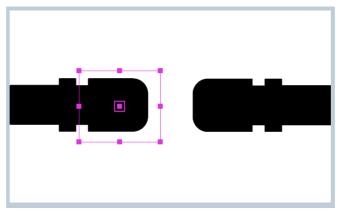
A model is taught in vision process **WTINEW_TMPL**; copy and modify it to create a new vision process. The gun tip is located on the left and the robot tip is located on the right of the screen. Change the

location according to the actual system if needed. <u>The model IDs of the vision tools define the gun and robot tips.</u>

	Model ID	Vision tool name
Gun tip	1	GunCap
Robot tip	2	RobotCap
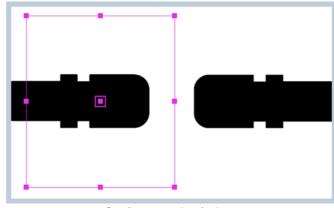
You can change the vision tool names.

6.   Confirm calibration data is selected in the screen.
7.   To teach the gun tip model pattern, select **[GunCap]** in the vision tools tree view. The vision process setup page appears.
8.   Click the [**Teach Pattern**] button on the right side of the page to teach the gun tip model pattern. <u>Operate the frame displayed on the screen to bring the gun tip end inside the frame</u>. After setup, click the [**OK**] button. For detailed information about the operation method, see Subsection 3.7.9, "Window Setup" in "R-30*i*B/R-30*i*B Mate CONTROLLER *i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)".

Teaching tip model

9.   Specify the range of the area of the model to be searched by clicking the [**Set Search Win.**] button on the right side of the screen. <u>Set a range that is slightly larger than the one the model taught in the previous step, taking into consideration that the tip position shifts by chip dressing.</u> If the tip gets out of the search window during detection, then a detection error will occur.

Setting search window

10. To teach Robot tip model pattern, select " **Robot Cap** " in vision tools tree view and set up as same as procedure 7~10.
11. After teaching two tip model, select the top of vision tools tree view and click [**Continuous S+F button**]. If there is no problem, please click [**Stop S+F button**].
12. Click the [**Save**] button on the lower right of the screen and select [**Close**] to end the inspection.

For details, see Section 23.3.6, "Note for teaching vision process" in this manual and Section 8, "COMMAND TOOLS" in "*i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)".

23.3.5.2 Dressed tip inspection

Create a vision process.

Procedure

1. Set new weld tip to spot welding gun.
2. Move the spot welding gun to the inspection position. Bring the weld tip end in front of the camera on the calibration plate surface.
3. Teach the inspection position to the TP program.

NOTE

Make sure that the positions of the spot welding gun and inspection station during inspection are the same every time.
Accurate inspection can be performed by taking an image of the welding tip on the calibration grid plane.

---

4. Turn on LED.
5. Click **[WTINEW_TMPL]** on the list of vision processes.

Vision process setup window
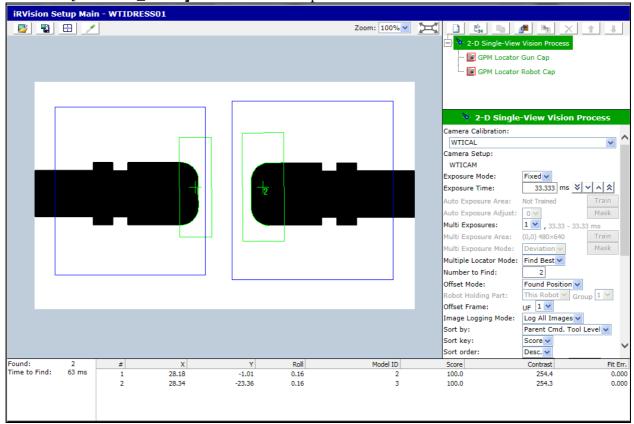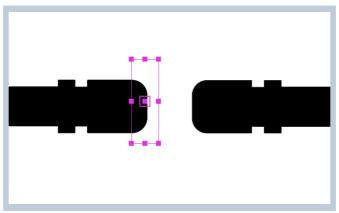
A model is taught in vision process **WTIDRESS_TMPL**; copy and modify it to create a new vision process. The gun tip is located on the left and the robot tip is located on the right of the screen. Change the location according to the actual system if needed. The model IDs of the vision tools define the gun and robot tips.

	Model ID	Vision tool name
Gun tip face	1	GunCap
Robot tip face	2	RobotCap
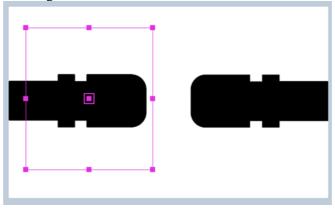
You can change the vision tool names.

6. Confirm calibration data is selected in the screen.
7. To teach a gun tip model pattern, select [GunCap] in the vision tools tree view. The vision process setup page appears.
8. Click the [**Teach Pattern**] button on the right side of the page to teach the gun tip model pattern. Operate the frame displayed on the screen to bring the gun tip end inside the frame. After setup, click the [**OK**] button. For detailed information about the operation method, see Subsection 3.7.9, "Window Setup" in "R-30iB/R-30iB Mate Controller *i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)."

Teaching tip face model

9. Specify the range of the area of the model to be searched by clicking the [**Set Search Win.**] button on the right side of the screen. Set a range that is slightly larger than the one the model taught in the previous step, taking into consideration that the tip position shifts by chip dressing. If the tip gets out of the search window during detection, then a detection error will occur.

Setting search window

10. To teach Robot tip model pattern, select " **RobotCap** " in vision tools tree view and set up as same as procedure 7~10.
11. After teaching two tip model, select the top of vision tools tree view and click [**Continuous S+F button**]. If there is no problem, please click [**Stop S+F button**].
12. Click [Save] button on the lower right of the screen and select [**Close**] to end the inspection.

For details, see Section 23.3.6, "Note for teaching vision process" in this manual and Section 7, "COMMAND TOOLS" in "*i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)".

23.3.5.3 Tip wear inspection

This process measures amount of tip wear.
Perform in the order of gun axis mastering, vision process creation, and initial value setting.

Gun axis mastering

Procedure
1. Complete gun axis mastering with new weld tip.
2. Perform the initial setting of wear measurement using the servo gun function. Either the one-step (WR_SETUP) or two-step (TW_SETUP) method can be used. For the details, see the "Servo Gun Function OPERATOR'S MANUAL (Reference) (B-83264EN)." This process is performed to reset more accurate reference values when vision data for tip wear inspection are lost for some reason. For details about vision data recovery, see Section 23.9, "Vision Data Recovery".

Create Vision Process

Procedure
1. Set new weld tip to spot welding gun.
2. Move the spot welding gun to the inspection position. Bring the weld tip end in front of the camera on the calibration plate surface.
3. Teach the inspection position to the TP program.
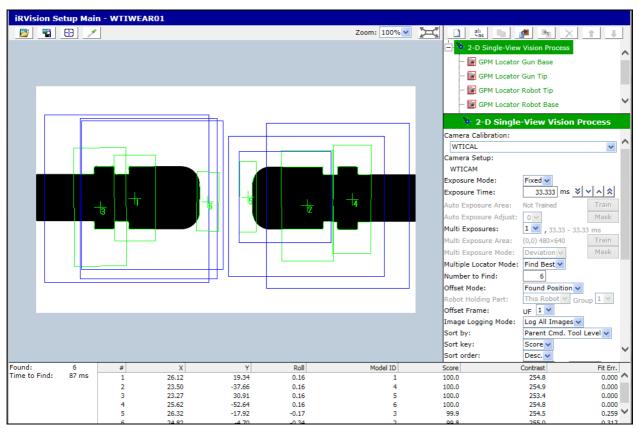
> **NOTE**
> Make sure that the positions of the spot welding gun and inspection station during inspection are the same every time.
> Accurate inspection can be performed by taking an image of the welding tip on the calibration grid plane.

> **NOTE**
> Please set up vision process just after gun axis mastering with new tip.

4. Turn on LED.
5. Click **[WTIWEAR_TMPL]** on the vision process list screen.

Vision process setup window

A model is taught in vision process **WTIWEAR**; modify this process. The gun tip is located on the left and the robot tip is located on the right of the screen of the model. Change the location according to the actual system if needed. The model IDs of the vision tools define the gun and robot tips.

	Model ID	Vision tool name (example)
Gun tip base	1	GunBase
Gun tip face	2	GunTip
Robot tip face	3	RobotTip
Robot tip base	4	RobotBase
Gun shank	5	GunShank
Robot shank	6	RobotShank
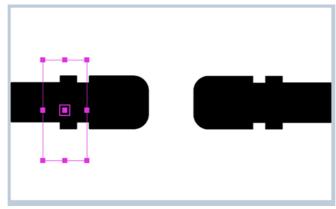
You can change the vision tool names.

NOTE
   wrong setting about gun tip and robot tip cause incorrect movement.

---

6   Confirm calibration data is selected in the screen.
     Teach the gun welding tip.
-    **Teaching the shank**
7.   To teach the gun shank, select "GunShank" in the vision tools tree view. The setup page appears on the screen.
8.   Click [**Teach Pattern**] on the right side of the screen.
9.   Teach the gun shank model <u>Operate the frame displayed on the screen to bring the gun tip base inside the frame.</u> After setting, click the [**OK**] button. For detailed information about the operation method, see Subsection 3.7.9, "Setting Window" in "R-30iB/R-30iB Mate Controller *i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)."
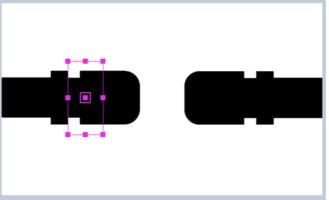
10. Click [**Set Search Win.**] on the right side of the screen and specify the search window for the model on the screen. Specify a range a little larger than the model taught in the above step.

Teaching shank model
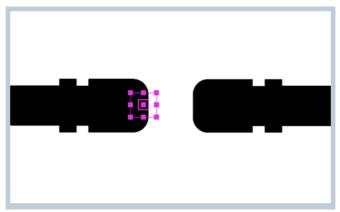
- **Teaching the tip base**
11. To teach the gun welding tip base, select "**GunBase**" in the vision tools tree view. The setup page appears on the screen.
12. Click [**Teach Pattern**] on the right side of the screen.
13. Teach the gun welding tip base model. Operate the frame displayed on the screen to bring the gun tip inside the frame. After setting, click the [**OK**] button.
14. Click [**Set Search Win.**] on the right side of the screen and specify the search window for the model on the screen. Specify a range a little larger than the model taught in the above step.
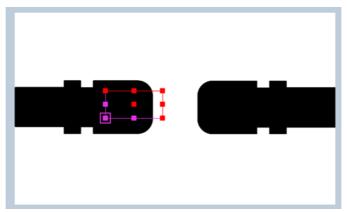
Teaching tip base model

- Teaching the tip face
15. To teach the gun welding tip face, select "**GunTip**" in the vision tools tree view. The setup page appears on the screen.
16. Click [**Teach Pattern**] on the right side of the screen.
17. Teach the gun welding tip face model. Operate the frame displayed on the screen to bring the gun tip inside the frame. By setting the straight section of the tip face with an area as large as possible, accuracy is improved. After setting, click the [**OK**] button.

Teaching Tip face model

18. Click [**Set Search Win.**] on the right side of the screen and specify the search window for the model on the screen. <u>Specify a range a little larger than the model taught in the above step toward the tip base direction while considering the face position shifts by tip dress.</u> Specify the range so that the width is not changed and the search window does not overlap with the robot tip.

Setting search window

19. To teach the robot welding tip, select "**RobotTip**" (for the tip face), "**RobotBase**" (for the tip base), and "**Robshank**" (for the shank) in the tree view, respectively. Teach the relevant models in the same way as in steps 7 to 18.
20. After teaching both tip models, select the top item in the tree view and click [**Continuous S+F button**] to execute the inspection. If there is no problem with detection, click [**Stop S+F button**].
21. Click [**Save**] on the lower-right section and click [**Close**] to end the inspection.

For details, see Section 23.3.6, "Note for teaching vision process" in this manual and Section 7, "COMMAND TOOLS" in "R-30iB/R-30iB Mate Controller *i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)."

23.3.5.4   Tip Dress amount inspection

This process measures the amount of tip dress.
Perform in the order of vision process creation and initial value setting.

Create Vision Process
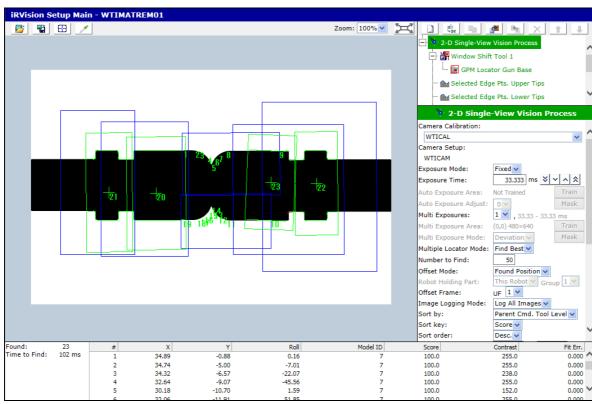
Procedure
1.   Set a new welding tip to the spot welding gun.
2.   Move the robot into the view position so that the welding tip face is placed in front of the camera along the calibration grid plate.
3.   Teach the view position to the robot. Bring the tips into contact with each other with a welding pressure of 0 kg.

NOTE
   Be sure to place the robot and inspection station in the same positions at every inspection.
   Accurate inspection is performed by taking an image of the welding tip placed on the calibration grid plane.

---

4.   Turn on the LED.
5.   Select and click "WTIMATREM_TMPL" on the vision process list screen.

Vision process setup window

To measure the tip dress amount, detect the edge of the contact area of the tip face since the figure of the tip face may change. It is necessary to set the search window more minutely, so first detect the reference position of the tip, then search for the tip face and base based on the detected position. You may teach the same position as that of the tip base as the reference position since it is required only that the figure be recognized uniquely.

A model is taught in vision process **WTIMATREM_TMPL**; copy and modify this process. The gun tip is located on the left side and the robot tip is located on the right side in the screen. Change the location according to the actual system if needed. The model IDs of the vision tools define the gun and robot tip.
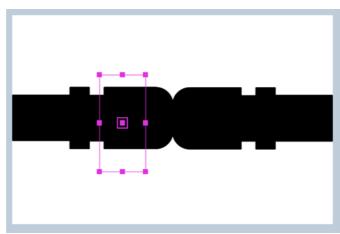
	Model ID	**Vision tool name**
Gun tip base	1	GunBase
Robot tip base	4	RobotBase
Gun shank	5	GunShank
Robot shank	6	RobotShank
Upper tip contact area	7	UpperTips
Lower tip contact area	8	LowerTips

You can change vision tool names.

NOTE
> A wrong setting of the gun or robot tip may cause incorrect movement of the robot.

---

6. Confirm calibration data is selected in the screen.
- **Teaching the tip reference position**
7. To teach the tip base as the tip reference position, select "**GPM Locator**" under "**Window Shift Tool**" in the vision tools tree view. The setup page appears on the screen.
8. Click [**Teach Pattern**] on the right side of the screen.
9. Teach the gun tip base model. <u>Operate the frame displayed on the screen to bring the gun tip base inside the frame</u>. After setting, click the [**OK**] button. For detailed information about the operation method, see Subsection 3.7.9, "Setting Window" in "R-30iB/R-30iB Mate Controller *i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)."
10. Click [**Set Search Win.**] on the right side of the screen and specify the search window for the model on the screen. <u>Specify a range a little larger than the model taught in the above step</u>.
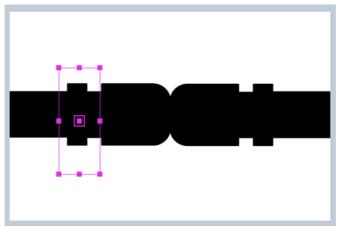
Teaching the tip base model

Teach the gun welding tip.
- **Teaching the shank**
11. To teach the gun shank, select "**GunShank**" in the vision tools tree view. The setup page appears on the screen.
12. Teach the gun welding tip base model. <u>Operate the frame displayed on the screen to bring the gun tip end inside the frame</u> After setting, click the [**OK**] button.
13. Click [**Set Search Win.**] on the right side of the screen and specify the search window for the model on the screen. <u>Specify a range a little larger than the model taught in the above step</u>.
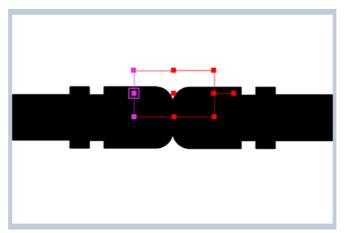
Teaching the shank model

- **Teaching the tip base**
14. To teach the gun welding tip base, select "**Gunbase**" in the vision tools tree view. The setup page appears on the screen.
15. Click [**Teach Pattern**] on the right side of the screen.
16. Teach the gun welding tip base model. Operate the frame displayed on the screen to bring the gun tip base inside the frame. After setting, click the [**OK**] button. For detailed information about the operation method, see Subsection 3.7.9, "Setting Window" in "R-30iB/R-30iB Mate Controller *i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)."
17. Click [**Set Search Win.**] on the right side of the screen and specify the search window for the model on the screen. Specify a range a little larger than the model taught in the above step.

- **Teaching the tip contact area**
18. To teach the upper section of the tip contact area, select "**Upper tips**" in the vision tools tree view. The setup page appears on the screen.
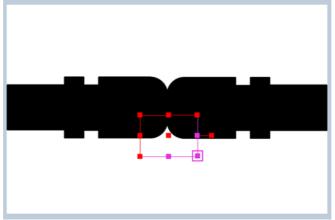
Teaching the upper section of the tip contact area

19. Click [**Set Search Win.**] on the right side of the screen and specify the search window for the upper section of the tip contact area on the screen. Specify a little larger range toward the tip base direction while considering the face position shifts by tip dress.

20. To teach the lower section of the tip contact area, select "**Lower tips**" in the vision tools tree view. The setup page appears on the screen.

Teaching the lower section of the tip contact area

21. Click [**Set Search Win.**] on the right side of the screen and specify the search window for the lower section of the tip contact area on the screen.

22. To teach the robot welding tip, select "**Robot Shank**" (for the shank) and "**Robot Base**" (for the tip base) in the tree view, respectively. Teach the relevant models in the same way as in steps 7 to 14.

23. After teaching both tip models, select the top item in the tree view and click [**Continuous S+F button**] to execute the inspection. If there is no problem with detection, click [**Stop S+F button**].

24. Click [**Save**] on the lower-right section and click [**Close**] to end the inspection.

For details, see Section 23.3.6, "Note for teaching vision process" in this manual and Section 7, "COMMAND TOOLS" in "R-30iB/R-30iB Mate Controller *i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)."

23.3.6   Note for Teaching Vision Process

- When teaching a vision process, use the mask function as needed. If there are parts reflecting light or parts that attract water drops and are susceptible to deformation on the vision model, then it is recommended to mask the area to prevent detection errors.

- The chip position may shift gradually due to aging. When setting the search window for the tip, consider its shift and set the window slightly larger to prevent detection errors.

- When a vision process is executed but some parts of the vision model are not detected, the value of the vision tool overlapping restriction may be too large; therefore, adjust the value.

- To measure the amount of tip wear, you can use the Line locator tool to detect the tip face since the figure of the tip face may change. In this case, it is necessary to set the search window more minutely, so first detect the shank, then search for the tip face and base based on the detected position. For detail, please see section 7.4 "LINE LOCATOR TOOL" and section 7.25 "WINDOW SHIFT TOOL" in "R-30iB/R-30iB Mate Controller *i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)."

For details, see "R-30iB/R-30iB Mate Controller *i*RVision OPERATOR'S MANUAL (Reference) (B-83304EN)."

23.4 SETUP
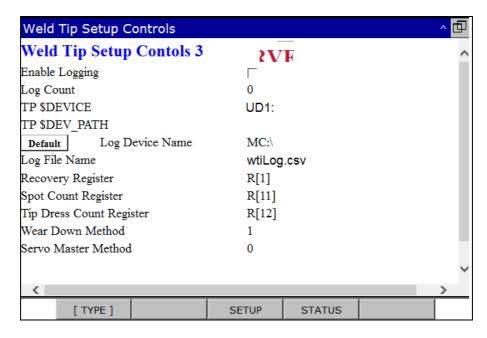
23.4.1 Setup Screen

Weld Tip Setup Controls Screen

Use the Weld Tip Setup Controls screen to set whether to enable or disable each function of welding tip inspection.

Procedure

1. Press the [MENU] key on the controller.
2. Select [SETUP] → [Wti Setup]. The following screen appears.

For the check box provided to set whether to enable or disable the relevant function, tap the relevant item on the touch panel to change the enable or disable state. For an item for which to input a number, tap the number, and a numeric value input screen appears as a pop-up.

You can also move the cursor on the screen and press the [INPUT] key to change the value of the item.

Item	Description
Enable Logging	Set whether to create a log file in the CSV format.
TP $DEVICE	Specify a device name.
TP $DEV_PATH	Specify the path to a directory.
Log File Name	Indicates the name of a log file.
Recovery Register	Indicates the number of a register used for setting the action when the inspection result is NG. Specify a value as the register number (*) and set 1 as the value of the register. 0: Retries. 1: Continues operation. 2: Ends. Normally, setting error or warning output and continuing the vision process is recommended. However, for example, setting 0 (retries) as the value of the specified register repeatedly retries when the inspection result is NG. When there is no problem found by checking the tip status by the operator after that, the value of the register can be set to 1 to make the target pass the inspection.

Item	Description
Spot Count Register	Indicates the number of the spot count register. <u>* Be sure to set this item.</u> For gun number 2 (device 2), directly set the register number in $SPOTEQSETUP[2].$REG_IDX[1].
Tip Dress Count Register	Indicates the number of the tip dress count register. <u>* Be sure to set this item.</u> For gun number 2 (device 2), directly set the register number in $SPOTEQSETUP[2].$TD_REG_IDX[1].
Wear Down Method	Indicates the number which specifies the wear measurement method. <u>Set 2.</u> 1: Measures the absolute position of the tip face (not supported). 2: Measures the distance between the tip face and base.
Servo Master Method	<u>Set 1.</u> 0: Does not perform mastering during wear compensation amount inspection. 1: Performs mastering during wear compensation amount inspection.

> **NOTE**
> (*) If no value is set as the register number, message "Register No. can not be 0."
> appears in the screen during the execution of the inspection and the inspection
> ends.
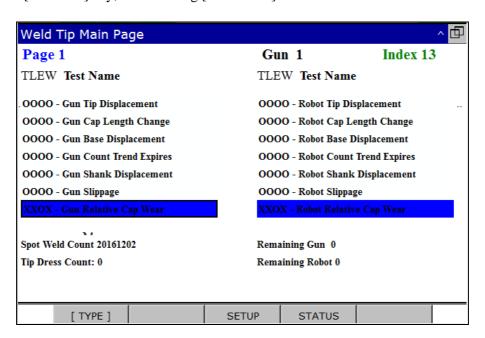
Tip Inspection Main Menu
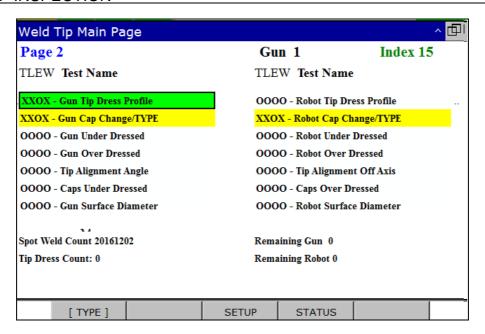
The tip inspection main menu displays the setting whether to enable or disable each function of the welding tip inspection.

Procedure
1   Press the [MENU] key on the controller.
2   Select [STATUS] → [WTI STATUS].
3   The following screen appears.

You can set whether to enable or disable each function by positioning the cursor on each inspection item, pressing the F4 [STATUS] key, and selecting [Test Detail].
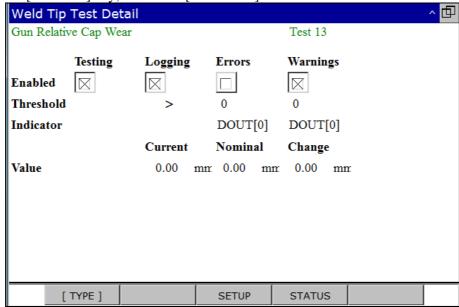
Item	No.	Corresponding inspection	Description
Gun (No)	–	–	Select the number of a gun to be inspected.
Page (No)	–	–	Set an inspection item list page (1 or 2).
Gun Relative Tip Wear	13	Tip wear inspection	Measures and inspects the gun tip wear amount.
Robot Relative Tip Wear	14	Tip wear inspection	Measures and inspects the robot tip wear amount.
Gun Tip Dress Profile	15	Dressed tip inspection	Inspects the dressed gun tip figure.
Robot Tip Dress Profile	16	Dressed tip inspection	Inspects the dressed robot tip figure.
Gun Tip Change	17	New tip inspection	Inspects the new gun tip figure.
Robot Tip Change	18	New tip inspection	Inspects the new robot tip figure.
Gun Under Dressed	19	Tip dress amount inspection	Inspects the gun tip dress amount.
Robot Under Dressed	20	Tip dress amount inspection	Inspects the robot tip dress amount.

*If you want to apply an inspection item other than the above, contact FANUC.

Tip Inspection Detail Menu

Procedure

1. Position the cursor on a target inspection item in the tip inspection main menu above.
2. Press the F4 [STATUS] key, and select [Test Detail] to enable or disable each item.

Item	Description
Test (No)	Set an inspection item number.
Testing	Set whether to enable or disable the inspection.
Logging	Set whether to save the inspection result in a log file.
Alarm	Set whether to output an alarm when the inspection result exceeds the threshold.
Warnings	Set whether to output a warning when the inspection result exceeds the threshold.
Threshold	Set a threshold for the tip wear amount or tip dress amount (in units of mm), or 0 for an inspection item whose result is OK or NG.
Indicator	Specify a DO output number for alarms and warnings.
Current	Indicates the current measurement value.
Nominal	Indicates the reference measurement value.
Change	Indicates the change amount obtained by comparing the measurement value with the reference measurement value.

Test Display Order Menu

You can change the number of each inspection item. Normally, do not change it.

Procedure
1. Press the [MENU] key on the controller.
2. Select [SETUP] → [wti Setup].
3. Press the F3 [SETUP] key and select "Test(No)" to display the menu.

Test Trend Detail Menu

You can display a graph of the measurement result using the log of each inspection item.
Procedure
1. Press the [MENU] key on the controller.
2. Select [STATUS] → [wti Setup].
3. On the tip inspection main menu, position the cursor on a target inspection item.
4. Press the F4 [STATUS] key and select [Trend Detail] to display the menu.

Test Status Detail Menu

The test status detail menu displays the alarm codes related to each inspection item and a description of the inspection.
Procedure
1. Press the [MENU] key on the controller.
2. Select [STATUS] → [wti Status].
3. On the tip inspection main menu, position the cursor on a target inspection item.
4. Press the F4 [STATUS] key and select [Static Detail] to display the menu.
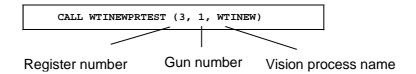
23.5   PROCEDURES FOR EXECUTING INSPECTION

23.5.1   New Tip Inspection

Procedure
1. Complete the creation of vision data.
2. On the tip inspection main menu, enable the Tip Change test. For details, see Subsection 23.4.1, "SETUP SCREEN".
3. Move the robot into the view position at which the vision process was taught.

4.   Call KAREL program **WTINEWPRTEST** while referencing TP program WTINEW_TMPL.TP and execute the vision process as shown below. Specify the name of the vision process created as described in Section 23.3, "CREATING VISION DATA".

```
CALL WTINEWPRTEST (3, 1, WTINEW)
```

Register number   Gun number   Vision process name
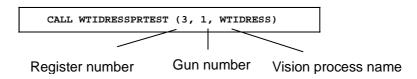
When the inspection ends with no problem, the value of the specified register is set to 1.
For details of how to set up a multi gun system, see Section 23.7, "SETUP MULTI GUN SYSTEM".

23.5.2   Test Tip Dress Profile

Procedure
1.   Complete the creation of vision data.
2.   On the tip inspection main menu, enable the Tip Dress Profile test. For details, see Subsection 23.4.1, "SETUP SCREEN".
3.   Move the robot into the view position at which the vision process was taught.
4.   Call KAREL program **WTIDRESSPRTEST** while referencing TP program WTIDRESS_TMPL.TP and execute the vision process as shown below. Specify the name of the vision process created as described in Section 23.3, "CREATING VISION DATA".
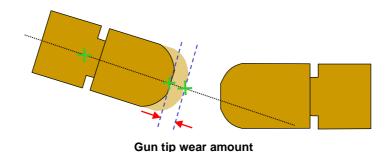
```
CALL WTIDRESSPRTEST (3, 1, WTIDRESS)
```

Register number   Gun number   Vision process name
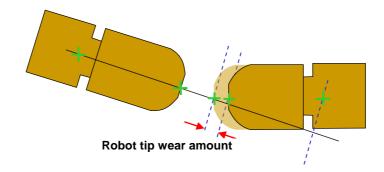
When the inspection ends with no problem, the value of the specified register is set to 1.
For details of how to set up a multi gun system, see Section 23.7, "SETUP MULTI GUN SYSTEM".
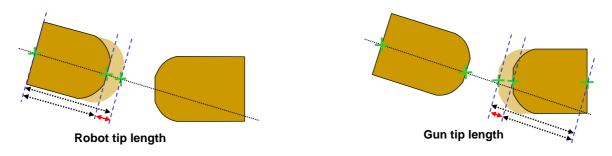
23.5.3   Test Tip Wear Amount

In the tip wear amount inspection, the wear amount is measured as shown below. The measured wear amount is used for the compensation of the position taught at spot welding.

Gun tip wear amount

Robot tip wear amount

In the tip wear inspection, the tip length inspection can be performed simultaneously.
Set the tip length inspection as described in Subsection 23.4.1, "SETUP SCREEN".

Robot tip length

Gun tip length
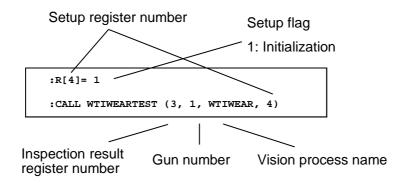
Setup Nominal Values

Immediately after teaching the vision process, set up nominal values including the welding tip wear amount according to the following procedure.

Procedure

1. Complete the creation of vision data.
2. On the tip inspection main menu, enable the Relative Tip Wear test. For details, see Subsection 23.4.1, "SETUP SCREEN".
3. Move the robot into the view position at which the vision process was taught.
4. Execute the vision process from the TP program as shown below.

Setup register number

Setup flag

1: Initialization

```
:R[4]= 1

:CALL WTIWEARTEST (3, 1, WTIWEAR, 4)
```

Inspection result register number

Gun number

Vision process name

When the inspection ends with no problem, the value of the setup register is reset to 0.
The value of the inspection result register is set to 1. If there is a problem, the value of the inspection result register is set to 0 or 2.
For details of how to set up a multi gun system, see Section 23.7, "SETUP MULTI GUN SYSTEM".

NOTE
 Be sure to teach the vision process and set up nominal values just after performing gun axis mastering with a new tip.

The setup of tip wear down compensation of the servogun function is also recommended.
The data is used to set up nominal values again more accurately if vision data is lost for some reason. For details about vision data recovery, see Section 23.9, "RECOVER VISION DATA".
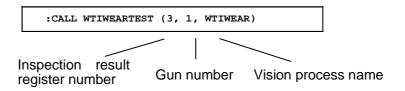
Measure Wear Amount

After the completion of setup, you can measure the tip wear amount.

Procedure
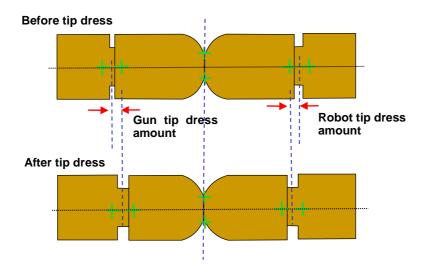
1. Complete gun zero mastering and setup of tip wear compensation.
2. Complete the creation of vision data.
3. On the tip inspection main menu, enable the Relative Tip Wear test. For details, see Subsection 23.4.1, "SETUP SCREEN".
4. Move the robot into the view position at which the vision process was taught.
5. Execute the vision process from the TP program as shown below.

```
:CALL WTIWEARTEST (3, 1, WTIWEAR)
```

Inspection result register number   Gun number   Vision process name

When the inspection ends with no problem, the value of the inspection result register is set to 1.
For details of how to set up a multi gun system, see Section 23.7, "SETUP MULTI GUN SYSTEM".
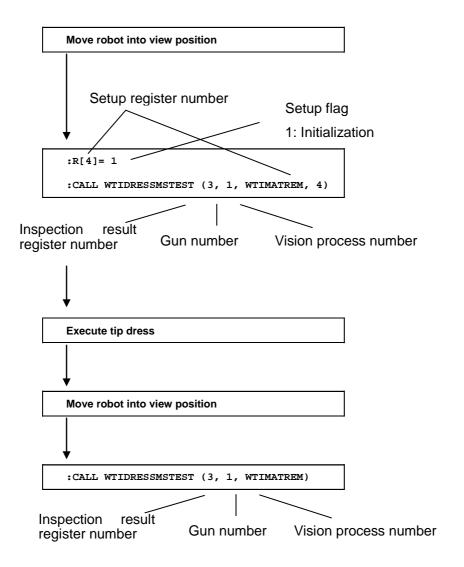
23.5.4   Test Tip Dress Amount

In the tip wear amount inspection, the inspection of the tip dress amount can also be performed by comparing the tip length before dress with that after dress.

Before tip dress

Gun tip dress amount   **Robot tip dress amount**

After tip dress

Procedure

1. On the tip inspection main menu, enable the Under Dressed test. For details, see Subsection 23.4.1, "SETUP SCREEN".

2. Before and after tip dress, add the tip inspection as shown below. Call KAREL program **WTIDRESSMSTEST** while referencing **WTIMATREM_TMPL.TP**. The tip length is stored as the reference tip length by setting the setup flag before tip dress. The tip dress amount can be obtained with the difference between the tip length before tip dress and that after tip dress by performing the inspection again after tip dress.

```
Move robot into view position
```

Setup register number

Setup flag

1: Initialization

```
:R[4]= 1

:CALL WTIDRESSMSTEST (3, 1, WTIMATREM, 4)
```

Inspection result register number

Gun number

Vision process number

```
Execute tip dress
```

```
Move robot into view position
```

```
:CALL WTIDRESSMSTEST (3, 1, WTIMATREM)
```

Inspection result register number

Gun number

Vision process number
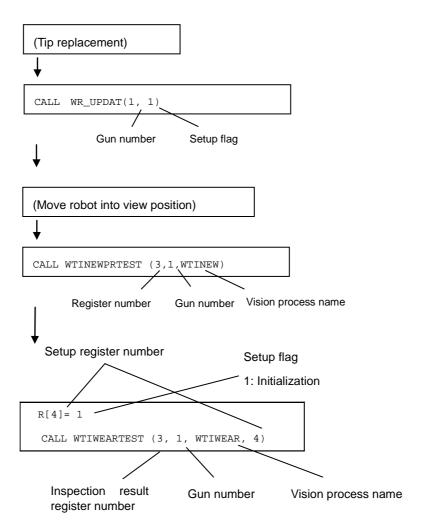
23.5.5 Examples of Inspection

Examples of inspection are shown below.

Inspection at Tip Replacement
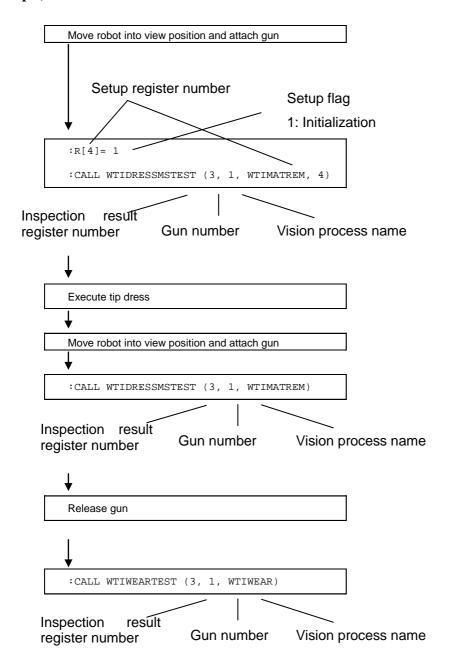
In the example below, after tip replacement, the wear amount is set up with the servogun wear compensation function, the new tip inspection is performed, and nominal values for the tip wear amount inspection are obtained at the same time.

```
(Tip replacement)
```
↓
```
CALL  WR_UPDAT(1, 1)
```
Gun number   Setup flag

↓

```
(Move robot into view position)
```
↓
```
CALL WTINEWPRTEST (3,1,WTINEW)
```
Register number   Gun number   Vision process name

↓

Setup register number   Setup flag

1: Initialization

```
R[4]= 1
 CALL WTIWEARTEST (3, 1, WTIWEAR, 4)
```
Inspection   result
register number   Gun number   Vision process name

Inspection at Tip Dress

In the example below, the tip dress amount inspection and tip wear amount inspection are performed at the same time after tip dress.

(Example)

```
Move robot into view position and attach gun
```

Setup register number

Setup flag

1: Initialization

```
:R[4]= 1
:CALL WTIDRESSMSTEST (3, 1, WTIMATREM, 4)
```

Inspection result register number   Gun number   Vision process name

```
Execute tip dress
```

```
Move robot into view position and attach gun
```

```
:CALL WTIDRESSMSTEST (3, 1, WTIMATREM)
```

Inspection result register number   Gun number   Vision process name

```
Release gun
```

```
:CALL WTIWEARTEST (3, 1, WTIWEAR)
```

Inspection result register number   Gun number   Vision process name

Approach movement to view position

Less mechanical vibration makes better accuracy of measurement at inspection. Make the approach movement to the view position as following for less vibration.

- Reduce velocity to the view position gradually.
- Reduce the acceleration simultaneously.
- Wait for a moment with the wait command before inspection.

(Example)

```
L P[1: Approach] 2000mm/sec CNT100

L P[2] 400mm/sec CNT100 ACC50

L P[3: Inspection] 100mm/sec FINE ACC20

WAIT 0.5sec


CALL WTIWEAR(WTIWEAR,1,0)


L P[1: Approach] 2000mm/sec CNT100
```

23.6 ALARMS

When tip inspection is enabled, the following alarms occur when an error occurs during an inspection. You can confirm the content of each error in the Test Status Detail Menu.

Item	Description	Which Inspection alarms
SPOT-306 PAUSE	Found duplicate model Verify vision process.	All
SPOT-307 PAUSE	Gun Tip Test missing model Verify vision process.	All
SPOT-308 PAUSE	Robot Tip Test missing model Verify vision process.	All
SPOT-310 WARN	Tip Alignment missing model Verify vision process.	Tip wear inspection
SPOT-311 WARN	Gun Tip Wear exceeded Tip wear amount exceeds threshold.	Tip wear inspection
SPOT-314 WARN	Gun Tip Changed Length Exceeded Tip changed length exceeds threshold.	Tip wear inspection
SPOT-315 WARN	Gun Shank Displaced Shank displacement exceeds threshold.	Tip wear inspection
SPOT-319 WARN	Gun Tip Increase Error Tip length increases over threshold.	Dressed tip inspection
SPOT-320 WARN	Robot Tip Wear exceeded Tip wear amount exceeds threshold.	Dressed tip inspection
SPOT-321 WARN	Robot Tip Changed Length Exceeded Tip changed length exceeds threshold.	New tip inspection
SPOT-322 WARN	Robot Shank Displaced Shank displacement exceeds threshold.	New tip inspection
SPOT-341 WARN	Gun Under Dressed Tip dress length is insufficient.	Tip dress amount inspection
SPOT-342 WARN	Robot Under Dressed Tip dress length is insufficient.	Tip dress amount inspection
SPOT-343 WARN	Gun Over Dressed Tip dress length exceeds threshold.	Tip dress amount inspection
SPOT-344 WARN	Robot Over Dressed Tip dress length exceeds threshold.	Tip dress amount inspection

23.7 SETUP MULTI GUN SYSTEM

Tip figures are different for each gun in the multi gun system. So vision process needs to be prepared for each gun.

Create vision process

Move each gun to view point. Connect Setup PC to master robot and copy or re-create vision process for each gun. The name of vision process needs to be different for each gun. Other restriction for the name does not exist.

(Example)
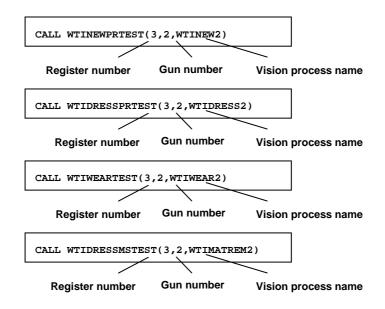
Original	Copy
WTINEW	WTINEW2
WTIDRESS	WTIDRESS2
WTIWEAR	WTIWEAR2
WTIMATREM	WTIMATREM2

Perform vision process

Configure the inspection settings after switching the gun number on the Weld Tip Setup Controls Screen.
Specify the new vision process name and gun number when executing the inspection program.

(Example)

```
CALL WTINEWPRTEST(3,2,WTINEW2)
```
Register number   **Gun number**   **Vision process name**

```
CALL WTIDRESSPRTEST(3,2,WTIDRESS2)
```
Register number   **Gun number**   **Vision process name**

```
CALL WTIWEARTEST(3,2,WTIWEAR2)
```
Register number   **Gun number**   **Vision process name**
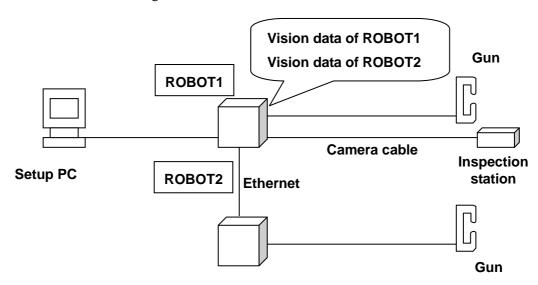
```
CALL WTIDRESSMSTEST(3,2,WTIMATREM2)
```
Register number   **Gun number**   **Vision process name**

23.8   SHARE ONE INSPECTION STATION WITH MULTI ROBOT

Constitution

To share one inspection station among multiple robot controllers, one of the robot controllers is connected to the inspection station and the robot controllers are connected via Ethernet. The inspection station is located within the movable range of all the robots and inspects their guns alternately. There is no restriction about the number of guns and robot.

The robot controller connected to the camera is defined as the master robot and other robot controllers are defined as slave robots in this section.

Setting up communication among robots

Connect Setup PC to master robot, with robot controllers connected to each other. Select "Robot Ring" on Vision Setup menu on *i*RVision. For details, see Section 6, "SETUP" in " R-30*i*B CONTROLLER Sensor Mechanical Unit / Control Unit OPERATOR'S MANUAL (Reference) (B-83434EN)".

Create Vision Process For Slave Robot

Move gun of slave robot to view point. Teach the vision data of all guns to the master robot. Connect setup PC to master robot and copy or re-create vision process for slave robot. The name of vision process needs to be different for each gun. Other restriction for the name does not exist.

(Example)

Original	Copy
WTINEW	WTINEW2
WTIDRESS	WTIDRESS2
WTIWEAR	WTIWEAR2
WTIMATREM	WTIMATREM2

Perform Inspection For Slave Robot
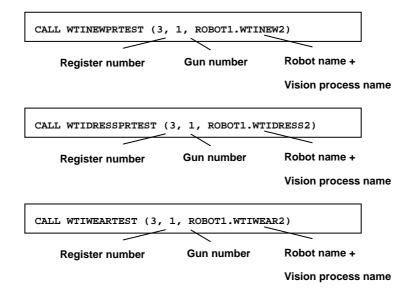
Move gun to view point and perform vision process from slave robot. To perform vision process of each robot, assign robot name that has vision process, vision process name and gun No.

Assign vision process as following. Robot name is same as the name assigned at robot ring setup.

```
┌─────────────────────────────────────┐
│  Robot Name. Vision Process Name     │
└─────────────────────────────────────┘
                         \
                          Dot
```

Gun No is the number in the slave robot.

(Example)

```
┌──────────────────────────────────────────────┐
│  CALL WTINEWPRTEST (3, 1, ROBOT1.WTINEW2)      │
└──────────────────────────────────────────────┘
                      /        \         \
         Register number    Gun number    Robot name +

                                          Vision process name
```

```
┌──────────────────────────────────────────────┐
│  CALL WTIDRESSPRTEST (3, 1, ROBOT1.WTIDRESS2)  │
└──────────────────────────────────────────────┘
                      /        \         \
         Register number    Gun number    Robot name +

                                          Vision process name
```

```
┌──────────────────────────────────────────────┐
│  CALL WTIWEARTEST (3, 1, ROBOT1.WTIWEAR2)      │
└──────────────────────────────────────────────┘
                      /        \         \
         Register number    Gun number    Robot name +

                                          Vision process name
```

23.9 RECOVER VISION DATA

When vision data is lost, recover the data as following.

New Tip Inspection

Procedure
Start Section 23.3.5.1, "New Tip Inspection" over again.

Dressed Tip Inspection

Procedure
Start Section 23.3.5.2, "Dressed Tip Inspection" over again.

Tip Wear Inspection

Even if a new tip is attached, the attachment position of the tip may be shifted due to aging. The effect of this positional shift can be minimized by using the servo gun tip wear compensation together with *i*RVision Tip Inspection. Tip wear amount is calculated as below.

```
Compensation Amount = Attachment shift + Tip wear
```

```
        Servogun Tip Wear            iRVision Tip Inspection
        Compensation calculate       Calculate
```

Procedure
1 Set new weld tip to spot welding gun.
2 Set up Tip wear down compensation of servo gun function. Either a one-step or a two-step method can be used. For details, Section 6, "Tip Wear Compensation".
3 Retry the Section "Create Vision Process" and "Setup Nominal Value" in 23.3.5.3 "Tip Wear Inspection". Skip the section "Gun Axis Mastering" in it

24   SERVOGUN DIAGNOSIS FUNCTION

24.1   OVERVIEW

Increase of the friction from the weariness of servogun decreases its pressure force. This function diagnoses the decrease of pressure force of servogun and urges the adjustment of it.

24.2   SPECIFICATION

24.2.1   Parameters for Monitoring

This function monitors and diagnoses the output torque and disturbance torque during servogun stroke motion. It outputs the result of diagnosis for external memory devices and they can observe the transition of values with csv format. *i*Pendant can also display the chart of values graphically.

24.2.2   Servogun Motion for Monitoring and Diagnosis

This function records a series of gun stroke motion. If gun presses and open after closing, each motion is recorded.

24.2.3   Condition for Diagnosis

If closing motion of a gun starts while diagnosis program runs, this function automatically starts to record the motion. The standard diagnosis program is TWZRCLB2.TP (the internal program of tip weariness detection). The diagnosis program is arbitrarily made and set by user.

-   If diagnosis program runs as sub program and gun closes during it, pressing and opening motion is recorded if they act during the main program runs.
-   The span for monitoring a stroke motion is 3200msec at maximum as default. It is changeable by $sgdiagcfg.$rec_size (Unit: 8 msec, Default: 400).
-   As for multi guns system, all guns can be recorded together.

After a series of gun motion, the record is diagnosed and outputted to files on following condition.

-   The gun finishes a stroke (close and open motion) and diagnosis program finishes. If only close motion acts by sub program, it diagnosed after the main program finishes.
-   (For multi gun system) No other gun is under monitoring.
-   (For multi gun system) No diagnosis program for other gun is running.

24.2.4   The Result of Diagnosis

This function calculates the maximum, average and minimum disturbance torque during each servogun motion, and records it. When disturbance torque exceeds the limit, it posts warning and output signal by I/O.
The base disturbance torque values are that of first diagnosis after the reset of record, they are automatically set.

Some or all of following values can be observed.

For closing motion, pressing and opening motion

Item	Description
Maximum disturbance torque	The maximum disturbance torque [%]
Average disturbance torque	The Average disturbance torque [%]
Minimum disturbance torque	The minimum disturbance torque [%]

For all motions in the diagnosis program

Item	Description
Maximum disturbance torque	The maximum disturbance torque [%]
Minimum disturbance torque	The minimum disturbance torque [%]

24.2.5   Save Diagnosis Records

Diagnosis records are following.

-    The details
-    Summary of diagnosis

24.2.5.1   The details

This is composed of the chart of the output torque, disturbance torque, current position and target position of a gun sampled every 8 msec during servo gun motion. Data files are created every diagnosis and saved in FROM as followings. They can copy these files to device automatically in each time or manually in status menu.

Detailed data is created in following format.

Time/date	2009/3/11 11:29		
Recorded times	7		
Tuned times	1		
From count 8 to count 50			
Max disturbance[%]	1.304587		
Min disturbance[%]	-2.156001		
Average disturbance[%]	-0.17469		
From count 53 to count 260			
Max disturbance[%]	11.727548		
Min disturbance[%]	-1.414447		
Average disturbance[%]	0.126959		
From count 260 to count 303			
Max disturbance[%]	0.068662		
Min disturbance[%]	-3.433123		
Average disturbance[%]	-1.006841		
Max disturbance in program[%]	12.263115		
Min disturbance in program[%]	-3.47432		
Number GUNDST	GUNPLS	GUNPOS	GUNTRQ
1 -1.043669	-294.546692	-293.971222	-1.071134
2 -1.043669	-294.546783	-292.243347	-1.071134
3 -1.016204	-294.540558	-288.787598	0.549299

Parameters
- Recording date and time
- Total time the gun is diagnosed since the record is reset
- Total time of auto tuning for the gun since the record is cleared
- The span disturbance torque is checked in the chart of each motion.
- Maximum disturbance torque in the span
- Average disturbance torque in the span
- Minimum disturbance torque in the spans
- Chart of following value

GUNDST	Disturbance torque [%]
GUNPLS	Current position [mm]
GUNPOS	Target position [mm]
GUNTRQ	Motor torque [%]

Sign of disturbance torque
Without pressing or opening motion, all values are 0.
The sign of disturbance torque is defined in detailed data as follows.
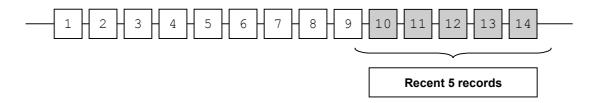
+	opposite to gun closing direction
-	opposite to gun opening direction

Save detailed data
The files of detailed data are saved in FROM as followings.
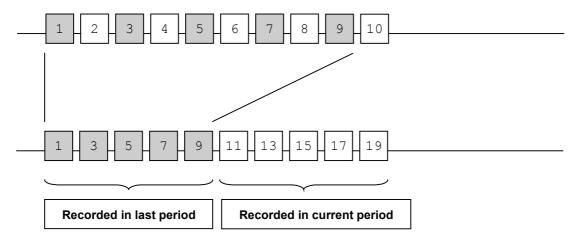
- Recent records

The latest 5 records are saved in controller automatically.

- Historical records

Beside the resent records as above, the records since the start of diagnosis are saved automatically.
If the number of saved records reaches 10, records of even number period are cleared. Then the record cycle becomes twice time.

24.2.5.2   Summary of diagnosis records

The summaries of records from all diagnosis are written in a file with csv format.

Number	Date	Tuned time	Pos at Peak	Max dst1	Ave dst1
1	09/03/11 11:25	1	-46.216011	1.441912	-.097467
2	09/03/11 11:25	1	-46.212273	1.386982	-.106985
3	09/03/11 11:28	1	-46.205978	1.455644	-.111199
4	09/03/11 11:29	1	-46.208038	1.414447	-.159999
5	09/03/11 11:29	1	-46.203880	1.414447	-.157764
6	09/03/11 11:29	1	-46.209717	1.386982	-.194264
7	09/03/11 11:29	1	-46.204224	1.304587	-.174690

Item	Description
Number	Total time the gun is diagnosed since the record is reset
Date	Day and time
Tuned time	Total time of auto tuning for the gun since the record is cleared
Pos at Peak	The position max disturbance torque is recorded during gun closing motion
Max dst	The maximum disturbance torque in close motion [%]
Ave dst	The average disturbance torque in close motion [%]

24.2.6   Save and Clear Diagnosis Data

Save records in external devices
They can record diagnosis records in external memory devices such as Flash ATA and observe the transition of values with csv format.

Reset diagnosis data
This is recommended at servogun retuning
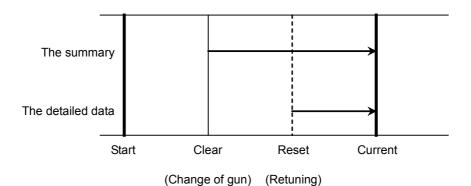
(a) The detailed data are cleared and the limit value is reset
(b) The summary remains.

Clear diagnosis data
It is recommended for the change of diagnosis program or servogun

(a) The detailed data are cleared and the limit value is reset
(b) The summary is cleared.

24.2.7   The Schedule of Diagnosis

They can set diagnosis time. At the start of a day the temperature of mechanical unit is colder than it on stream. It restrains the errors that occur from dispersion of the temperature.

24.2.8   Multi Servogun

For multi servogun system, this function diagnoses each servogun and the results are saved individually.

24.3   USER INTERFACE

24.3.1   Diagnosis Setup Screen

This menu is for setting of this function.

Step

1   Press the [MENU] key.
2   Select [SETUP] → [Servo Gun].
3   Select [General Setup] on the screen.
4   Select [Servogun diagnosis] on the screen.

Following screen will be displayed.

Servogun diagnosis setup screen

```
SETUP Servo Gun Diagnosis
   SERVOGUN DIAGNOSIS / EQ:1 Gun:1    1/12

     1 Diagnosis enable/disable: ENABLE
     2 OVR CHECK:                ENABLE

     3 Max Torque check:         DISABLE
     4 Max Torque tolerance:          0.0%
     5 Average Torque check:     DISABLE
     6 Average Torque tolerance:      0.0%

       Program Name:
     7 TWZRCLB2
     8  Diagnosis interval:      0DAYS
     9    Diagnosis Time:        10:00
    10   Torque check Alarm      DO[  0]
    11   Alarm clear             DI[  0]
    12   Consecutive number      1times


   [ TYPE ]  EQUIP    GUN    ENABLE  DISABLE  >
```

Expansion

They can also check the disturbance torque during pressing and opening motion, not only that of closing motion.
Servogun diagnosis setup menu turns as blow with $SGDIAGCFG.$CUSTOM = 1
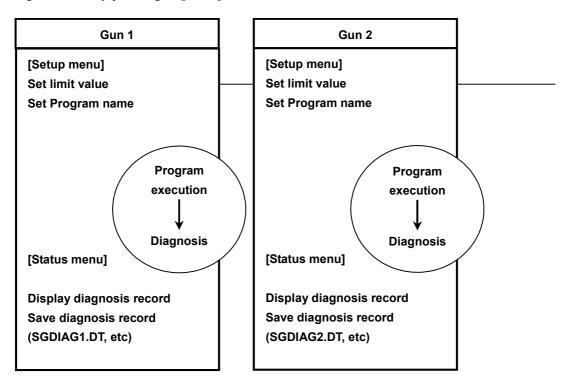
Servogun diagnosis setup screen (Extended version)

```
SETUP Servo Gun Diagnosis
   SERVOGUN DIAGNOSIS / EQ:1 Gun:1     1/30


    1 Diagnosis enable/disable: ENABLE
    2 OVR CHECK:                ENABLE


      Closing motion

    3 Max Torque check:         DISABLE
    4 Max Torque tolerance:          0.0%
    5 Average Torque check:     DISABLE
    6 Average Torque tolerance:      0.0%
    7 Min Torque check:         DISABLE
    8 Min Torque tolerance:          0.0%


      Pressing motion

    9 Max Torque check:         DISABLE
   10 Max Torque tolerance:          0.0%
   11 Average Torque check:     DISABLE
   12 Average Torque tolerance:      0.0%
   13 Min Torque check:         DISABLE
   14 Min Torque tolerance:          0.0%


      Opening motion

   15 Max Torque check:         DISABLE
   16 Max Torque tolerance:          0.0%
   17 Average Torque check:     DISABLE
   18 Average Torque tolerance:      0.0%
   19 Min Torque check:         DISABLE
   20 Min Torque tolerance:          0.0%


      All motion in program

   21 Max Torque check:         DISABLE
   22 Max Torque tolerance:          0.0%
   23 Min Torque check:         DISABLE
   24 Min Torque tolerance:          0.0%


      Program Name:
   25 TWZRCLB2
   26  Diagnosis interval:      1DAY
   27    Diagnosis Time:        10:00
   28  Torque check Alarm       DO[  0]
   29  Alarm clear              DI[  0]
   30  Consecutive number       1times


   [ TYPE ]   EQUIP    GUN    ENABLE   DISABLE   >
```

24.3.1.1 Gun no.

If the system has a multi servogun, this function can diagnose each servogun individually and record the results. To change the gun displayed on this screen, press F2[EQUIP] to select the equipment number, and change Gun No by pressing F3[GUN]

```
+-------------------------+   +-------------------------+
|          Gun 1          |   |          Gun 2          |
+-------------------------+   +-------------------------+
| [Setup menu]            |   | [Setup menu]            |
| Set limit value         |   | Set limit value         |
| Set Program name        |   | Set Program name        |
|                         |   |                         |
|          Program        |   |          Program        |
|          execution      |   |          execution      |
|             |           |   |             |           |
|             v           |   |             v           |
|          Diagnosis      |   |          Diagnosis      |
|                         |   |                         |
| [Status menu]           |   | [Status menu]           |
|                         |   |                         |
| Display diagnosis record|   | Display diagnosis record|
| Save diagnosis record   |   | Save diagnosis record   |
| (SGDIAG1.DT, etc)       |   | (SGDIAG2.DT, etc)       |
+-------------------------+   +-------------------------+
```

24.3.1.2 Enable/Disable diagnosis

Usually this item is enabled. If it is turned to enable from disable, cycle power is necessary.

24.3.1.3 Override check

If this item is enable and override during the diagnosis get different from $SGDIAGn.$SETUP.$DEF_OVR(standard value is 100), diagnosis is interrupted.

24.3.1.4 Torque check

If the disturbance torque value of each sort exceeds the limit, it posts warning.
The definition of each value is as below. The positive value of disturbance torque is opposite to gun closing direction.

Closing motion, pressing

Item	Condition for alarm
Maximum torque check	Maximum disturbance torque comes over[base value] + [tolerance value]
Average torque check	Average disturbance torque comes over[base value] + [tolerance value] (Average disturbance torque comes under[base value] - [tolerance value]) *
Minimum torque check	Minimum disturbance torque comes under[base value] - [tolerance value]

Opening motion

Item	Condition for alarm
Maximum torque check	Minimum disturbance torque comes under[base value] - [tolerance value]
Average torque check	Average disturbance torque comes under[base value] - [tolerance value] (Average disturbance torque comes over[base value] + [tolerance value]) *
Minimum torque check	Maximum disturbance torque comes over[base value] + [tolerance value]

All motion in diagnosis program

Item	Condition for alarm
Maximum torque check	Maximum disturbance torque comes over[base value] + [tolerance value]
Minimum torque check	Minimum disturbance torque comes under[base value] – [tolerance value]

* Enabled if bit1(2) of \$SGDIAGCFG.\$CUSTOM is on.

24.3.1.5 Diagnosis program

Set program name
Program name for diagnosis is set. Servogun motion during the program leads diagnosis.

Start by system variables
They can also monitor and diagnose a gun by system variables setting, not by registration of diagnosis program.

\$SGDIAGn.\$MON_START = 1   (Start monitoring)
\$SGDIAGn.\$DIAG_START = 1   (Start diagnosis)
Each variable turns off after execution.

Following is an example of diagnosis program.

```
1: $SGDIAG1.$MON_START = 1
2: CALL <program for close motion>
3: CALL <program for open motion>
4: $SGDIAG1.$DIAG_START = 1
```

24.3.1.6 Diagnosis schedule

They can define the time and cycle for diagnosis.

Diagnosis time
This function diagnoses a gun after specified time in a day.

Diagnosis cycle

WEEK	A gun is diagnosed at the first time from Sunday to Saturday with specified cycle.
DAY	A gun is diagnosed at the first time after specified days passed from the last day.
HOUR	For example, if diagnosis time is 7:00 and the cycle is 8 hours, it diagnoses a gun at first time after 7:00, 15:00 and 23:00.

Consecutive number
To avoid accidental alarm, they can specify a number of consecutive diagnosis measurements which must be over the limit before alarm.

24.3.2   Diagnosis Status Screen

Step
1   Press the [MENU] key.
2   Select [Status] → [Gun diag]
3   Select [Servogun diagnosis] on the screen.

History
Press F2[HIST] and the chart of summary of data is shown in chart menu.

Gun No
Press F3[GUN] and select the gun number which is displayed on the screen.

Chart screen for detailed data
Move cursor at each record and press F4[CHART], the chart of detailed data is shown in chart menu.

Save the records
Press F5[SAVE] and all records are saved in default device set in file menu. These records can be viewed in a CSV file.

Saved files are followings. (n : Gun number)

File name	Description
SGDIAn01.DT～SGDIAn05.DT	Last 5 records are saved.
SGDIAn11.DT～SGDIAn19.DT	Historical records are saved.
SGDIAGn.DT	The summary, time, date and results for all saved records are written.

Save all records in external device
If $SGDIAGCFG.$REC_DEVICE > 0, all detailed data and summary data is recorded to the device defined in $DEVICE each time.

File name of detailed data are as below
SGDIAnaabbcceeee.DT
(n: gun_num, aabbcc: Date, eeee: Time)

Reset the records
Press F-> key and F4[RESET], then all detail records except summary are cleared after prompt.

If Bit0(1) of $SGDIAGCFG.$AUTORESET is on, it will reset data at next diagnosis and then bit0 turns off.
If Bit1(2) of $SGDIAGCFG.$AUTORESET is on, it will reset data after auto tuning.

Clear the records
Press F→ and F4[RESET], and a warning message is displayed. Then, press F4[OK], to clear all records

24.3.3   Chart Menu

When F2[HIST] or F4[CHART] is selected in Servogun Diagnosis status menu, the following screen will be displayed and transition of each value is shown graphically.

Limit values of disturbance torque during gun closing motion are also displayed.

24.3.4   Alarm

If some disturbance torque check is valid and it excesses the tolerance at diagnosis, this function following warns it with followings.

DO

Specified DO turns on at alarm, It turns off when specified DI is on.

Warning

Warning is posted with following message.

Item	Description
SVGN-223Max disturbance torque excess (Gun: i)	Status of the max disturbance torque is NG. Pressure might be insufficient.
SVGN-224Average disturbance torque excess (Gun: i)	Status of average disturbance torque is NG.
SVGN-225Min disturbance torque excess (Gun: i)	Status of the min disturbance torque is NG. Pressure might be too large.

24.4   SYSTEM VARIABLE

In this section, it describes system variables related to servogun diagnosis function.

$SGDIAGn.$SETUP(n:Gun number)

Item	Default value	Description
For one cycle motion **i = 1 : closing motion** **i = 2 : pressing** **i = 3 : opening motion**		
$AVE_CHKi	FALSE	Enable / Disable average disturbance torque check
$AVE_LMTi	0	Tolerance value from base value for alarm
$AVE_BASEi	0	Base value of average disturbance torque
$MAX_CHKi	FALSE	Enable / Disable maximum disturbance torque check
$MAX_LMTi	0	Tolerance value from base value for alarm
$MAX_BASEi	0	Base value of maximum disturbance torque
$MIN_CHKi	FALSE	Enable / Disable minimum disturbance torque check
$MIN_LMTi	0	Tolerance value from base value for alarm
$MIN_BASEi	0	Base value of minimum disturbance torque
$STRT_CNTi	0	First count for checking disturbance torque
$END_CNTi	0	Last count for checking disturbance torque
For all motion in program		
$PRG_MAXCHK	FALSE	Enable / Disable maximum disturbance torque check
$PRG_MAXLMT	FALSE	Tolerance value from base value for alarm
$PRG_MAXBASE	0	Base value of maximum disturbance torque
$PRG_MINCHK	FALSE	Enable / Disable minimum disturbance torque check
$PRG_MINLMT	0	Tolerance value from base value for alarm
$PRG_MINBASE	0	Base value of minimum disturbance torque
Others		
$COUNT_LOCK	2	Change the span of disturbance torque check for each motion in the chart as following.0: From first peak to last peak of motor torque in each motion (exclude the start and the end of motion)1: Specified span by user ($STRT_CNTn to $END_CNTn)2: All of each motion (include the start the end of motion)"
$PROG_NAME	TWZRCLB2	Diagnosis program name
$ALM_DO_NO	0	Number of Alarm DO
$ALM_DI_NO	0	Number of Alarm clear DI
$CNSCTV_NUM	1	Consecutive number of disturbance excesses for posting alarm
$CONSECTIVED	0	Consecutive number that disturbance has exceeded the limit
$DEF_OVR	100	Override value is checked in monitoring with this value
$OVR_CHECK	TRUE	Enable / Disable override check
$RETUNED	TRUE	Turns TRUE at Auto tuning and FALSE at diagnosis
$TUNED_TIME	0	Total number of auto tuning since diagnosis started
$REC_TIME	0	Total recorded number of diagnosis since diagnosis started
$INTVL_NUM	1	Number of interval
$INTVL_TYP	1	Type of interval
$DIAG_HOUR	10	Diagnosis hour/min (hour)
$DIAG_MIN	0	Diagnosis hour/min (minute)
$DIAG_AMPM	1	24 hour or AM/PM indication
$LAST_YEAR	0	Day and time of latest record (year)
$LAST_MON	1	Day and time of latest record (month)
$LAST_DAY	1	Day and time of latest record (day)
$LAST_HOUR	0	Day and time of latest record (hour)
$LAST_MIN	0	Day and time of latest record (minute)

$SGDIAGn(n:Gun number)

Item	Default value	Description
$MON_START	0	Monitoring the gun starts if this value > 0
$DIAG_START	0	Output the record and diagnose about the monitored gun if this value > 0

$SGDIAGCFG

Item	Default value	Description
$REC_DEVICE	0	Output the detailed data for external device if this value > 0
$AUTORESET	0	Automatically resets the record if following bit is onbit0(1): At the recording of next time(automatically turns off after auto reset)bit1(2): At auto tuning
$REC_SIZE	400	Maximum number of one record (Unit: 8msec)
$CUSTOM	0	The condition about checking the torque varies if following bit is on.bit0(1): Display servogun diagnosis setup menu with expansion.bit1(2): Not only increase of average disturbance torque , but also decrease is checked
$CHK_MAINPRG	3	Check the status of diagnosis program if following bit is on. (Bit1 and Bit2 are used when the diagnosis program is executed as a sub program) bit0(1): Check the diagnosis program starts from line 1.bit1(2): If Only closing motion has finished during diagnosis task runs, diagnosis starts after the main program finishes.bit2(4): Diagnosis starts when the main program finishes.bit3(8): If diagnosis task runs for another gun, diagnosis of itself starts after the main program for another gun finishes.

24.5   PRESSURE CHECK FUNCTION

24.5.1   Overview

This function provides pressure estimation and compensation (pressure calibration adjustment) based on the diagnosis.

> **NOTE**
> This function is an option to Servogun Diagnosis (A05B-2***-J950). If you want to use this function, please order both of Pressure Check (A05B-2***-J948) and Servogun Diagnosis (A05B-2***-J950), or Servogun Diagnosis Package(A05B-2***-J895)

> **NOTE**
> This function estimates pressure based on position of servogun axis. So if servogun has large friction, it will be low accuracy for estimated pressure.

> **NOTE**
> This function estimates pressure based on position of servogun axis. So if servogun has crack or some damage, estimated pressure will be incorrect. Please confirm servogun if estimated pressure is large different from original pressure. You can post warning if estimated pressure is large different from original pressure by enabling pressure check on setup screen.
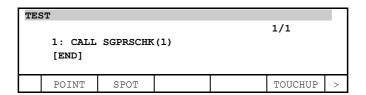
NOTE
Servogun Diagnosis (A05B-2***-J950) can detect symptom for incorrect estimation like increase of mechanical friction by using torque check. Please refer to "24.1 OVERVIEW" ~ "24.4 SYSTEM VARIABLE" for more details.

24.5.2   Pressure Check/Adjustment Procedure

24.5.2.1   Pressure check calibration

You should complete pressure check calibration previously to perform pressure check/adjustment. Please perform either method of the following two and complete pressure check calibration.

1   Perform pressure check calibration from pressure calibration screen:
    You can perform pressure check calibration after completing pressure calibration. If you don't perform pressure check calibration at completing pressure calibration, please perform pressure check calibration in accordance with the following procedure.
2   Perform pressure check calibration by calling KAREL program:
    Please create a TP program which calls KAREL program SGPRSCHK as below and perform it. Argument for SGPRSCHK is gun number. Please specify 2 if you perform pressure check calibration with servogun whose gun number is 2.

```
TEST
                                          1/1
     1: CALL SGPRSCHK(1)
     [END]


      POINT    SPOT                          TOUCHUP    >
```

⚠ **CAUTION**
   The servogun axis moves during pressure check calibration. Note the following.
   • Remove force/pressure gage
   • Reset Faults
   • Disable STEP mode
   • Set override to 100% (If you perform in the pressure calibration screen, it is automatically set to 100%.)
   • Set AUTO or T2 mode
   • (T2 mode) Don't release both of dead man switch and the [SHIFT] key

NOTE
The following warnings are posted during pressure check calibration.
SVGN-413 Pressure Check Init Start
SVGN-414 Pressure Check Init Complete

NOTE
SGPRSCHK after completing pressure check calibration perform pressure check/adjustment. If you want to re-perform pressure check calibration, press F9 "CLEAR" or F10 "RESET" on status screen.
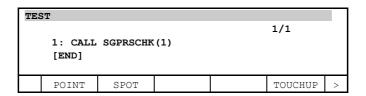
NOTE
If you change pressure calibration value after completing pressure check calibration, you have to re-perform pressure check calibration. Please perform pressure check calibration after changing pressure calibration value.

24.5.2.2 Pressure check

You can perform pressure check by calling a program for diagnosis after completing pressure check calibration. Please create a TP program which calls KAREL program SGPRSCHK as below and perform it. The first parameter is gun number. Please specify 2 if you want to perform pressure check with servogun whose gun number is 2.

If pressure check completes without any problem, you can see pressure errors (which is deviation from values at pressure check calibration) on status screen. For more details on pressure check result, please refer to "24.5.4 Status Screen".

```
TEST
                                            1/1
     1: CALL SGPRSCHK(1)
     [END]


     POINT     SPOT                      TOUCHUP    >
```
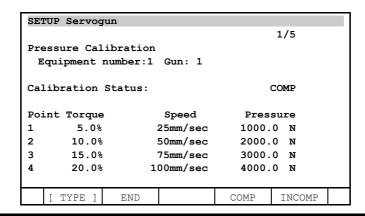
⚠**WARNING**
The servogun axis moves during pressure check. Note the following.
- Remove force/pressure gage
- Reset Faults
- Disable STEP mode
- Set override to 100%
- Set AUTO or T2 mode
- (T2 mode) Don't release both of dead man switch and the [SHIFT] key

NOTE
Pressures for diagnosis are values at pressure calibration result. If the following is pressure calibration result, pressures for diagnosis are 1000N, 2000N, 3000N and 4000N.

```
SETUP Servogun
                                            1/5
Pressure Calibration
  Equipment number:1  Gun: 1


Calibration Status:                    COMP


Point Torque          Speed          Pressure
1        5.0%         25mm/sec       1000.0  N
2       10.0%         50mm/sec       2000.0  N
3       15.0%         75mm/sec       3000.0  N
4       20.0%        100mm/sec       4000.0  N


    [ TYPE ]    END              COMP    INCOMP
```

> **NOTE**
> Pressure check is not performed for pressures which is less than
> $SGDIAG#.$SETUP.$PRSCHK_LOW (pressure unit : kgf). The default value is
> 100kgf, so please change $SGDIAG#.$SETUP.$PRSCHK_LOW if you want to
> perform pressure check for pressures which is less than 100kgf.

You can post "SVGN-415 Pressure Check Tolerance Exceed" and turn on specified DO by enabling "Pressure Check" on setup screen. For more details, please refer to "24.5.3 Setup Screen".

> **NOTE**
> This function estimates pressure based on position of servogun axis. So if servogun
> has crack or some damage, estimated pressure will be incorrect. You can detect
> crack or some damage for servogun by using pressure check alarm (SVGN-415).

24.5.2.3 Pressure adjustment

Pressure torque is automatically adjusted at pressuring after pressure check by enabling "Pressure Auto Adjust" on setup screen. Generally, pressure error becomes compensation value. But if pressure error exceeds "Pressure Adjust Tol", "SVGN-416 Pressure Adjustment Tol Exceed" occurs and compensation value is clamped to "Pressure Adjust Tol" value. For more details, please refer to "24.5.3 Setup Screen".

24.5.3 Setup Screen

Please display setup screen by the following procedure.
1   Press the [MENU] key.
2   Select "SETUP" -> "Servo Gun" -> "General Setup"
3   Select "Servogun diagnosis"
4   Select "Pressure check/adjust"

```
┌─────────────────────────────────────────────────┐
│ SETUP Servo Gun Diagnosis                        │
│ PRESSURE CHECK / EQ:1 Gun:1            1/9        │
│                                                  │
│     Pressure Check:            ENABLE            │
│     Pressure Check Tol:           10%            │
│     Pressure Check Alarm:      DO[   0]          │
│     Consective number:         1times           │
│     Pressure Auto Adjust:      ENABLE           │
│     Pressure Adjust Tol:           5%           │
│     Pressure Adjust Alarm:     DO[   0]         │
│     Alarm Clear:               DI[   0]         │
│     Override Check Severity:   ERROR            │
│                                                  │
├──────┬────────┬───────┬────────┬─────────┬──────┤
│[TYPE]│ EQUIP  │  GUN  │ ENABLE │ DISABLE │      │
└──────┴────────┴───────┴────────┴─────────┴──────┘
```

Configurations

Item	Description
Pressure Check	Enable/Disable pressure check. If this item is enabled, "SVGN-415 Pressure Check Tolerance Exceed" occurs and specified DO becomes ON when pressure error exceeds Pressure Check Tol. NOTE: This function estimates pressure based on servogun axis position. So if servogun has crack or some damage, estimated pressure will be incorrect. You can detect crack or some damage for servogun by using this item.

Pressure Check Tol	Specify a tolerance for pressure check.
	"SVGN-415 Pressure Check Tolerance Exceed" occurs and specified DO becomes ON if pressure error exceeds the specified value.
	You can choice unit for tolerance, "%" or "kgf/lbf/nwt"(depending on current force unit). The followings show how to calculate pressure error.
	  case "%":
	  error [%] = (diag pressure – base pressure) / (base pressure)
	  case "kgf/lbf/nwt":
	  error [kgf/lbf/nwt] = diag pressure – base pressure
	NOTE: The probability of occurrence for SVGN-415 will increase if you set "%" and low pressure is diagnosed.

Pressure Check Alarm	You can turn on a specified DO when pressure error exceeds Pressure Check Tol. If you specify 0, any DO does not become ON. If Alarm Clear signal is ON, the specified DO becomes OFF.
Consecutive number	You can specify a number of consecutive pressure check exceeding that must be over the limit before alarm. This is for avoiding accidental alarm.
Pressure Auto Adjust	Enable/Disable pressure auto adjustment. If pressure auto adjustment is enabled, pressure torque is automatically adjusted at pressuring after pressure check. Generally, pressure error becomes compensation value. But if pressure error exceeds "Pressure Adjust Tol", compensation value is clamped to "Pressure Adjust Tol" value.

Pressure Adjust Tol	Specify a tolerance for pressure auto adjustment.
	"SVGN-416 Pressure Adjustment Tol Exceed" occurs and specified DO becomes ON if pressure error exceeds the specified value.
	You can choice unit for tolerance, "%" or "kgf/lbf/nwt"(depending on current force unit). The followings show how to calculate pressure error.
	  case "%":
	  error [%] = (diag pressure – base pressure) / (base pressure)
	  case "kgf/lbf/nwt":
	  error [kgf/lbf/nwt] = diag pressure – base pressure
	NOTE: The probability of occurrence for SVGN-416 will increase if you set "%" and low pressure is diagnosed.

Pressure Adjust Alarm	You can turn on a specified DO when pressure error exceeds Pressure Adjust Tol. If you specify 0, any DO does not become ON. If Alarm Clear signal is ON, the specified DO becomes OFF.
Alarm Clear	Clear the above two DO for alarm. If you specify 0, you can't clear DO.

Override Check Severity	Specify behavior when override is not 100%.
	  ERROR: alarm occurs, and pressure check stops
	  WARN: warninig occurs, and pressure check does not stop
	  NONE: alarm/warning does not occur, and pressure check does not stop
	NOTE: override affects diagnosis accuracy. Please perform pressure check with override 100%.

Function keys

Item	Description
F2 "EQUIP"	Switch to a specified equipment
F3 "GUN"	Switch to a specified gun

24.5.4 Status Screen

24.5.4.1 General status screen

Please display general status screen by the following procedure.
1   Press the [MENU] key.
2   Select "-- NEXT --" -> "STATUS" -> "Gun Diag"
3   Select "Pressure check/adjust"

```
Servogun diagnosis
Pressure check/adjust                     1/15
      Gun number:           1

      Last 5 Diagnosis Records
      Time/Date   Times MaxErr[%]
  1 09/25 10:27       10   10.2      <*DETAIL*>
  2 09/24 19:09        9    2.2      <* DETAIL *>
  3 09/22 10:56        8    2.2      <* DETAIL *>
  4 09/21 10:44        7    2.3      <* DETAIL *>
  5 09/20 10:30        6    1.4      <* DETAIL *>

      Historical Records - Summary
      Time/Date   Times MaxErr[%]
 10 09/14 10:30        1    1.0      <* DETAIL *>
  9 09/15 10:44        2    1.0      <* DETAIL *>
  8 09/17 10:56        3    1.0      <* DETAIL *>
  7 09/18 19:09        4    1.4      <* DETAIL *>
  6 09/19 10:27        5    1.3      <* DETAIL *>
  5 09/20 10:30        6    1.4      <* DETAIL *>
  4 09/21 10:44        7    2.3      <* DETAIL *>
  3 09/22 10:56        8    2.2      <* DETAIL *>
  2 09/24 19:09        9    2.2      <* DETAIL *>
  1 09/25 10:27       10   10.2      <* DETAIL *>
```

	[TYPE]	HIST	GUN		SAVE	
			GUN	CLEAR	RESET	

Displayed Items

Item	Description
Time/Date	Time and Date the gun is diagnosed
Times	Total times the gun is diagnosed
MaxErr	Max value of pressure error for the diagnosis. For more details on pressure error, move cursor on "<* DETAIL *>" and press the [ENTER] key. Detail status screen will be displayed.

Function keys

Item	Description
F2 "HIST"	Display the history of max error in a graph (Refer to "24.5.4.3 History Screen."
F3, F8 "GUN"	Switch to a specified gun
F5 "SAVE"	Save diagnosis records to current specified device.
F9 "CLEAR"	Clear all diagnosis records. Summary of the records is also cleared. (Refer to 24.5.5.1.) And clear pressure check calibration data. So pressure check calibration is performed when you call SGPRSCHK after this operation.
F10 "RESET"	Clear all diagnosis records. Summary of the records is not cleared. (Refer to 24.5.5.1.) And clear pressure check calibration data. So pressure check calibration is performed when you call SGPRSCHK after this operation.

Last 5 and historical (extracted up to now) diagnosis records are displayed on status screen.

Please refer to "24.2.5.1 The details" for more details on historical records.

24.5.4.2 Detail status screen

On the pressure diagnosis/compensation general status screen, you can display the details status screen by placing the cursor on "<*DETAIL*>" and pressing [ENTER],

```
Servogun diagnosis
Pressure check/adjust(detail)                    1/10
     Gun number:        1
     Time/Date: 09/25 10:27
     Times: 2
     Max Error[%]: 10.2
     Base[nwt] Diag[N] Err[ % ]  CHK      ADJ
  1 1004.2   1003.1      1.1     OK       OK
  2 2002.7   2000.1      2.6     OK       OK
  3 3000.2   2988.2     12.0     OK       OK
  4 3998.0   4056.0    -58.0     OK       OK
  5 5004.2   5263.1   -259.9     OK       NG
  6 6000.0   5390.0    610.0     NG       NG
  7    0.0      0.0      0.0     **       **
  8    0.0      0.0      0.0     **       **
  9    0.0      0.0      0.0     **       **
 10    0.0      0.0      0.0     **       **


      [ TYPE ]            UNIT                      >
```

Displayed Items

Item	Description
Time/Date	Time and Date the gun is diagnosed
Times	Total times the gun is diagnosed
MaxErr	Max value of pressure error for the diagnosis.
Base	Pressure values at pressure check calibration.
	These values are determined from pressure calibration.
Diag	Estimated pressure values by pressure check (diagnosis).
Err	= Base value – Diag value
	You can change unit of pressure error by F3 "UNIT"
CHK	OK : pressure error does not exceed pressure check tol.
	NG : pressure error exceeds pressure check tol.
ADJ	OK : pressure error does not exceed pressure adjust tol.
	NG : pressure error exceeds pressure adjust tol.

Function keys

Item	Description
F3 "UNIT"	Change pressure error unit

24.5.4.3   History screen

You can see max error history with graphical view by pressing F2 "HIST" on general status screen. Red lines are displayed if pressure check / adjustment are enabled.

24.5.5   Log File

Summary/detail of record will be saved to selected device if F5 "SAVE" is pressed on general status screen. The file can be browsed on PC and so on.

24.5.5.1   Summary of record

Summary of all records is saved.
The record file name is SGDGPRSn.DT. (n : gun number)

Record Format

Number	Date	Prs Check	Prs Adjust	Max Error[%]	Max Error[kgf]
1	1303221359	OK	OK	3.74857E-01	1.14674E+00
2	1303231359	OK	OK	3.26709E-01	9.99452E-01
3	1303251359	OK	OK	4.70431E-01	1.43912E+00
4	1303271359	OK	OK	6.88984E-01	2.10771E+00
5	1303281359	OK	OK	9.09005E-01	2.78078E+00
6	1303301359	OK	OK	6.83054E-01	2.08956E+00

Record Item

Item	Description
Number	Total times the gun is diagnosed.
Date	Time and date the gun is diagnosed. In YYMMDDhhmm format. YY: Year, MM: Month, DD: Day, hh: Hour, mm: Minute
Prs Check	OK : pressure error does not exceed pressure check tol. NG : pressure error exceeds pressure check tol.
Prs Adjust	OK : pressure error does not exceed pressure adjust tol. NG : pressure error exceeds pressure adjust tol.
Max error [%]	Max value of pressure error [%] for the diagnosis.
Max error [kgf]	Max value of pressure error [kgf] for the diagnosis.

24.5.5.2 Detail of record

Detail of record is saved as follow format.
The record file names are as follow. (n : gun number)
 - SGDGPn01.DT ~ SGDGPn05.DT : Latest diagnosis records on the status screen
 - SGDGPn11.DT ~ SGDGPn20.DT : Historical records displayed on status screen

Record Format

Time/date	13/03/22 14:44									
Recorded times	6									
Max error [%]	1.27021E+00									
Press check tolerance [%]	1.00000E+01									
Press adjust tolerance [%]	5.00000E+00									
Spring rate(approx.)[kgf/mm]	2.04291E+02									
Number	Trq	Err[kgf]	Err[%]	Chk	Adj	Diag Pos	Diag Prs	Base Pos	Base Prs	SoloUpdt
0	1.0	--	--	--	--	0.01	--	0.01	--	
1	5.0	1.1	0.1	OK	OK	1.02	1003.1	1.03	1004.2	
2	10.0	2.6	0.1	OK	OK	2.02	2000.1	2.03	2002.7	
3	15.0	12.0	0.4	OK	OK	3.01	2988.2	3.04	3000.2	
4	20.0	58.0	1.5	OK	OK	4.06	4056.0	4.00	3998.0	
5	--	--	--	--	--	--	--	--	--	
6	--	--	--	--	--	--	--	--	--	
7	--	--	--	--	--	--	--	--	--	
8	--	--	--	--	--	--	--	--	--	
9	--	--	--	--	--	--	--	--	--	
10	--	--	--	--	--	--	--	--	--	

Record Item

Item	Description
Time/date	Time and Date the gun is diagnosed.
Recorded Times	Total times the gun is diagnosed.
Max error [%]	Max value of pressure error for the diagnosis.
Spring rate(approx.)[kgf/mm]	Estimated spring rate (approximate value)
Press check tolerance	Tolerance for pressure check
Press adjust tolerance	Tolerance for pressure auto adjustment
Number	Point number (corresponding to pressure calibration)
Trq	Torques at diagnosis
Err [kgf]	Pressure error [kgf]
Err [%]	Pressure error [%]
Chk	OK : pressure error does not exceed pressure check tol. NG : pressure error exceeds pressure check tol.
Adj	OK : pressure error does not exceed pressure adjust tol. NG : pressure error exceeds pressure adjust tol.
Diag Pos	Pressure position at diagnosis
Diag Prs	Estimated pressure value at diagnosis
Base Pos	Pressure position at pressure check calibration

Item	Description
Base Prs	Estimated pressure value at pressure check calibration
SoloUpdt	"*" shows which pressure is updated when pressure check is performed individually.

24.5.5.3   Automatic save to external device

Detail of record is saved to selected device every diagnoses if $SGDIAGCFG.$REC_DEVICE > 0.
The record file name is SGDGPn_aabbccdd.DT. (n : gun number, aa : month, bb : day, cc : hour, dd : minute)

24.5.6   Pressure Check/Adjustment Individually

Normally, diagnosis is performed for all pressures corresponding to pressure calibration.
But it might take time and it is difficult to perform it with robot motion.
This section describes how to diagnose for specified pressure.

NOTE
Pressures that can be specified are values at pressure calibration result. If the following is pressure calibration result, you can specify 1000N(point number 1), 2000N(point number 2), 3000N(point number 3) and 4000N(point number 4).

```
SETUP Servogun
                                          1/5
Pressure Calibration
  Equipment number:1  Gun: 1

Calibration Status:                    COMP

Point Torque          Speed        Pressure
1       5.0%          25mm/sec     1000.0  N
2      10.0%          50mm/sec     2000.0  N
3      15.0%          75mm/sec     3000.0  N
4      20.0%         100mm/sec     4000.0  N

     [ TYPE ]    END            COMP    INCOMP
```

24.5.6.1   Pressure check procedure

The first parameter for SGPRSCHK is gun number and the second parameter for SGPRSCHK is point number (on pressure calibration). The following TP program will diagnose gun1's point number 3 (if the above is pressure calibration result, it's pressure is 3000N).

```
TEST
                                          1/1
    1: CALL SGPRSCHK(1, 3)
    [END]

      POINT    SPOT                  TOUCHUP   >
```

Pressure for diagnosis will be changed every SGPRSCHK by specifying 0 for point number. For example, if the above is pressure calibration, point number will be changed 1 -> 2 -> 3 -> 4 -> 1 -> … (pressure will be changed 1000N -> 2000N -> 3000N -> 4000N -> 1000N -> …).

```
TEST
                                           1/1
     1: CALL SGPRSCHK(1, 0)
     [END]

       POINT     SPOT                    TOUCHUP    >
```

24.5.6.2 Pressure check result / status screen

Pressure check result will be overwritten to the previous result.
" * " shows which pressure check result is updated by displaying detail status screen.

```
Servogun diagnosis
Pressure check/adjust(detail)              1/10
     Gun number:         1
     Time/Date: 09/25 10:27
     Times: 2
     Max Error[%]: 10.2
     Base[nwt] Diag[N] Err[ % ]  CHK      ADJ
  1 1004.2    1003.1    1.1      OK       OK
  2 2002.7    2000.1    2.6      OK       OK
  3 3000.2    2988.2    12.0     OK       OK
  4 3998.0    4056.0    -58.0    OK       OK
 *5 5004.2    5263.1    -259.9   OK       OK
  6 6000.0    5390.0    610.0    OK       OK
  7    0.0       0.0     0.0     **       **
  8    0.0       0.0     0.0     **       **
  9    0.0       0.0     0.0     **       **
 10    0.0       0.0     0.0     **       **


       [ TYPE ]              UNIT                   >
```

24.5.6.3 Pressure check by multi task

During performing pressure check individually, only gun axis moves and it might not take a long time. Using multi task, pressure check can be executed together robot motion. For example, during robot returns to home position after tip dress, pressure check can be executed. Please refer to the following sample.

TEST.TP : Call a program that robot moves to home position (GO_HOME) after running diagnosis program (DO_PRSCHK).
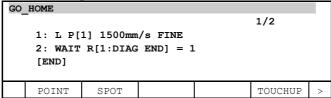
```
TEST
                                           1/2
     1: RUN DO_PRSCHK
     2: CALL GO_HOME
     [オワリ]

       POINT     SPOT                    TOUCHUP    >
```

DO_PRSCHK.TP : Call diagnosis (SGPRSCHK).

```
DO_PRSCHK
                                           1/2
     1: CALL SGPRSCHK(1, 0)
     2: R[1:DIAG END] = 1
     [END]

       POINT     SPOT                    TOUCHUP    >
```

GO_HOME : Robot moves to home position.

```
GO_HOME
                                        1/2
   1: L P[1] 1500mm/s FINE
   2: WAIT R[1:DIAG END] = 1
   [END]


   | POINT | SPOT |  |  | TOUCHUP | > |
```

> ⚠ **CAUTION**
> In case using multi task, do not specify group mask of gun to robot motion program (GO_HOME.TP in the above sample).
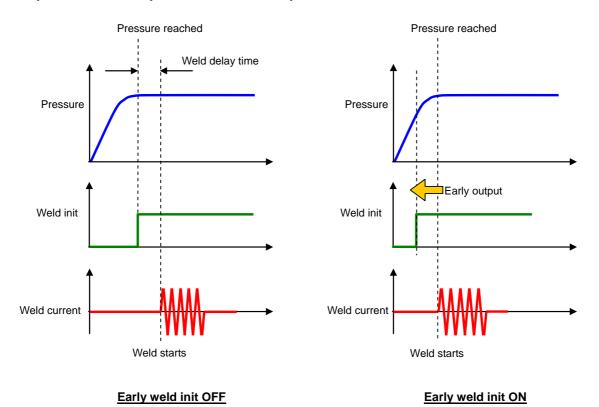
> ⚠ **CAUTION**
> During the pressure check using a multi task, do not change the servo gun posture largely (such as changing from a horizontal posture to a vertical one) with robot motion. Large changing posture would cause incorrect pressure check/adjustment.

25   EARLY WELD INIT FUNCTION
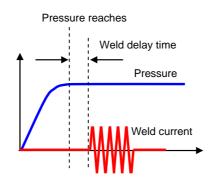
25.1   OVERVIEW

In SPOT welding sequence, weld init signal is output to weld timer when gun reaches target pressure. Ideally, weld current flows immediately. However, communication delay and/or internal process time of weld timer can cause current flow to lag (current flows some time after target pressure is reached).

Early weld init function asserts weld init signal prior to gun reaching target pressure, to compensate for this delay. Therefore, early weld init can reduce cycle time.

Early weld init OFF   **Early weld init ON**

25.2   WELD DELAY TIME MEASUREMENT

Weld delay time is a configuration (input) parameter for this function. Measure weld delay time with a sensor that can observe weld current and pressure simultaneously.

25.3   EARLY WELDING CALIBRATION

Execute early welding calibration to use this function.

> **NOTE**
>   Change $SGSYSCFG.$SHO_ELYWLD to TRUE, prior to this operation. No need re-power controller.

Procedure for early welding calibration.
1   Press the [MENU] key.
2   Select UTILITIES.
3   Press F1, [TYPE] and select SG Gun setup. The following screen will be displayed.

```
UTILS Gun Setup
EQ: 1 Gun:1                              1/3
1.Set gun motion sign:                  COMP
2.Set Gun specs, master gun             COMP
     Tip Displacement:      10.000(mm/rev)
     Open stroke limit:        -55.0(mm)
     Close stroke limit:        20.0(mm)
3.Auto Tune:                            COMP
4.Pressure Compensation Setup: <*DETAIL*>
5.Servo gun optional Calibration;
     Thickness Check Cal.:         COMP
     Early Welding Cal.:          INCOMP


    [ TYPE ]   EQUIP    EXEC   RESTART
```

4   Complete Steps 1-3 of the Servo gun Gun setup utility.
5   Complete Pressure Calibration.
6   Select the appropriate equipment and gun number using the F-keys.
7   Move the cursor to select "Servo gun optional calibration".

> **NOTE**
>   Both thickness calibration and early welding calibration execute during servo gun optional calibration.
>   Please refer to chapter 15 for thickness check calibration.
>   Note that early welding calibration can not execute without thickness check calibration.

> ⚠ **CAUTION**
>   Before calibration starts, the following items must be confirmed:
>   ● The gun's zero position must be correct (mastering error leads to error in calibration).
>   ● Pressure Calibration must be complete before Step 4.
>   ● Robot may have to be placed in AUTO or T2 and all faults cleared.

> **NOTE**
>   Accuracy of early weld init depends on accuracy of pressure calibration. For best accuracy, calibrate pressure at actual pressures used during welding.

8   Press Shift + F3 (EXEC) to initiate calibration. The following prompt box will be displayed when you do this.

```
The following calibration
exercises will begin.
 - Thickness Check Cal.
 - Early welding Cal.
ARE YOU SURE YOU WANT TO DO
THIS?

        [YES]    NO
```

9   Select YES and press the [ENTER] key.   The selected gun will open and close several times to
perform the calibration.   The robot will not move during this process.

25.4   SETUP EARLY WELD INIT FUNCTION
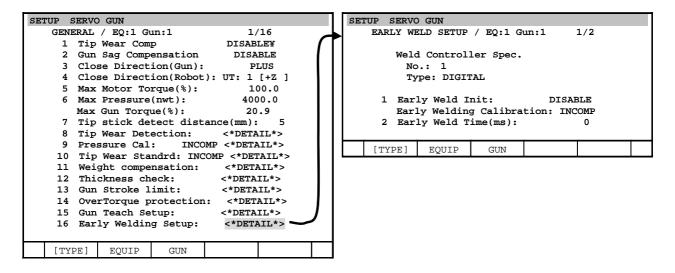
Before using this function, set up parameters in the early weld setup screen.

NOTE
    Change $SGSYSCFG.$SHO_ELYWLD to TRUE, prior to this operation. No
    need re-power controller.

Procedure to display early welding setup screen
1   Press the [MENU] key.
2   Select " SETUP".
3   Press F1"[TYPE]", Select "Servo Gun" to display the SERVO GUN SETUP screen.
4   Select "8 General Setup" by placing the cursor on <*DETAIL*> and pressing the [ENTER] key).
Then move to cursor, and press the [ENTER] key on "Early Welding Setup"

```
SETUP  SERVO GUN
    GENERAL / EQ:1 Gun:1           1/16
     1  Tip Wear Comp          DISABLE¥
     2  Gun Sag Compensation      DISABLE
     3  Close Direction(Gun):       PLUS
     4  Close Direction(Robot): UT: 1 [+Z ]
     5  Max Motor Torque(%):        100.0
     6  Max Pressure(nwt):         4000.0
        Max Gun Torque(%):           20.9
     7  Tip stick detect distance(mm):    5
     8  Tip Wear Detection:      <*DETAIL*>
     9  Pressure Cal:    INCOMP <*DETAIL*>
    10  Tip Wear Standrd: INCOMP <*DETAIL*>
    11  Weight compensation:     <*DETAIL*>
    12  Thickness check:         <*DETAIL*>
    13  Gun Stroke limit:        <*DETAIL*>
    14  OverTorque protection:   <*DETAIL*>
    15  Gun Teach Setup:         <*DETAIL*>
    16  Early Welding Setup:     <*DETAIL*>

 [TYPE]   EQUIP    GUN
```

```
SETUP  SERVO GUN
    EARLY WELD SETUP / EQ:1 Gun:1     1/2

       Weld Controller Spec.
        No.: 1
        Type: DIGITAL

     1  Early Weld Init:        DISABLE
        Early Welding Calibration: INCOMP
     2  Early Weld Time(ms):         0

 [TYPE]   EQUIP    GUN
```

5   Refer to the following table for setup items.

Item		Description
Weld Controller Spec.	No.	This parameter indicates weld timer number assigned to selected gun. This number can not be changed in this screen. Assign weld timer number in SPOT configuration screen.
	Type	This parameter indicates weld timer type. Weld timer type can not be changed in this screen. Change weld timer type in SPOT configuration screen.
Early Weld Init Default : DISABLE		Specify whether early weld init is enabled or disabled. DISABLE : Early weld init is not output with the early weld time. ENABLE: Early weld init is output with set an early weld time. Note that early weld init can not be enabled if early welding calibration is incomplete.
Early Welding Calibration Default : INCOMP		This parameter indicates status of early welding calibration. This parameter can not be changed in this screen.
Early Weld Time(ms) Default : 0ms		This parameter specifies early weld time.

NOTE

Early Weld init(output) is controlled for ITP time. If early welding time is not a multiple of ITP time, the early welding time is rounded up to multiple of ITP time. Therefore, specified early welding time would not be always   realized.

NOTE

Maximum early weld time = duration between gun close detection and gun reaching pressure. If early weld time value exceeds this duration, the following alarm is posted.
 SVGN-304 Invalid early welding time
Reduce early weld time value if this alarm occurs.

25.5   EARLY WELD INIT FUNCTION OPERATION

Procedure to use early weld init function

Use the early weld init function by following the procedures below.

1   Enable early weld init via early weld setup screen.
2   Specify early weld time (weld delay time that is measured beforehand).
3   Execute SPOT instruction or manual weld.

⚠**CAUTION**

Setup confirmation is strongly recommended.
   a. Use a sensor that observes both weld current and pressure to ensure
   that timing of weld current is correct.
   b. Confirm weld quality.

⚠**CAUTION**

Early weld init function can work when override is 100%. When override is less
than 100%, even if this function is enabled, early welding does not work.

NOTE

If pause occurs during pressure motion (and early weld init is enabled) , early
weld init is skipped at resume (for this spot). The following warning message
informs user of this.
SVGN-300 Early welding OFF at resuming
However, early weld init is enabled (again) at the next SPOT instruction or if
BWD is executed, prior to resuming this spot.

⚠**CAUTION**

If the following alarm is posted, weld init signal was asserted but pressure was
not reached.
SVGN-302 Welding in pressure shortage
If this alarm is posted:
1. confirm that weld quality of the SPOT is ok
2. correct root cause via cause/remedy of SVGN-020 "Pressure shortage".
If SVGN-302 persists, perform early welding calibration again. Before calibration,
ensure that calibration for pressure used during this spot is ok.
Note that for some guns, this alarm may occur when override is low.

NOTE

In case of dual gun, if early weld init is not enabled for both guns, the following
warning message is posted.
SVGN-303 Gun#: Disabled early welding
(# is gun number that disables early weld init)
When this message is posted, enable or disable early weld init on both guns.

---

26   TIP WEAR DIAGNOSTICS FUNCTION

This function provides diagnostics for tip wear value.
This function is optional (not standard).

ServoGun tipwear diagnostics	A05B-2***-R826

> **NOTE**
> Basic FANUC tip wear down compensation function must be used to use this function.
> This function cannot work well if tip wear compensation in your own way is used.
> Please refer to chapter 6 about basic FANUC tip wear down compensation.
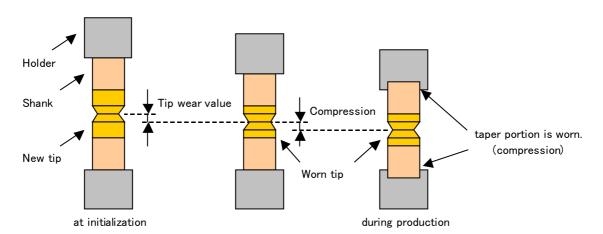
26.1   OVERVIEW

When the holder and the shank is tapered coupling, end of tip is changed by wear of the tapered portion regardless of tip wear as shown by the figure below. So change of end of tip during production consists of tip wear value and compression (by worn taper portion).
On the other hand, basic tip wear down compensation function measures and compensates not actual tip wear value but change of end of tip. So basic tip wear down compensation function has measurement error due to compression and cannot use tip completely with aging.

This function makes it possible to use tip completely by measuring not end of tip but actual tip wear value and compression. And this function also provides archive of wear measurements and various helpful tools for tip wear diagnosis.

This chapter use the following terms.

Term	Explanation
Tip wear value	Tip erosion or material consumed during weld process.
	NOTE: This is NOT same as wear down value for basic tip wear down compensation.
Compression	Displacement of shank into holder by worn taper portion.
Change of end of tip	Change of end of tip = tip wear value + compression.
	NOTE: This is same as wear down value for basic tip wear down compensation.
Wear percent	Percentage of robot/gun tip wear value to total tip wear value.
	NOTE: This is NOT same as wear ratio for basic tip wear down compensation.

26.2   TIP WEAR DIAG SCREEN

Tip wear diag screen configures alarm and monitoring parameters for tip wear.

Procedure to display tip wear diag screen
1   Press the [MENU] key, then select "6 SETUP".
2   Press F1 [TYPE], then select "Servo Gun".
3   "General Setup" → "Tip Wear Detection" → "Tip wear diag". The following will be displayed.

```
SETUP Servogun
   TIP WEAR DIAG / EQ:1 Gun:1        1/28
      Cap wear config(mm)
   1   Max wear robot tip:           10.0
   2   Max wear gun tip:             10.0
   3   Alarm severity:               Warn
   4    Output index:                   0
       Change date:    ****************
      Compress config(mm)
   5   Standard val robot tip:        0.0
   6   Negative tol robot tip:        5.0
   7   Positive tol robot tip:        5.0
   8   Standard val gun tip:          0.0

   [TYPE]    GUN   AUTORATE AUTOPRCT RESETAV  >
   RESETMAX                                   >
```

26.2.1   Settings

ITEM	DESCRIPTION
Tip wear config(mm)	
Max wear robot tip	If robot tip wear value exceeds the specified value, "SVGN-423 Fixed tip capwear:#.# (limit)" occurs.
Max wear gun tip	If gun tip wear value exceeds the specified value, "SVGN-424 Movable tip capwear:#.# (limit)" occurs.
Alarm severity	Severities of SVGN-423, SVGN-424 alarms: none, warn or pause
Output index	Specified DO[#] is asserted when SVGN-423 or SVGN424 alarm occurs.
Change date	Date of most recent change to "Tip wear config(mm)" parameters.
Compress config (mm)	
Standard val robot tip	Expected distance that new robot tip is installed after tip wear initial setup. Change this value to accommodate a different shank, for example.
Negative tol robot tip	Max difference from standard value, in negative direction. If compression < (standard value – negative tol), "SVGN-429 Fixed tip compression: #.# overtol." occurs.
Positive tol robot tip	Max difference from standard value, in positive direction. If compression > (standard value + positive tol), "SVGN-429 Fixed tip compression: #.# overtol." occurs.
Standard val gun tip	Expected distance that new gun tip is installed after tip wear initial setup. Change this value to accommodate a different shank, for example.
Negative tol gun tip	Max difference from standard value, in negative direction. If compression < (standard value – negative tol), "SVGN-430 Movable tip compression: #.# overtol." occurs.
Positive tol gun tip	Max difference from standard value, in positive direction. If compression > (standard value + positive tol), "SVGN-430 Movable tip compression: #.# overtol." occurs.
Alarm severity	Severities of SVGN-429, SVGN-430 alarms: none, warn or pause
Output index	Specified DO[#] is asserted when SVGN-429 or SVGN430 alarm occurs.
Change date	Date of most recent change to "Compress config(mm)" parameters.

Wear rate config(mm/spot*1000)	
Standard val robot tip	Expected wear rate for robot tip. Specify wear value per 1000 spots.
Negative tol robot tip	Max difference from standard wear rate, in negative direction. If compression < (standard value – negative tol), "SVGN-425 Fixed tip wear rate(mm/spot): #.# overtol." occurs.
Positive tol robot tip	Max difference from standard wear rate, in positive direction. If compression > (standard value + positive tol), "SVGN-425 Fixed tip wear rate(mm/spot): #.# overtol." occurs.
Standard val gun tip	Expected wear rate for gun tip. Specify wear value per 1000 spots.
Negative tol gun tip	Max difference from standard wear rate, in negative direction. If compression < (standard value – negative tol), "SVGN-426 Movable tip wear rate(mm/spot): #.# overtol." occurs.
Positive tol gun tip	Max difference from standard wear rate, in positive direction. If compression > (standard value + positive tol), "SVGN-426 Movable tip wear rate(mm/spot): #.# overtol." occurs.
Alarm severity	Severities of SVGN-425, SVGN-426 alarms: none, warn or pause
Output index	Specified DO[#] is asserted when SVGN-425 or SVGN426 alarm occurs.
Change date	Date of most recent change to "Wear rate config(mm/spot*1000)" parameters.
Wear percent config(%)	
Standard val robot tip	Expected wear percentage for robot tip.
Negative tol robot tip	Max difference from standard wear percent, in negative direction. If compression < (standard value – negative tol), "SVGN-427 Fixed tip wear percent: #.# overtol." occurs.
Positive tol robot tip	Max difference from standard wear percent, in positive direction. If compression > (standard value + positive tol), "SVGN-427 Fixed tip wear percent: #.# overtol." occurs.
Standard val gun tip	Expected wear percentage for gun tip.
Negative tol gun tip	Max difference from standard wear percent, in negative direction. If compression < (standard value – negative tol), "SVGN-428 Movable tip wear percent: #.# overtol." occurs.
Positive tol gun tip	Max difference from standard wear percent, in positive direction. If compression > (standard value + positive tol), "SVGN-428 Movable tip wear percent: #.# overtol." occurs.
Alarm severity	Severities of SVGN-427, SVGN-428 alarms: none, warn or pause
Output index	Specified DO[#] is asserted when SVGN-427 or SVGN428 alarm occurs.
Change date	Date of most recent change to "Wear percent config(%)" parameters.

26.2.2   Function Keys

FKEYS	DESCRIPTION
F3 AUTORATE	Automatically set wear rate standard and tolerance parameters based on current averages.
F4 AUTOPRCT	Automatically set wear rate percent and tolerance parameters based on current averages.
F5 RESETAV	Reset average to date.
F6 RESETMAX	Reset max value to date for all parameters.

26.3   TIP MEASUREMENT INFO SCREEN

Tip measurement info screen is used to review tip wear status and diagnose trend of tip wear.

26.3.1   TIP INFO SCREEN (MAIN)
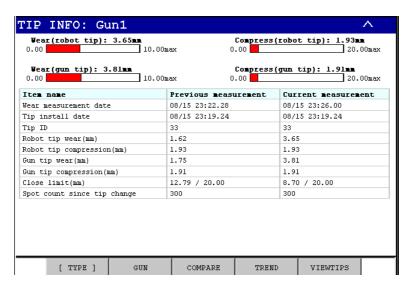
This screen is used to review current tip wear status.
Use VIEW TIPS screen for graphical description of current status.
Use TIP TREND screen and TIP COMPRARISON screen for detailed review and diagnostics.

Procedure to display tip info screen
1   Press the [MENU] key, then select "0 – NEXT –" -> "4 STATUS".
2   Press F1 [TYPE], then select "Servo Gun".
3   Select "Tip measurement info".

ITEM	DESCRIPTION
Wear measurement date	Date and time that tip wear measurement is performed.
Tip install date	Date and time that new tip is installed.
Tip ID	Unique number that increments each time new tip is installed. Tip ID for tip wear initial setup is 1.
Robot tip wear(mm)	Tip wear value for robot tip.
Robot tip compression(mm)	Compression value for robot tip.
Gun tip wear(mm)	Tip wear value for gun tip.
Gun tip compression(mm)	Compression value for gun tip.
Close limit(mm)	Close stroke limit.
Spot count since tip change	SPOT count since new tip is installed.
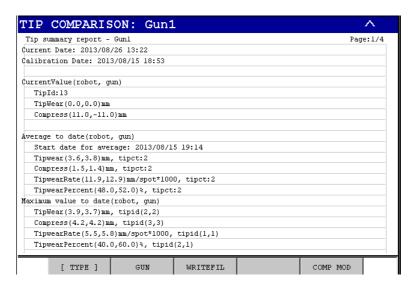
FKEYS	DESCRIPTION
F2 GUN	Change gun number.
F3 COMPARE	Display TIP COMPARISON screen.
F4 TREND	Display TIP TREND screen.
F5 VIEWTIPS	Display VIEW TIPS screen.

26.3.2   TIP COMPARISON SCREEN

Tip comparison screen is used to review tip data and compare tips. Several comparison modes are available.

Procedure to display tip comparison screen

1   Press the [MENU] key, then select "0 – NEXT –" -> "4 STATUS".
2   Press F1 [TYPE], then select "Servo Gun".
3   Select "Tip measurement info".
4   Press F3 "COMPARE".

```
TIP COMPARISON: Gun1                                          ^
  Tip summary report - Gun1                          Page:1/4
Current Date: 2013/08/26 13:22
Calibration Date: 2013/08/15 18:53

CurrentValue(robot, gun)
   TipId:13
   TipWear(0.0,0.0)mm
   Compress(11.0,-11.0)mm

Average to date(robot, gun)
   Start date for average: 2013/08/15 19:14
   Tipwear(3.6,3.8)mm, tipct:2
   Compress(1.5,1.4)mm, tipct:2
   TipwearRate(11.9,12.9)mm/spot*1000, tipct:2
   TipwearPercent(48.0,52.0)%, tipct:2
Maximum value to date(robot, gun)
   TipWear(3.9,3.7)mm, tipid(2,2)
   Compress(4.2,4.2)mm, tipid(3,3)
   TipwearRate(5.5,5.8)mm/spot*1000, tipid(1,1)
   TipwearPercent(40.0,60.0)%, tipid(2,1)

        [ TYPE ]        GUN        WRITEFIL              COMP MOD
```

Three comparison modes are available by pressing F5 "COMP MOD".
- Compare mode1: Tip summary
- Compare mode2: Average vs. Tip A
- Compare mode3: Tip B vs. Tip A
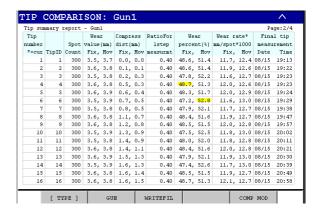
26.3.2.1   Compare mode1: Tip summary

In this mode, cumulative values are presented on first page.
Final measurement value for each tip is presented on subsequent pages. This information is called "archive". This archive stores latest 500 data.

```
TIP COMPARISON: Gun1                    ^
Tip summary report - Gun1       Page:1/4
Current Date: 2013/08/26 13:22
Calibration Date: 2013/08/15 18:53

CurrentValue(robot, gun)
   TipId:13
   TipWear(0.0,0.0)mm
   Compress(11.0,-11.0)mm

Average to date(robot, gun)
   Start date for average: 2013/08/15 19:14
   Tipwear(3.6,3.8)mm, tipct:2
   Compress(1.5,1.4)mm, tipct:2
   TipwearRate(11.9,12.9)mm/spot*1000, tipct:2
   TipwearPercent(48.0,52.0)%, tipct:2
Maximum value to date(robot, gun)
   TipWear(3.9,3.7)mm, tipid(2,2)
   Compress(4.2,4.2)mm, tipid(3,3)
   TipwearRate(5.5,5.8)mm/spot*1000, tipid(1,1)
   TipwearPercent(40.0,60.0)%, tipid(2,1)

     [ TYPE ]    GUN    WRITEFIL         COMP MOD
```

```
TIP COMPARISON: Gun1                                    ^
Tip summary report - Gun1                       Page:2/4
```

Tip number *=cur	TipID	Spot Count	Wear value(mm) Fix, Mov	Compress dist(mm) Fix, Mov	RatioFor 1step measurmt	Wear percent(%) Fix, Mov	Wear rate* mm/spot*1000 Fix, Mov	Final tip measurement Date Time
1	1	300	3.5, 3.7	0.0, 0.0	0.40	48.6, 51.4	11.7, 12.4	08/15 19:13
2	2	300	3.6, 3.8	0.1, 0.1	0.40	48.6, 51.4	11.9, 12.6	08/15 19:22
3	3	300	3.5, 3.8	0.2, 0.3	0.40	47.8, 52.2	11.6, 12.7	08/15 19:23
4	4	300	3.6, 3.8	0.5, 0.3	0.40	48.7, 51.3	12.0, 12.6	08/15 19:23
5	5	300	3.6, 3.9	0.6, 0.4	0.40	48.3, 51.7	12.0, 12.9	08/15 19:24
6	6	300	3.5, 3.9	0.7, 0.5	0.40	47.2, 52.8	11.6, 13.0	08/15 19:29
7	7	300	3.5, 3.8	0.8, 0.5	0.40	47.9, 52.1	11.7, 12.7	08/15 19:38
8	8	300	3.6, 3.8	1.1, 0.7	0.40	48.4, 51.6	11.9, 12.7	08/15 19:47
9	9	300	3.6, 3.8	1.2, 0.8	0.40	48.5, 51.5	12.0, 12.8	08/15 19:57
10	10	300	3.5, 3.9	1.3, 0.9	0.40	47.5, 52.5	11.8, 13.0	08/15 20:02
11	11	300	3.5, 3.8	1.4, 0.9	0.40	48.0, 52.0	11.8, 12.8	08/15 20:11
12	12	300	3.6, 3.8	1.4, 1.1	0.40	48.4, 51.6	12.0, 12.8	08/15 20:21
13	13	300	3.6, 3.9	1.5, 1.3	0.40	47.9, 52.1	11.9, 13.0	08/15 20:30
14	14	300	3.5, 3.9	1.6, 1.3	0.40	47.4, 52.6	11.7, 13.0	08/15 20:39
15	15	300	3.6, 3.8	1.6, 1.4	0.40	48.5, 51.5	11.9, 12.7	08/15 20:49
16	16	300	3.6, 3.8	1.6, 1.5	0.40	48.7, 51.3	12.1, 12.7	08/15 20:58

```
     [ TYPE ]    GUN    WRITEFIL         COMP MOD
```

26.3.2.2   Compare mode2: Average vs. Tip A

This screen compares values for selected tip vs average. Select left column and press up/down arrow to toggle between archive average and average to date. Select right column and press up/down arrow to change tip selection.

Press F3 "SHOCHART" to display graphic line charts at bottom of screen.
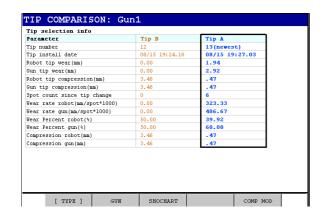
26.3.2.3   Compare mode3: Tip B vs. Tip A
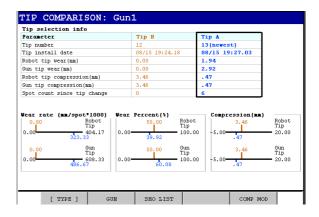
This screen compares values for selected tip vs average.
Select left column and press up/down arrow to change tip B selection.
Select right column and press up/down arrow to change tip A selection.

Press F3 "SHOCHART" to display graphic line charts at bottom of screen.
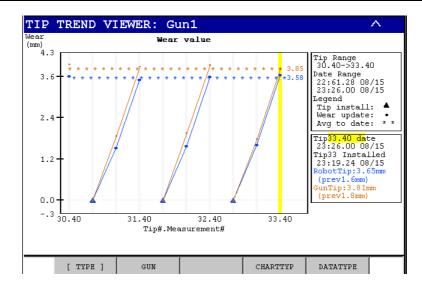
26.3.3   TIP TREND SCREEN

Tip trend screen displays trend data (series of measurements) for wear and other parameters.

Procedure to display tip trend screen
1   Press the [MENU] key, then select "0 – NEXT –" -> "4 STATUS".
2   Press F1 [TYPE], then select "Servo Gun".
3   Select "Tip measurement info".
4   Press F4 "TREND".
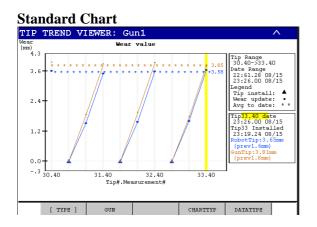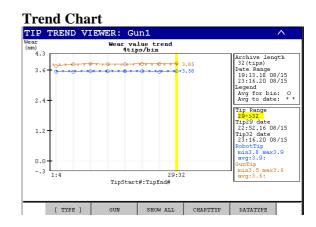
FKEYS	DESCRIPTION
F2 GUN	Change gun number.

F3 SHOW ALL/SHOW AVG	This key is displayed when chart type = trend chart.
	    SHOW ALL: all points are displayed for each bin
	    SHOW AVG: averages of bin column are displayed
	e.g. when total size of data is 100 points,
	SHOW ALL : 10 points are displayed for each bin
	SHOW AVG : 1 point (average of bin) is displayed for each bin

F4 CHARTTYP	Standard chart: Each bin corresponds to the specified measured value. You can see old/new data by pressing left/right arrow key. Trend chart: Each bin corresponds to a series/average of the specified measured value. For example if archive contains 100 points, then 10 points per bin are displayed (or average of 10 points is displayed). You can understand trend of the data by using trend chart. F3 key changes display type of points.
F5 DATATYPE	Select type of data from wear value, wear rate, wear percent, compression value or compress rate.

26.3.3.1 Chart1: Wear value

Wear values at wear update are displayed when standard chart is selected. Wear values at the last wear update for the tips are displayed when trend chart is selected.

Standard Chart

Trend Chart

26.3.3.2   Chart2: Wear rate

Wear rates for tips (wear values per 1000 spots) are displayed when wear rate is selected.

Standard Chart

Trend Chart

26.3.3.3   Chart3: Wear percent

Wear percents for tips (percentages of tip wear values to the whole) are displayed when wear percent is selected.

Standard Chart

Trend Chart

26.3.3.4   Chart4: Compression value

Compression values after tip change are displayed when compression value is selected.

Standard Chart
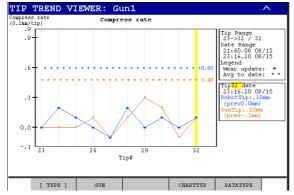
Trend Chart

26.3.3.5   Chart5: Compress rate

Compression rates for tips (compression values per 10 tips [mm]) are displayed when compression rate is selected.

Standard Chart

TIP TREND VIEWER: Gun1

Compress rate
(0.1mm/tip)   Compress rate

Tip Range
 23->32 / 32
Date Range
 21:60.08 08/15
 23:16.20 08/15
Legend
 Wear update: •
 Avg to date: * *
Tip32 date
 23:16.20 08/15
RobotTip:.10mm
 (prev0.0mm)
GunTip:.10mm
 (prev-.1mm)

[TYPE]   GUN   CHARTTYP   DATATYPE

Trend Chart

TIP TREND VIEWER: Gun1

Compress rate
(0.1mm/tip)   Compress rate
                                 4tips/bin
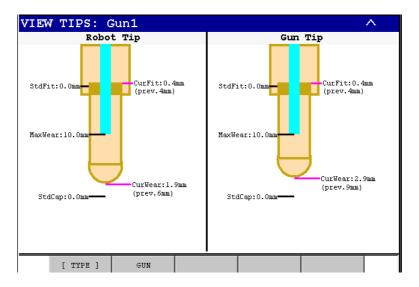
Archive length
 32(tips)
Date Range
 19:13.18 08/15
 23:16.20 08/15
Legend
 Avg for bin: O
 Avg to date: * *
Tip Range
 29->32
Tip29 date
 22:52.16 08/15
Tip32 date
 23:16.20 08/15
RobotTip
 min-.1 max.3
 avg:.1:
GunTip
 min0.0 max.1
 avg:.0:

[TYPE]   GUN   SHOW ALL   CHARTTYP   DATATYPE

26.3.4   VIEW TIPS SCREEN
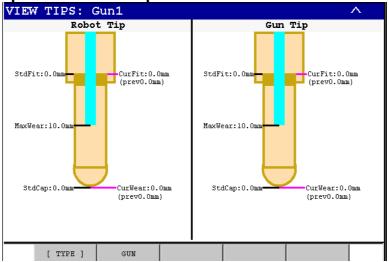
View tips screen is used to see a visual representation of current tip condition.

Procedure to display tip trend screen
1   Press the [MENU] key, then select "0 – NEXT –" -> "4 STATUS".
2   Press F1 [TYPE], then select "Servo Gun".
3   Select "Tip measurement info".
4   Press F4 "VIEWTIPS".
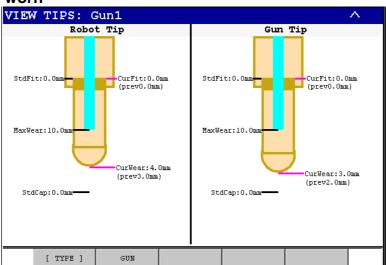
VIEW TIPS: Gun1

Robot Tip   Gun Tip

StdFit:0.0mm   CurFit:0.4mm   StdFit:0.0mm   CurFit:0.4mm
                    (prev.4mm)   (prev.4mm)

MaxWear:10.0mm   MaxWear:10.0mm

                    CurWear:1.9mm   CurWear:2.9mm
                    (prev.6mm)   (prev.9mm)
StdCap:0.0mm   StdCap:0.0mm

[TYPE]   GUN

-385-
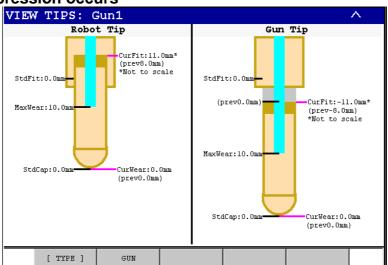
Example1: After tip wear initial setup

```
VIEW TIPS: Gun1                                                    ^
         Robot Tip                              Gun Tip

StdFit:0.0mm        CurFit:0.0mm      StdFit:0.0mm        CurFit:0.0mm
                    (prev0.0mm)                           (prev0.0mm)



MaxWear:10.0mm                        MaxWear:10.0mm



StdCap:0.0mm        CurWear:0.0mm     StdCap:0.0mm        CurWear:0.0mm
                    (prev0.0mm)                           (prev0.0mm)


       [ TYPE ]       GUN
```

Example2: Tip is worn

```
VIEW TIPS: Gun1                                                    ^
         Robot Tip                              Gun Tip

StdFit:0.0mm        CurFit:0.0mm      StdFit:0.0mm        CurFit:0.0mm
                    (prev0.0mm)                           (prev0.0mm)



MaxWear:10.0mm                        MaxWear:10.0mm

                    CurWear:4.0mm                         CurWear:3.0mm
                    (prev3.0mm)                           (prev2.0mm)
StdCap:0.0mm                          StdCap:0.0mm


       [ TYPE ]       GUN
```

Example3: Compression occurs

```
VIEW TIPS: Gun1                                                    ^
         Robot Tip                              Gun Tip

                    CurFit:11.0mm*
                    (prev8.0mm)
                    *Not to scale
StdFit:0.0mm                          StdFit:0.0mm

                                      (prev0.0mm)         CurFit:-11.0mm*
MaxWear:10.0mm                                            (prev-8.0mm)
                                                          *Not to scale

                                      MaxWear:10.0mm


StdCap:0.0mm        CurWear:0.0mm
                    (prev0.0mm)
                                      StdCap:0.0mm        CurWear:0.0mm
                                                          (prev0.0mm)

       [ TYPE ]       GUN
```

APPENDIX

A TROUBLESHOOTING (GUN CHANGE)

A.1 THE ATTACH INSTRUCTION IS EXECUTED WHEN THE GUN IS NOT ATTACHED.

·Symptom

The gun is not actually attached. So, a communications alarm such as "SRVO-068 DTERR alarm" occurs on the Pulsecoder. Correct this by Remedy 1 or Remedy 2 below according to the present conditions.

·Remedy 1

1 Turn the machine lock ON in the servo gun operation group (normally, group 2) in the Test Cycle screen.
2 Move the robot by manual feed so that the robot and gun are physically attached.
3 Turn the controller OFF then ON again.

Battery-less gun (calibration motion types 1, 2)

4 The gun pulse values and mastering data are lost. So, first move the gun by manual feed to cancel the "SRVO-075 Pulse not established" alarm.
5 Then, carry out gun 0 position mastering and calibration manually.

Battery-less gun (calibration motion types 3, 4, 5, 6)

6 The gun pulse values and mastering data are lost. So, move the gun by manual feed to cancel the "SRVO-075 Pulse not established" alarm.
7 Carry out gun 0 position mastering and calibration manually. The gun 0 position may be an approximate position.
8 Execute the detach instruction to temporarily detach the gun. Also, physically detach the gun from the robot. Otherwise, the gun will not be calibrated at the next attach operation.
9 Execute the attach instruction again to attach the gun. Calibration this time is carried out at the reference position to restore the position.

Battery mounted gun

10 The gun is attached and positioned, so it can be used as it is.

·Remedy 2

1 Directly change the system variable to detach the gun. To do this, set the following system variable to "0":
$SCR_GRP[servo gun operation group No. (normally, 2)].$AXISORDER[all 1 to 9] = 0
2 Turn the controller power OFF then back ON.
3 The robot starts up with the gun in a detached state. Move the robot by manual feed to physically attach the robot and gun.
4 Execute the attach instruction to attach the gun.
5 The gun can be used as it is after it is attached regardless of the battery type.

A.2   THE ROBOT STOPPED DURING CALIBRATION.

·Symptom

This symptom occurs only on battery-less guns. NOTE that the symptom and remedy vary according to the preset calibration type.

Battery-less gun (calibration motion types 1, 2)

The "SVGN-081 Gun mastering data is lost" alarm has occurred.

Battery-less gun (calibration motion types 3, 4, 5, 6)

Alarm has not occurred.

·Remedy

Calibration motion types 1, 2

1   The gun pulse values and mastering data are lost. So, first move the gun by manual feed to cancel the "SRVO-075 Pulse not established" alarm.
     This alarm may not be occurring. If so, skip this step and proceed to step 2.
2   Then, carry out gun 0 position mastering and calibration manually.

Calibration motion types 3, 4, 5, 6

1 Gun operation can be resumed as it is.

A.3   CALIBRATION MOTION FAILED.

·Symptom

The "SVGN-089 Calibrate motion is failed" alarm occurred.
This symptom occurs only when the calibration motion type is 3, 4, 5 or 6 on a battery-less gun.
This alarm occurs when the touch torque or detection signal conditions are not satisfied during calibration.
In both of the following Remedies 1 and 2, the gun is calibrated again. So, calibration motion will fail again if the touch torque or detection signal conditions are not satisfied. Before you remedy this symptom, make sure that the touch torque or detection signal conditions are correct.

·Remedy 1

Carry out Steps 6 to 9 of B.1 Remedy 1.

·Remedy 2

Same as Remedy 2 of B.1.

A.4   A DIFFERENT GUN FROM THAT SPECIFIED BY THE ATTACH INSTRUCTION IS ATTACHED.

・Symptom
The gun is attached to the robot, but the gun's current position is the wrong value. On a battery-less gun, an alarm may cause the robot to stop during calibration.

・Remedy

1   In this state, the gun cannot be detached from the robot by the detach instruction. So, directly change the system variable to detach the gun. To do this, set the following system variable to "0":

$SCR_GRP[servo gun operation group No. (normally, 2)].$AXISORDER[all 1 to 9] = 0

2   Turn the controller power OFF then back ON.
3   The gun starts up in a detached state.
4   Execute the attach gun[2] instruction to attach gun 2. (In this state, gun 2 should be physically connected to the robot.)

When gun 2 is a battery-less gun and the calibration motion type is 1 or 2:
If gun 2 is moved when attached by mistake instead of gun 1, gun 2 will move and be at a position different to when it was detached. So, gun 2 may be calibrated to the wrong position by the attach instruction executed in step 4 above, resulting is misalignment between its actual and desired positions. In this case, carry out gun 0 position mastering and calibration manually.

When gun 2 is other than the above:
Gun 2 can be used as it is.

5   Gun 1 can be used as it is by executing the attach instruction to attach the gun.

A.5   THE ATTACHED GUN HAS BEEN DETACHED BY MISTAKE (WITHOUT USING THE DETACH INSTRUCTION).

・Symptom
The gun is not actually attached. So, a communications alarm such as "SRVO-068 DTERR alarm" occurs on the Pulsecoder. Correct this by Remedy 1 or Remedy 2 below according to the present conditions.

・Remedy 1
Same as Remedy 1 of B-1

・Remedy 2
Same as Remedy 2 of B-1

A.6   THE GUN AXIS OF A DETACHED GUN HAS MOVED.

·**Symptom**

  Battery-less gun (calibration motion types 1, 2):

  Misalignment has occurred. Misalignment occurs as a result of calibration at the wrong position when the gun is attached with the gun axis having moved to a different position. NOTE, however, that misalignment does not occur when gun axis movement is within the allowable errors indicated below.
  The allowable error must fall within the respective following ranges for the direct-acting axis and rotary axis:

  Direct-acting axis: ±(gear ratio/2)mm or less around the detach position
  Rotary axis: ±((360/gear ratio)/2)deg or less around the detach position

  Other instances:

  No problem has occurred.

·**Remedy**

  Battery-less gun (calibration motion types 1, 2):
  1   Execute the attach instruction to attach the gun.
  2   If misalignment occurs, carry out gun 0 position mastering and calibration manually.

A.7   THE BATTERY VOLTAGE HAS FALLEN.

·**Symptom**

  The "SRVO-065 BLAL" alarm has occurred with the gun in an attached state.

·**Remedy**

  1.   Change the battery with the gun attached.
  2.   The gun can be used as it is.

A.8 THE BATTERY RAN LOW WHILE THE GUN WAS DETACHED.

·Symptom

The "SRVO-062 BZAL" and "SRVO-075 Pulse not established" alarms occurred when the gun was attached.
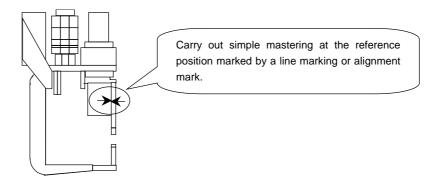
·Remedy

When the reference position has not been set:
1 Press F3:RESET_PULSE in the Calibration screen, and select YES.
2 Turn the controller OFF then ON again.
3 Move the gun by manual feed to cancel the "SRVO-075 Pulse not established" alarm.
4 Carry out gun 0 position mastering and calibration manually.

When the reference position has been set:
1 Press F3:RESET_PULSE in the Calibration screen, and select YES.
2 Turn the controller OFF then ON again.
3 Move the gun by manual feed to cancel the "SRVO-075 Pulse not established" alarm.
4 Move the gun by manual feed to the reference position marked by a line marking or alignment mark.
5 Execute 3 QUICK MASTERING in the Calibration screen.

Carry out simple mastering at the reference position marked by a line marking or alignment mark.
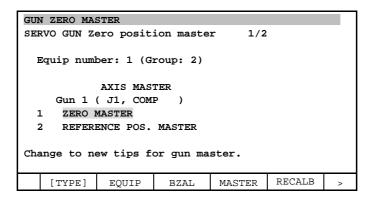
B GUN ZERO MASTERING

B.1 GUN MASTER UTILITY

Use the Gun Master screen to reset BZAL (Battery Zero Alarm), perform Magnet Phase Detection function, and master gun axes. The following list describes the items on the GUN MASTER screen.

Function Key	Description
EQUIP	Press this key to change equipment number Note: active group automatically changes at equipment selection. This key will displayed only if more than one equipment exists.
BZAL	Press this key to reset Battery Zero Alarm (BZAL) for the servo gun axis after loss of battery power. This key will be displayed only if BZAL condition exists
MASTER (displayed when cursor is on "ZERO POSITION MASTERING")	Press this key to zero position master the gun with new tips. Please confirm both tips is new and tips contact before performing MASTER. Tip wear values are reset to 0, when MASTER completes. After that, if init setup program of tip wear measurement has not been executed yet, execute init setup program and then teach position. After that, if init setup program of tip wear measurement has done, confirm teaching position of spot welding. If correction of teaching is necessary, perform touchup.
MPDT	Press this key to execute the Magnet Phase Detection function if the message "Execute MPDT(Magnetic Phase Detection)" is displayed. If displayed, the gun cannot be jogged until the function is performed. The gun will move slightly during execution so be sure gun tips are free to move. NOTE: this key is displayed only if a non-8 pole motor (i.e. 4 pole or 6 pole) motor is selected and MPDT is not done, after BZAL condition has been cleared.
RECALB (displayed when cursor is on "ZERO POSITION MASTERING")	Press this key to re-calibrate the master position of the servo gun axis. Existing tip wear values are maintained. Tips must be touching. Be sure that tip wear has not changed significantly since the last tip wear measurement. NOTE: this key is only displayed if tip wear setup is performed.
Rec.Ref (displayed when cursor is on "REFERENCE POS. MASTERING")	Press the key to record the reference position of the servo gun axis. Please make sure that the gun is at the position where you want to set as reference position. By performing reference position record, temporary pulse count of gun axis is stored. Please refer to Appendix C.5 for more information on reference position mastering.
Ref.Mstr (displayed when cursor is on "REFERENCE POS. MASTERING")	Press the key to perform reference position mastering of the selected gun. Please make sure that the gun is at the position where you had set as reference position beforehand. By performing reference position mastering, temporary pulse count is recovered by the pulse count stored on reference position record. After this operation, please perform tip wear measurement. Please refer to Appendix C.5 for more information on reference position mastering.
DGIDX	Press NEXT to expose this function key. Press this key to select the correct gun for mastering when using a dual-gun. Pressing this key will switch between the 1st and 2nd gun of the dual-gun. The correct gun must be selected before performing the mastering operation, otherwise the wrong gun will be mastered. This key is only displayed if selected equipment type is dual gun.

Function Key	Description
ATMASTR	Press NEXT to expose this function key. Press this key with the [SHIFT] key to close the selected gun automatically and zero position master the gun with new/non-worn tips. Tip wear values are reset to 0, when ATMASTR completes. If the init setup program of tip wear measurement has not been executed yet, then execute the init setup program and teach the position. (The same applies when the init setup program is re-executed.) If the init setup program of tip wear measurement has been done, then execute tip wear measurement. Afterward, confirm the teaching position of spot welding. If correction of teaching is necessary, then touchup needs to be performed. For the details of tip wear measurement, refer to 5. TIP WEAR DOWN COMPENSATION. If this operation is performed while a BZAL is occurring, then the BZAL is reset and power is restarted automatically.
ATRECLB	Press NEXT to expose this function key. Press this key with the [SHIFT] key to close the selected gun automatically and re-calibrate the master position of the servo gun axis. This key masters the selected servo gun and maintains existing tip wear values. Be sure that tip wear has not changed significantly since the last tip wear measurement. If this operation is performed while a BZAL is occurring, then the BZAL is reset and power is restarted automatically. This key is only displayed if the tip wear setup is performed.
HIST	Press NEXT to expose this function key. Press this key to display the ATMASTR and ATRECLB history (log).

```
GUN ZERO MASTER
SERVO GUN Zero position master      1/2

  Equip number: 1 (Group: 2)


            AXIS MASTER
    Gun 1 ( J1, COMP   )
 1    ZERO MASTER
 2    REFERENCE POS. MASTER


Change to new tips for gun master.


   [TYPE]   EQUIP   BZAL   MASTER   RECALB   >
```

⚠ **CAUTION**

If gun stroke changes due to tip holder or gun arm, update stroke limit accordingly via stroke limit setup screen, before mastering (MASTER, or RECALB or ATMASTR or ATRECLB).

B.2   RESET ALARM

Procedure C-1 Resetting BZAL (Battery Zero) and "Pulse Not Established" Alarms

1   Connect Pulsecoder cable and Power Up controller.
2   Display Gun Master screen.
     [MENU] key -> SYSTEM -> F1[TYPE] -> Gun Master
3   Press F3 "**BZAL**." The system displays the following message.
     "Reset BZAL alarm."
     "Please power OFF/ON."
4   Turn OFF/ON the power of the robot controller.
5   SRVO-075 Pulse not established will be displayed.
6   Establish Pulse
     a.   For 8-pole motors (all FANUC motors) jog motor more than 1 revolution using jog keys,then
           press the RESET key to reset this alarm
     b.   For less than 8-pole motors, Execute the MPDT routine (see procedure below)

B.3   MAGNET PHASE DETECTION (MPDT)

Procedure C-2 Establishing Pulse for Less than 8-pole Motor Using the Magnet Phase Detection(MPDT) Feature

The MPDT softkey (F5) is displayed on the Gun Master screen when MPDT is required. The message "Execute MPDT (Magnetic Phase Detection)" will be displayed. MPDT is required when the servo motor connected to a non-8pole servo gun motor whose magnets have not been located.

> **NOTE**
>   A motor that requires MPDT cannot be jogged prior to completion of this procedure.

During MPDT, the tips may move slightly. Before executing MPDT, be sure the tips are not fully closed or fully opened. and can move a few mm in either direction.
1   Display Gun Master screen.
     [MENU] key -> 0 NEXT PAGE -> 6 SYSTEM -> F1[TYPE] -> Gun Master
2   Press the **MPDT** softkey. The system displays the following messages.
     "Execute MPDT. Are you ready? "
     " YES NO"
3   With the system in teach, press the deadman switch, reset faults and press F4 "YES."
4   Magnet Phase Detection will commence. If MPDT completes successfully, the following message is displayed
     "Completed MPDT."
     If MPDT does NOT complete successfully, the following message is displayed
     "Failed MPDT."
     "Execute MPDT(Magnetic Phase Detection)."
5   If MPDT failed, the motor will need to be manually turned to establish the magnet phase. To do this, locate the manual override key/gear on the servogun actuator (if included) to drive the tips open/closed at least (1) full motor revolution. This must be done until the "Completed MPDT" message is posted.
6   The servo gun can now be jogged using the jog keys.

B.4   MASTERING

Procedure C-3 Executing Zero Position Mastering

Two (2) methods are available to master the gun.
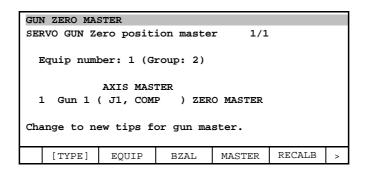
• **Standard Master**—Press MASTER; tip wear values are set to zero

• **Re-Calibration Master**—Press RECALIB; tip wear values are not modified

1   Decide whether to install new tips, based on function used:
     Standard Master is performed when the F4 key, **MASTER** is pressed. New tips must be installed
     before performing this operation. This operation sets tip wear value to zero for both tips.
     Re-Calibration Master is performed when the F5 key, **RECALB** is pressed. New tips should NOT
     be installed on the gun when performing this operation—this operation masters a gun with worn tips.
     Do not perform this operation if tip wear values are incorrect, (tip wear values are not modified).
2   Jog the gun axes until tips touch.
3   Display Gun Master screen.
     [MENU] → 0 NEXT PAGE → 6 SYSTEM → F1[TYPE] → Gun Master

```
GUN ZERO MASTER
SERVO GUN Zero position master      1/1


  Equip number: 1 (Group: 2)


             AXIS MASTER
 1  Gun 1 ( J1, COMP   ) ZERO MASTER


Change to new tips for gun master.


    [TYPE]    EQUIP    BZAL    MASTER    RECALB    >
```

NOTE

    F2 "EQUIP" displays only if system has more than one equipment.
    F3 "BZAL" displays only if BZAL condition is present.
    F5 "RECALB" displays only if tip wear setup is performed.

---

4   Use F2 "EQUIP" to select the equipment number when multiple equipment exists.
5   Execute gun axis mastering by pressing MASTER (F4) or RECALB (F5), in accordance with the
     descriptions above. RECALB (F5) is displayed after performing tip wear setup.
     a.   If tips are new or not worn, press F4 "MASTER."
     b.   If tips are worn or to retain present wear reference data, press F5 "RECALIB."
6   Press F4 "YES" and system will master the gun axis. If MASTER was pressed, tip wear values are
     reset to 0.0. If RECALB was pressed wear values do not change.
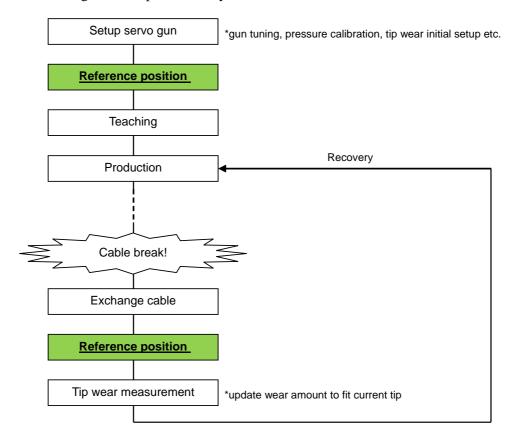
B.5   REFERENCE POSITON MASTERING

> **NOTE**
>   This function has been supported since software version 7DC3P14.

Pulse count of the servo gun axis is sometimes lost because of cable rupture etc. In such case, after mechanical repair (by replacement of broken cable etc.), the gun axis should be re-setup by mastering.
Following operation of reference position mastering saves the trouble of the re-setup and achieves the re-establishment of the gun.
The following flowchart shows a sample to introduce and manage this function for reference. Please apply management according to actual production system.
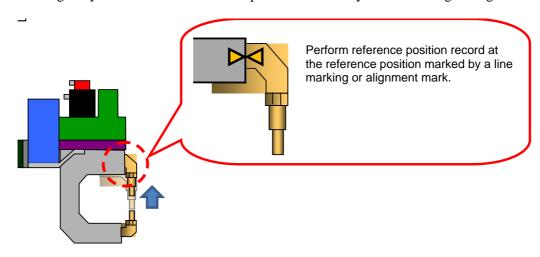
B.5.1   Reference Positon Record Procedure

By the following steps, please move the servo gun axis to reference position and perform reference position record.
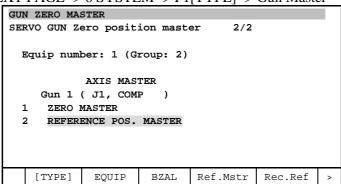
Procedure C-4 Executing Reference Position Record

1   Move the gun by manual feed to reference position marked by a line marking or alignment mark.

Perform reference position record at the reference position marked by a line marking or alignment mark.

2   Display Gun Master screen.
     [MENU] -> 0 NEXT PAGE -> 6 SYSTEM -> F1[TYPE] -> Gun Master

```
GUN ZERO MASTER
SERVO GUN Zero position master     2/2

  Equip number: 1 (Group: 2)

            AXIS MASTER
    Gun 1 ( J1, COMP   )
  1   ZERO MASTER
  2   REFERENCE POS. MASTER



    [TYPE]   EQUIP    BZAL    Ref.Mstr   Rec.Ref   >
```

NOTE
     F2 "EQUIP" displays only if system has more than one equipment.
     F3 "BZAL" displays only if BZAL condition is present.
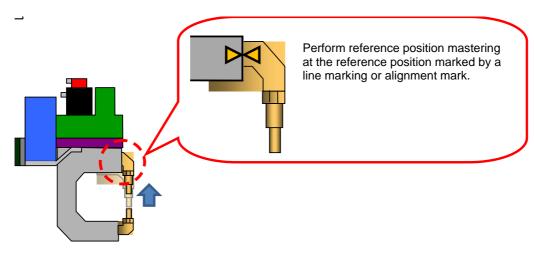
3   Use F2 "EQUIP" to select the equipment number when multiple equipment exists.
4   To perform reference position record of the gun axis, move the cursor on "REFERENCE POS. MASTER" and press F5 "Rec.Ref," and select F4 "YES" twice.

B.5.2 Reference Positon Mastering Procedure
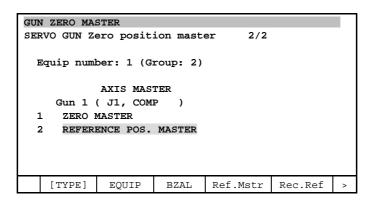
After the loss of pulse count, please move the servo gun axis to reference position and perform reference position mastering by the following steps

Procedure C-5 Executing Reference Position Recording

1 Move the gun by manual feed to reference position marked by a line marking or alignment mark.

Perform reference position mastering at the reference position marked by a line marking or alignment mark.

2 Display Gun Master screen.
[MENU] → 0 NEXT PAGE → 6 SYSTEM → F1[TYPE] → Gun Master

```
GUN ZERO MASTER
SERVO GUN Zero position master      2/2

  Equip number: 1 (Group: 2)

            AXIS MASTER
    Gun 1 ( J1, COMP   )
  1   ZERO MASTER
  2   REFERENCE POS. MASTER


    [TYPE]   EQUIP   BZAL   Ref.Mstr   Rec.Ref   >
```

NOTE
   F2 "EQUIP" displays only if system has more than one equipment.
   F3 "BZAL" displays only if BZAL condition is present.

3 Use F2 "EQUIP" to select the equipment number when multiple equipment exists.
4 To perform reference position mastering of the gun axis, move the cursor on "REFERENCE POS. MASTER" and press F4 "Ref.Mstr," and select F4 "YES" twice. After performing reference position mastering, please perform tip wear measurement and update tip wear amount.

⚠**CAUTION**
   The gun axis position at which reference position recording is performed and the gun axis position at which reference position mastering is performed must be the same.

B.6   AUTOMASTER FUNCTION

Automaster function executes the following sequence.
1   Reset BZAL alarm and repower (if BZAL condition exists)
2   Reset "Pulse Not Established" alarm (if pulse not established condition exists)
3   Move to coarse zero position (coarse close)
4   Move to fine zero position (fine close)—if pressure calibration is complete
5   Master the gun axis

⚠ **WARNING**
    The servo gun axis moves during Automaster.

⚠ **CAUTION**
    Automaster function uses a position register PR[90] by default. This register can
    be changed via Automaster config screen.

B.6.1   Automaster Procedure

Two (2) methods are available to master the gun automatically.
• **Auto Standard Master**—Press ATMASTR; tip wear values are set to zero
• **Auto Re-Calibration Master**—Press ATRECLB; tip wear amounts are not modified

1   Decide whether to install new tips according to the information below:
     Auto Standard Master is performed when the F9 key, **ATMASTR** is pressed. This operation
     automatically closes gun, masters axis and then sets tip wear values to zero. New tips must be placed
     on the gun before performing this operation.
     Auto Re-Calibration Master is performed when the F10 key, **ATRECLB** is pressed. This operation
     automatically closes gun, masters axis, but does not change tip wear value. Therefore, tips should not
     be changed, before performing this operation.
2   Display Gun Master screen.
     [MENU] -> 0 NEXT PAGE -> 6 SYSTEM -> F1[TYPE] -> Gun Master
3   Use F2 "EQUIP" to select the equipment number when multiple equipment exists.
4   Execute gun axis auto mastering by pressing ATMASTR (F9) or ATRECLB (F10). Make the choice
     according to the descriptions above.
     a.   If this is the initial master attempt for the gun with new tips, press the [NEXT] key then press F9
          "ATMASTR" with the [SHIFT] key.
     b.   If this is a re-master operation and the tips are worn and have a measured wear value from Tip
          Wear Compensation, press NEXT then press F10 "ATRECLB" with the [SHIFT] key.

```
GUN ZERO MASTER
ZERO POS MASTER WITH MOTION/EQ:1 Gun:1 1/14
  1 Battery OK (NO BZAL):          TRUE
  2 Pulse Established:             TRUE
  3 Master Done:                   TRUE
  4 Calibration Done:              TRUE
  5 Current position(mm):         -22.00
  6 Current pulsect:             -576717
  7 Current mstrct:                    0
  8 TW calibration status:    INCOMPLETE
  9 NewTip.mstrct(pls0):               0
 10 Cur.mstrct-NewTip.mstrct(mm): ******
 11 Total wear(mm):                 0.00


      DGIDX    HIST          ATMASTR  ATRECLB
```

⚠ **WARNING**
    The servo gun axis moves during Automaster. Please make sure that no
    personnel are in the vicinity of the gun when you execute Automaster.

NOTE
    In case of T1/T2 mode, enable TP, and do not release both of dead man switch
    and the [SHIFT] key during Automaster. In case of AUTO mode, disable TP, and
    need not hold dead man and the [SHIFT] key during Automaster.

NOTE
    If BZAL alarm exists, Automaster resets BZAL alarm and cycles
    power.Re-execute ATMASTR/ATRECLB again after repower, to complete
    operation, in this case.

5   When Automaster completes, the wear mount is set to zero in the case of normal mastering. In the case
     of recalibration, the wear amount data is maintained.

NOTE
    When Automaster is performed, the following WARNING are posted.
    SVGN-193 Automastered:XXmm from old master pos.
    SVGN-195 Masterct(Old:YY, New:ZZ).
    SVGN-196 TW recalibrated:XXmm from old pulse0.
    SVGN-198 Pulse0ct(Old:YY, New:ZZ).
    These messages indicate master position and pulse count changes.

⚠ **CAUTION**
    If the following alarms occur, confirm cause of error in alarm screen.
    SVGN-194 Automaster failed.
    SVGN-197 TW recalibrate failed.
    SVGN-199 Automaster message.

⚠ **CAUTION**
    If the following alarm occurs, press fault reset and request Automaster again.
    SVGN-200 FCTRL must be off for Automaster.

⚠ **CAUTION**
    If the following alarm occurs, increase the system variable $SGGUN#[Gun
    No.].$SETUP.$STOPERLIM or reduce the close stroke limit of the gun axis.
    SVGN-143 Stoperlim::XXmm < PushDepth :YYmm.

B.6.2   **Auto Zero Calibration Screen**

Auto Zero Calibration Screen (Auto ZC Screen) is displayed by pressing the [NEXT] key at Gun Master Screen. ATMASTR and ATRECLB can be performed from this screen. Current axis status is displayed on this screen.

```
GUN ZERO MASTER
ZERO POS MASTER WITH MOTION/EQ:1 Gun:1 1/14
   1 Battery OK (NO BZAL):              TRUE
   2 Pulse Established:                 TRUE
   3 Master Done:                       TRUE
   4 Calibration Done:                  TRUE
   5 Current position(mm):            -22.00
   6 Current pulsect:                -576717
   7 Current mstrct:                       0
   8 TW calibration status:      INCOMPLETE
   9 NewTip.mstrct(pls0):                  0
  10 Cur.mstrct-NewTip.mstrct(mm): ******
  11 Total wear(mm):                    0.00


      DGIDX    HIST            ATMASTR  ATRECLB
```

> **NOTE**
> F1 "DGIDX" displays only if equipment is dual gun.
> F5 "ATRECLB" displays only if tip wear setup is performed.

Item	Description
Battery OK (NO BZAL)	Battery zero alarm is not present in this group. BZAL reset is not needed.
Pulse Established	Pulse has been established. Encoder rotation is not needed.
Master Done	Master count has been recorded for this axis.
Calibration Done	Position has been calibrated for this group, i.e., position has been determined, based on master count.
Current position (mm)	Current axis position.
Current pulsect	Current axis machine pulse.
Current masterct	Current axis master count.
TW calibration status	Tip wear compensation status. Possible states are: - Incomplete - Complete - Pulse0state
NewTip masterct(pls0)	Pulse count for new tip recorded at tip wear setup/calibration.
Cur.masterct − NewTip masterct (mm)	Difference between current tips and worn tips. Value should be the same as total wear, except when mastering or the initial setup for tip wear compensation has not been performed after a BZAL occurs.
Total wear (mm)	Sum of gun tip wear + robot tip wear
TW strokelim protection	Status of stroke limit protection (enabled or disabled) The stroke limit protection function automatically adjusts stroke limits based on the difference between current master count and new tip master count. The stroke limit protection function is automatically enabled when the TW calibration status changes to "Complete." However, the stroke limit protection function will not be enabled when mastering or the initial setup for tip wear compensation has not been performed after a BZAL occurs.
Current close limit (mm)	Axis limit in gun close direction with current wear amount.
Standard close limit (mm)	Axis limit in gun close direction with wear = 0.

B.6.3 Zero Calibration Config Screen

Zero Calibration Config Screen (ZC Config Screen) is displayed by pressing ATMASTR or ATRECLB key at Auto ZC Screen. Automaster settings can be confirmed and changed from this screen.

```
GUN ZERO MASTER
ZERO MASTER CONFIG                1/10
  1 Close speed (mm/sec):               10
  2 Close pressure (presslim%):    100
  3 Open speed (mm/sec):                10
  4 Relax pressure (presslim%):     25
  5 Position register index (PR[#]):   90
  6 Max close distance (mm):         100.0
  7 Max relax distance (mm):          10.0
  8 Open dist before fine close (mm):10.0
  9 Post status message at comp:     TRUE
 10 History file line limit:          999

     [TYPE]    END
```

Item	Description
Close speed (mm/sec)	Speed of close operations during Automaster.
Close pressure (presslim%)	Presslim% for gun close detection at coarse close.
Open speed (mm/sec)	Speed of open operations during Automaster.
Relax pressure (presslim%)	Presslim% for gun relax detection at coarse close.
Position register index (PR[#])	Position register index used during Automaster.
Max close distance (mm)	Max distance to move in close direction for coarse close.
Max relax distance (mm)	Max distance to move in open direction for relax detection.
Open distance for fine close (mm)	Distance to open before starting fine close.
Post status message at comp	Post alarm at Automaster completion to indentify result.
History file line limit	Number of lines for log history file. Refer to zero calibration history screen.

B.6.4 Zero Calibration History Screen
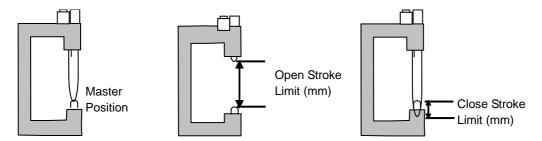
This screen serves as both debug log and change log. You can refer to history logs by F4[NEWER] and F5[OLDER].

```
GUN ZERO MASTER
LOG HISTORY (2 files avail)       1/49
FR:ZCDBG1.TXT
ZERO CALIBRATE REPORT
Operation: AUTOMASTER
Gun:1: (grp:2,axs:1)
Date: 2011.11.11
Time: 11:11.11
****************************************
Sequence details
t1: COARSE CLOSE
  status: Coarse close complete
  DT cnd basis: pressure table


     [TYPE]                     NEWER    OLDER
```

C   SETTING GUN STROKE LIMITS

The axis limits for the servo gun, are referenced from the master position. The master position is set where the tips touch. The Gun stroke limit screen allows the user to directly specify the maximum allowable stroke in each direction OPEN and CLOSE from the master position. The stroke limits may have been set correctly during the axis configuration as Controlled Start. However, it is good to confirm the proper setting before starting the autotuning program.
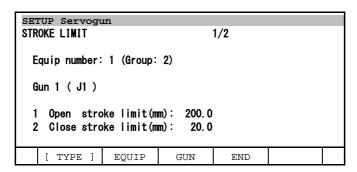
The Open Stroke Limit (mm) is the maximum open distance for the gun. This may be directly specified by the gun manufacturer, or it may need to be measured.

The Close Stroke Limit (mm) is the maximum gun tip extension allowed past where the tips touch. This must be enough to allow for tip wear and bending of the gun arms during pressurization. But, it cannot be larger than the physical stroke limit of the gun's moving mechanism. Consult with the gun manufacturer to determine the appropriate setting for the Close Stroke Limit. Typical range for the value is 15-30mm.

If you would rather set the OPEN stroke limit by directly recording the position, use the Gun Setup Utility discussed earlier. This is recommended for most users.

PROCEDURE
1   Go to the Servo Gun General Operations Setup screen
2   Scroll to the Gun Stroke Limit item and press the [ENTER] key. The following screen will be displayed.
3   Adjust the Open and Close stroke limit as needed.

```
SETUP Servogun
STROKE LIMIT                        1/2


  Equip number: 1 (Group: 2)


  Gun 1 ( J1 )


  1  Open  stroke limit(mm):  200.0
  2  Close stroke limit(mm):   20.0


  [ TYPE ]   EQUIP    GUN     END
```

NOTE
    Both OPEN and CLOSE stroke limit should be entered as positive values. The magnitude of stroke distance from the master position is the required value.

D   **AUTOTUNE MACRO PROGRAM**

Autotuning via the macro program

Executing the autotuning macro program performs autotuning.

> ⚠️ **CAUTION**
> The Servo gun axis moves at max speed, during autotuning. Autotuning can be performed with the teach pendant enabled or disabled.
> Please make sure that no personnel are in the vicinity of the gun when executing autotuning with the teach pendant disabled.

Autotune macro program

Program name: AUTOTUNE (There is in the macro list)

The user has to set up the following prior to running the AUTOTUNE macro program.

     Tip displacement ratio
     Mastering
     Stroke limit
     Gun closing direction & motion sign
     Max gun pressure

Furthermore, the user may need to set parameters in the program call to AT_KLTUN to ensure that the proper exercises are initiated.

1   Press the [SELECT] key
2   Press the F1 key <TYPE>
3   Select MACRO
4   You should now see the list of macro programs. Scroll to the program AUTOTUNE and press the [ENTER] key to select it.
5   The following screen will be displayed.

```
AUTOTUNE
                               1/18
  1:  !Autotuning Main Program
  2:
  3:  !Input parameters for autotuning
  4:  !P1: Equipment number(1 to 5)
  5:  !P2: Dual gun index(1 or 2)
  6:  !P3: Enable debug msg(0 or 1)
  7:  !P4: Reload parameters(0 or 1)
  8:  !P5: Starting load ratio(1 to 5)
  9:  !P6: Pushing depth(1 to strklim)
 10:  !P7: Acc estimation method
 11:  !(1: determine automatically)
 12:  !(2: use specified values)
 13:  !(3: use previous values)
 14:  !P8: Accel time1(100 to 384)
 15:  !P9: Min acc shm(100 to 384)
 16:  !P10: Initial Filter (Hz)
 17:  CALL AT_KLTUN
[END]


    [ INST ]                      [ EDCMD ]
```

6. If default settings are not sufficient, enter custom parameters in the program line

CALL AT_KLTUN(P1,P2,P3…,P10)

Descriptions and Default setting for the parameters are as follows:
P1 – Equipment Number
    Default = 1
P2 – Dual Gun Index: defines if gun 1or 2 in the case of a dual gun is to be tuned
    Default = 1
P3 – Enable Debug messages (1)
    Default = 0 (false)
P4 – Initialize/Reload default servo parameters
    Default = 0 (false)
P5 – Starting load ratio
    Default = 3
P6 – Pushing Depth (mm)
    Default = 5
P7 – Acceleration estimation method
    Default = 1 (determine automatically)
P8 – Accel Time 1 (ms)
    Default = 100
P9 - Min acc shm
    Default = 100
P10 – Initial Filter Frequency (Hz)
    Default = 0 (filter disabled)

7. Set the 3 mode switch to T2.
8. While holding down the [SHIFT] key, press FWD.
9. The [SHIFT] key must be held down until the autotuning program is completed.

⚠**CAUTION**
    After Autotuning is started, the servo gun will perform the following by opening and
    closing the gun:
    • Acceleration settings
    • Inertia measurements
    • Friction measurements
    • Spring constant measurements
    • Force control gain settings
    • Contact speed settings
    • (Profile option is selected) Profile internal parameter settings

---

⚠**CAUTION**
    If acceleration times were changed during autotuning, then an SVGN-050
    "Autuning: Re-power required" is posted. Repowering the controller makes the
    new acceleration effective, and clears the SVGN-50 message.

If autotuning did NOT complete successfully (indicated by status FAILED instead of COMP), then try the
following:
• Make sure axis limits are set properly.
• Check motor selection.
• Make sure mastering of the gun axis is correct.
• Re-perform autotuning until it completes successfully.

-407-

E PRESS ON NEW TIPS
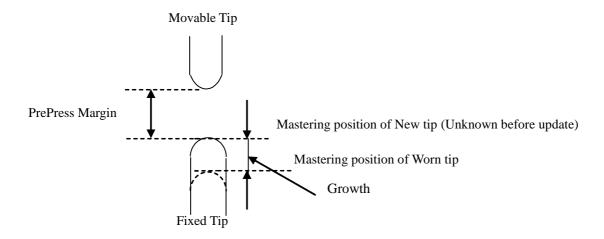
After changing to new tips, it is good practice to be sure the tips are fully pressed on the tip holder before returning to welding or updating the tip wear amount. The macro program TW_PRSRT can perform this function automatically. This macro and the TW_PRS01 template program are loaded with the load-option by setting $sgsyscfg.$load_twd=12 .

The program will squeeze the tips together several times, so the tips are pressed fully onto the tip holder.

The user must specify (8) parameters for TW_PRS01 to define how the routine executes. Below is a description of each parameter and a few examples of the pressing operation with different parameters. This macro or template program can be run anytime, but is best to run after changing tips and before getting an updated tip wear measurement.

```
TW_PRS01
                                    1/17
  1: !PROGRAM NAME: TW_PRSRT;
  2: !Program function: ;
  3: ! Compress caps after tip change ;
   :
  8: !Parameters supplied to TW_PRESS ;
  9: !1: Equipment number ;
 10: !2: Force end value (Kgf) ;
 11: !3: Number of steps ;
 12: !4: Number of repititions ;
 13: !5: Dwell time (ms) ;
 14: !6: Register number R[#] ;
 15: !7: PrePress margin ;
 16: !8: Max growth ;
 17: CALL TW_PRSRT(1,500,2,4,1,10,5,15) ;
[END]


     [ INST ]                        [ EDCMD ]
```

Check the equipment number.

No	Parameter	Default	Description
1	Equipment Number	1	Specifies the equipment number of the gun.
2	Force End Value (kgf)	500	The maximum force that will be applied during the tip pressing operation. If the value specified here exceeds the max pressure for the gun, the software will limit the pressure to the Max Pressure, automatically.
3	Number of Steps	2	Specifies how many sets of squeezing repetitions will be performed. The force during step n, will be equal to: (Parameter 2) * [n/(Parameter 3)]
4	Number of Repetitions	4	The number of repetitions performed during each step. The total number of squeezing repetitions is equal to: (Parameter 3) * (Parameter 4)
5	Dwell Time (ms)	1	Squeezing time of each repetition.
6	Register Number	10	Register used to track program status internally. R[10] is the standard register for tip wear measurement, so it is generally unnecessary to change this.
7	PrePress Margin (mm)	5	Defines an extra open distance required to reach the pressing speed
8	Max Growth (mm)	15	Defines the maximum expected increase in length between (2) worn tips and (2) new tips. The actuator position between repetitions is equal to: Worn tips zero position + (Parmater 7) + (Parameter 8)

Movable Tip

PrePress Margin

Mastering position of New tip (Unknown before update)

Mastering position of Worn tip

Growth

Fixed Tip

TIP PRESSING EXAMPLE SEQUENCES
Pressing sequence with default settings [CALL TW_PRSRT(1,500,2,4,1,10,5,15)]

Step #	Operation	Critical Parameters
Step 1	Gun Closes to pressure, 250kgf	(Force End Value) * [(1/Number of Steps)]
	Pressure is help for 1ms	Dwell Time
	Gun opens to 20mm compared to worn tips zero position	PrePress Margin + Max Growth
	Above steps are repeated (4) times	Number of Repetitions
Step 2	Gun Closes to pressure, 500kgf	(Force End Value) * [2/(Number of Steps)]
	Pressure is help for 1ms	Dwell Time
	Gun opens to 20mm compared to worn tips zero position	PrePress Margin + Max Growth
	Above steps are repeated (4) time	Number of Repetitions

Pressing sequence with custom settings [CALL TW_PRSRT(1,300,1,6,1,10,5,10)]

Step #	Operation	Critical Parameters
Step 1	Gun Closes to pressure, 300kgf	(Force End Value) * [1/(Number of Steps)]
	Pressure is help for 1ms	Dwell Time
	Gun opens to 15mm compared to worn tips zero position	PrePress Margin + Max Growth
	Above steps are repeated (6) times	Number of Repetitions

F   TROUBLE SHOOTING (TIP WEAR COMPENSATION)

F.1   WEAR DOWN AMOUNT IS NOT MEASURED CORRECTLY

In case that wear down amount is not measured correctly, there are some symptom & cause. Confirm symptom, then investigate cause and perform correct remedy.

F.1.1   Gun Does Not Close Completely with Pressure Motion

Symptom

During gun closing with pressure motion, gun tip stops before gun tip contacts robot tip. There is a gap between gun tip and robot tip.

Cause

Since friction in gun mechanism increases, so tip contacting position is mis-detected.

NOTE
The following lists up the cause that friction in gun mechanism increases .
- Lost oil firm in gun mechanism.
- Deterioration grease in gun mechanism.
- Decrease grease viscosity with low temperature.

It recommends gun maintenance together the following remedy.
Also, decrease grease viscosity with low temperature often occurs in winter.
Therefore warming up gun (repeat gun open and close) could solve decrease grease viscosity.

Remedy

The following procedure is temporary remedy.
1   Display system variable screen.: MENU > SYSTEM > Variables
2   Display system variable $SBR[axis].$PARAM[186].
  Where axis is hardware axis number.
  In case if typical servo gun system that robot and servo gun;
  Gun 1: axis=7 ($SBR[7].$PARAM[186])
  Gun 2: axis=8 ($SBR[8].$PARAM[186])
  Gun 3: axis=9 ($SBR[9].$PARAM[186])

  In case of robot have extend axis like rail axis, gun axis number will be different from the above.
  Please confirm system configuration.

3   Increase the parameter by 1.3 times. Do not change the sign.
4   Re-power controller.

⚠CAUTION
If the gun has been applied this temporary remedy once, do not apply this temporary remedy again. For the gun that has been applied this temporary remedy once, perform the following effective remedy as possible as soon.

The following is effective remedy. Please perform this sooner maintain day.
1   Install new tip, perform gun zero mastering.
2   Perform gun auto tune.
3   Perform pressure calibration.
4   Perform init setup of wear down measurement (TW_SETUP or WR_SETUP).
5   Confirm taught position.

F.1.2   Gun Tip Does Not Contact Fixture in Fixture Touch Motion

Symptom
Using 2 step measurement method, when fixture touch motion is executed, gun tip stops before gun tip contacts fixture. here is a gap between gun tip and fixture.

Cause
Since friction in gun mechanism increases, so tip contacting position is mis-detected.

NOTE
The following lists up the cause that friction in gun mechanism increases .
- Lost oil firm in gun mechanism.
- Deterioration grease in gun mechanism.
- Decrease grease viscosity with low temperature.

It recommends gun maintenance together the following remedy.
Also, decrease grease viscosity with low temperature often occurs in winter.
Therefore warming up gun (repeat gun open and close) could solve decrease grease viscosity.
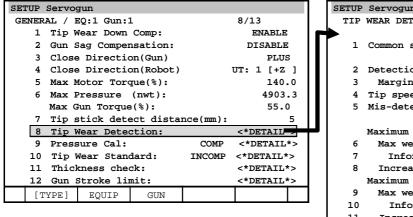
Remedy
The following procedure is temporary remedy.
1   Display servo gun setup screen. (MENU > SETUP > servo gun > general setup)
2   Select Tip Wear Detection <*DETAIL*> to display the tip wear detection setup screen.

```
SETUP Servogun
 GENERAL / EQ:1 Gun:1                8/13
   1  Tip Wear Down Comp:           ENABLE
   2  Gun Sag Compensation:        DISABLE
   3  Close Direction(Gun)            PLUS
   4  Close Direction(Robot)     UT: 1 [+Z ]
   5  Max Motor Torque(%):           140.0
   6  Max Pressure  (nwt):          4903.3
      Max Gun Torque(%):             55.0
   7  Tip stick detect distance(mm):     5
   8  Tip Wear Detection:        <*DETAIL*>
   9  Pressure Cal:        COMP  <*DETAIL*>
  10  Tip Wear Standard:  INCOMP <*DETAIL*>
  11  Thickness check:           <*DETAIL*>
  12  Gun Stroke limit:          <*DETAIL*>
   [TYPE]   EQUIP    GUN
```

```
SETUP Servogun
  TIP WEAR DETECT / EQ:1 Gun:1         3/11

   1  Common setup:              <*DETAIL*>

   2  Detection type:                 LOAD
   3   Margin of load(nwt):            294
   4  Tip speed(mm/sec):               30
   5  Mis-detect toler.(mm):          5.00

      Maximum wear check(Gun)
   6   Max wear value(mm):            0.00
   7    Inform signal:            DO[  0]
   8   Increase error(mm):           0.00
      Maximum wear check(Robot)
   9   Max wear value (mm):          0.00
  10    Inform signal:            DO[  0]
  11   Increase error (mm):          0.00
   [TYPE]   EQUIP    GUN     END
```

3   Increase "Margin of load " by 1.3 times. No need re-power controller.

⚠ **CAUTION**
If the gun has been applied this temporary remedy once, do not apply this temporary remedy again. For the gun that has been applied this temporary remedy once, perform the following effective remedy as possible as soon.

The following is effective remedy. Please perform this sooner maintain day.
1   If "Margin of load " is increased by 1.3 times, change default value(294N or 30kgf).
2   Install new tip, perform gun zero mastering.
3   Perform gun auto tune.
4   Perform pressure calibration.
5   Perform init setup of wear down measurement (TW_SETUP).
6   Confirm taught position.

F.1.3   Position of Fixture Is Changed

Symptom
Position of fixture is changed (or deformed or largely bended) after tip wear detection initialization.
Search motion of 2nd step touches gun on panel with 30kgf.

Cause
Position of fixture is changed (or deformed or largely bended) after tip wear detection initialization, the changing position becomes tip wear down amount error.

Remedy
Fix fixture not to change the position.
If fixture is deformed, replace more rigid fixture. If the deflection is in elastic deformation, it is no problem. But if the deflection is in plastic deformation, do not use the fixture.
Fixture to use with 2step measurement method must have position repeatability.

After the above remedy, perform the following
1   Install new tip, perform gun zero mastering.
2   Perform init setup of wear down measurement (TW_SETUP).
3   Confirm taught position.

F.1.4   Gun Tip Contact Fixture Sidlingly in Fixture Touch Motion

Symptom
Using 2 step measurement method, when fixture touch motion is executed, gun tip contact fixture sidlingly.
Especially, in case of X gun, trajectory of (worn) gun tip is not linear , so sidling touch often occurs.

Cause
When gun tip contact fixture sidlingly, gun tip would slip on fixture. This slipping amount cause wear down amount error.
Additionally, slipping amount is irregular, wear down amount error is irregular, too.

Remedy
Change robot position to touch gun tip as possible as vertically.

After the above remedy, perform the following
1   Install new tip, perform gun zero mastering.
2   Perform init setup of wear down measurement (TW_SETUP).
3   Confirm taught position.

F.1.5   Gun Zero Mastering with Worn Tip

Symptom

In gun zero mastering screen, gun zero mastering (Press F4[EXEC]) was performed with worn tip.

Cause

In gun zero mastering screen, standard master count of new tip is updated with the tip. If tip is worn, standard master count is not correct. Therefore wear down measurement does not work correctly.

Remedy

Perform the following
1   Install new tip, perform gun zero mastering.
2   Perform init setup of wear down measurement (TW_SETUP or WR_SETUP).
3   Confirm taught position.

F.1.6   Init Setup of Wear Down Measurement with Worn Tip

Symptom

Init setup of wear down measurement (TW_SETUP or WR_SETUP) was performed with worn tip.

Cause

Standard master count by worn tip is applied, so wear down measurement does not work correctly.

Remedy

Perform the following
1   Install new tip, perform gun zero mastering.
2   Perform init setup of wear down measurement (TW_SETUP or WR_SETUP).
3   Confirm taught position.

F.2   ALARM RELATED TO TIP WEAR DOWN MEASUREMENT

In this section, it descript alarm related to tip wear down measurement

SVGN-118 Max wear exceeded (Gun Tip)
Cause
a)   Maximum tip wear amount has been exceeded on gun tip.
b)   Gun tip wear amount that exceed maximum tip wear amount is mis-detected.

Remedy
a)   Replace gun tip, then run update program again.
b)   To remedy mis-detection, refer to section G.1.

SVGN-119 Max wear exceeded (Rbt Tip)
Cause
a)   Maximum tip wear amount has been exceeded on robot tip.
b)   Robot tip wear amount that exceed maximum tip wear amount is mis-detected.
Remedy
a)   Replace robot tip, then run update program again.
b)   To remedy mis-detection, refer to section G.1.

SVGN-32 Tip increased error(Gun)
Cause
The measured tip wear on the gun side (moving tip) indicates that the tip has grown by an amount greater than the Gun Increased Error(mm)
a)   New tips were placed on the gun, but the new tips flag was not set in the update program.
b)   A piece of metal from tip dressing operation remained on the tip making it longer.
c)   Gun tip wear amount that exceed increased error tolerance is mis-detected.

Remedy
a)   Properly seat the tips, then set the new tips flag and run the update program again.
b)   Remove the excess metal, then run the update program again.
c)   To remedy mis-detection, refer to section G.1.

SVGN-33 Tip increased error(Robot)
Cause
The measured tip wear on the robot side (stationary tip) indicates that the tip has grown by an amount greater than the Robot Increased Error(mm) setting.
a)   New tips were placed on the gun, but the new tips flag was not set in the update program.
b)   A piece of metal from tip dressing operation remained on the tip making it longer.
c)   Robot tip wear amount that exceed increased error tolerance is mis-detected.

Remedy
a)   Properly seat the tips, then set the new tips flag and run the update program again.
b)   Remove the excess metal, then run the update program again.
c)   To remedy mis-detection, refer to section G.1.

SVGN-97 Tip wear misdetection.(CLB)
Cause
Gun closing is mis-detected during pressure motion.

Remedy
To remedy mis-detection, refer to section H.1.1.

SVGN-114 Tip wear misdetection.(FIX)
Cause
Gun touching is mis-detected during fixture touch motion.

Remedy
To remedy mis-detection, refer to section H.1.2.

SVGN-20 Pressure shortage
Cause
During pressure motion, pressure enough to detect gun closing did not occur. This alarm is often posted in case of long arm X gun.
a)   Tip worn over , and then close stroke limit is too short. Therefore tips cannot push enough each other.

NOTE
   Close stroke limit is compensated with tip wear amount. Please refer to section 6.7 a bout compensation stroke limit.
---

b)   Standard close stroke limit is not correct. Therefore tips cannot push enough each other.

> **NOTE**
> Stroke limit that is specified when initial setup program is executed is applied to standard stroke limit.
> When initial setup program run, the following warning is posted;
> SVGN-178   Open/CloseLim=XXmm/YYmm
> This indicates standard stroke limit that is compensated with tip wear amount.
> If standard stroke limit is incorrect, pressure motion can not work.

   c)   Pushing depth for pressure motion of tip wear measurement is short. Therefore tips cannot push enough each other.

Remedy
   a)   Replace robot tip, then run update program again.
   b)   Confirm standard stroke limit, then set correct stroke limit. Refer to appendix D about setting stroke limit.
   c)   Add 5.0 to $SGGUN#.$SGTWD.$TW_PSHMGN. (where # is gun number.)
       Pushing depth for pressure motion of tip wear measurement will increase +5.0mm.

SRVO-24 Move error excess(G:xx A:yy)
(xx means group number of servo gun axis. yy means group axis number of servo gun axis.)
Cause
Motion command for servo gun axis was performed, but servo gun did not actually move. The error between command position and actual position exceeded tolerance.
   a)   Broke brake wire.
   b)   Friction in gun mechanism has increased.

Remedy
   a)   Confirm brake wire connection.
   b)   For friction increase, refer to section G.1.

INTP-302 (xxxx, yyy) Stack overflow
(xxxx means program name. Yyy means program line)
Cause
When calling rank with CALL instruction is to deep, this alarm is posted.
Init setup/update program use CALL instruction internally. So if these program is called on user' program that is deep calling rank, this alarm would be posted.

Remedy
Perform the following procedure.
1   Display program list screen, and select main program that calls init setup/update program. Then press the [NEXT] key, and press F2[Detail]
2   Increase stack size 300.
3   Executed main program, confirm reproduction alarm.
4   If INTP-302 reproduce, increase stack size 300 again in program detail screen.

F.3   RELOAD TIP WEAR MEASUREMENT PROGRAMS

Tip wear measurement TP programs and KAREL programs can be reloaded by setting $SGSYSCFG.$LOAD_TWD along the following table when these programs are deleted by mistake or broken by unknown reasons. (cycle power is required after changing the value)

$LOAD_TWD	reloaded TP programs	reloaded KAREL programs
8	TWTHOLD2.TP, TWZRCLB1.TP, TWZRCLB2.TP, TWZRCLB3.TP, TWZRCLB4.TP, TWZRCLB5.TP TWFXTCH1.TP, TWFXTCH2.TP, TWFXTCH3.TP TWFXTCH4.TP, TWFXTCH5.TP	TWKINIT.PC, TWKCALC.PC, TWKGQSKP.PC, TWKPCOND.PC TWKRSWDN.PC, TWKSTROK.PC TWKTHINI.PC, TWKTHSET.PC
11	WR_SETUP.TP, WR_UPDAT.TP, WR_SET01.TP, WR_UPD01.TP, TW_MVGUN.TP, XW_UPDAT.TP, XW_UPD01.TP	TWKRSMOV.PC, TWKRSFIX.PC TWKPULSE.PC, TWKNOSKP.PC TWKTHCHK.PC, TWKGNSL2.PC
12	TW_PRS01.TP, TW_PRSRT.TP	TWKTHOLD.PC, TWKZRCLB.PC TWKFXTCH.PC, TWKRSCLB.PC
15	TW_SET0X.TP, TW_UPD0X.TP, WR_SET0X.TP, WR_UPD0X.TP, XW_UPD0X.TP	TWKSTCHK.PC, TWKINCPH.PC TWKCALC2.PC, TWKWRTPR.PC TWKGPMSK.PC, TWKLSEAT.PC

G   VARIABLE REMOTE TCP SETUP METHOD

Variable Remote TCP function is that Remote TCP moves in response to movement of the Positioner. This function can improve welding posture flexibility and reduce cycle time by reducing the amount of change of position of the robot.

This function requires the following options.
- Positioner Mechanical Software
- Remote TCP (J624)

About Coordinated Motion Function with Positioner, please refer to Coordinated Motion Function OPERATOR'S MANUAL (B-83484EN).

About Remote TCP Function, please refer to Optional Function OPERATOR'S MANUAL (B-83284EN-2).

NOTE
This chapter describes the setting method when the information on the positioner's mechanism (axis orientation, offset between axes, gear ratio, and axis type) is available.
For the setting method of positioners in other cases, please refer to the Coordinated Motion Function OPERATOR'S MANUAL (B-83484EN) as well.
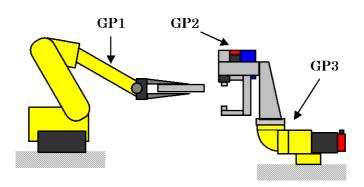
G.1   SYSTEM CONFIGURATION

Configure system as the followings.
- Group 1: Robot
- Group 2: Servo gun
- Group 3: Positioner

G.2   CALIBRATING POSITIONER

Calibrating Positioner is described in this section. For more information about calibration positioner, please refer to Coordinated Motion Function OPERATOR'S MANUAL (B-83484EN).

NOTE
This section describes the setting method when the information on the positioner's mechanism (axis orientation, offset between axes, gear ratio, and axis type) is available.
When you use other positioners, please refer to the Coordinated Motion Function OPERATOR'S MANUAL (B-83484EN).
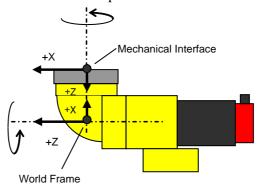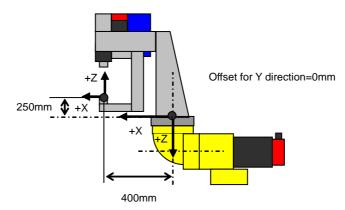
G.2.1   Setting Tool Frame of the Positioner

Read Tool Center Point of positioner when all axes are 0 degree from a drawing input it to a Tool Frame of the positioner directly.

1   World frame and Mechanical Interface of a positioner are defined as the follows.

2   Set the Tool Center Point from Mechanical Interface. For example of the following figure, set as X=400mm, Y=0mm, Z=-250mm, W=180deg, P=0deg, R=0deg.
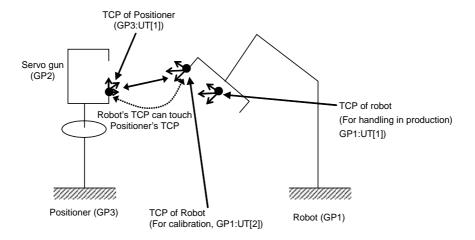
G.2.2   Setting Tool Frame of the Robot (For Calibration)

Set a Tool frame of the robot. This is used for calibration, and TCP can touch with the TCP of the Positioner.
(In other words, robot's TCP can touch the top of fixed tip of the pedestal gun.)
Select Tool frame number for using calibration as follows.
   - Calibrate by using TCP for handling in production : Select the number as same as the Positioner
   - Calibrate by a different TCP from that for handling in production : Select a different number from that
     of Positioner
Example)
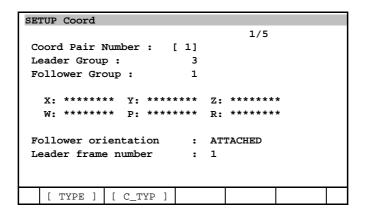
G.2.3   Calibration

Calibration is done in calibration screen. Display calibration screen by executing the following procedure.
   - Press the [MENU] key to bring up the screen menu, and select "SETUP".
   - Press F1 [TYPE] to display the pull-up menu, and select "Coord"
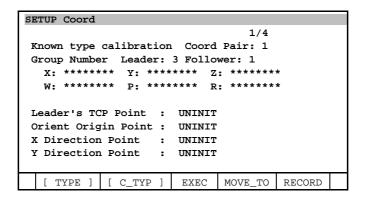
```
SETUP Coord
                               1/5
Coord Pair Number :   [ 1]
Leader Group :         3
Follower Group :       1


  X: ********  Y: ********  Z: ********
  W: ********  P: ********  R: ********


Follower orientation    :  ATTACHED
Leader frame number     :  1



   [ TYPE ]  [ C_TYP ]
```
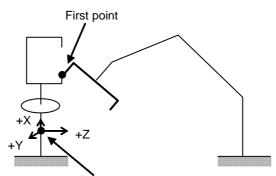
Calibration Procedure
1   Input pair number, leader group number (Positioner) and follower group number (Robot).
     Select F4 "YES" for the message "Position data will be cleared!".

2   Press F2 [C_TYP] and select "Known 4 Pt". Then the following screen will be displayed.

```
SETUP Coord
                                    1/4
 Known type calibration  Coord Pair: 1
 Group Number  Leader: 3 Follower: 1
   X: ********  Y: ********  Z: ********
   W: ********  P: ********  R: ********


 Leader's TCP Point   :  UNINIT
 Orient Origin Point  :  UNINIT
 X Direction Point    :  UNINIT
 Y Direction Point    :  UNINIT


  [ TYPE ]  [ C_TYP ]   EXEC   MOVE_TO   RECORD
```
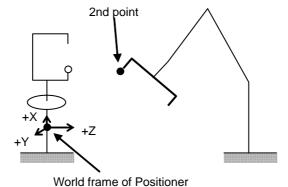
3   Record the following 4 positions. (Operation : SHIFT + F5 "RECORD")
    1st point "Leader's TCP Point" : Touch robot's TCP with Positioner's TCP
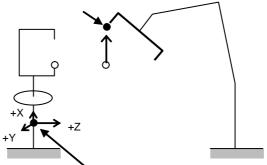
2nd point "Orient Origin Point" : Robot can move along both +X and +Y direction of Positioner's World frame.

3rd point "X Direction Point" : Move robot along +X direction of Positioner's World frame.
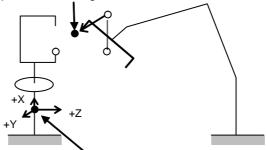
3rd point: Move along +X of Positioner's World frame

World frame of Positioner
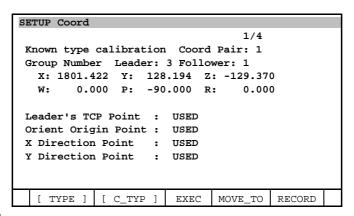
4th point "Y Direction Point" : Move robot along +Y direction of Positioner's World frame.

4th point: Move along +Y of World frame of Positioner

World frame of Positioner

4   Press SHIFT + F3 "EXEC" to execute calibration. Then the calibration result will be displayed.

```
SETUP Coord
                                    1/4
 Known type calibration  Coord Pair: 1
 Group Number  Leader: 3 Follower: 1
   X: 1801.422  Y:  128.194  Z: -129.370
   W:    0.000  P:  -90.000  R:    0.000


 Leader's TCP Point  :  USED
 Orient Origin Point :  USED
 X Direction Point   :  USED
 Y Direction Point   :  USED



   [ TYPE ]   [ C_TYP ]   EXEC   MOVE_TO   RECORD
```

5   Cycle the power.

NOTE
  Calibration data will not be used until cycling power.

Calibration is finished.

G.2.4 **Other Notes**

You do not have to set the following frames.
•   User frame and Tool frame of the gun (Group 2)
•   User frame of Positioner (Group 3)
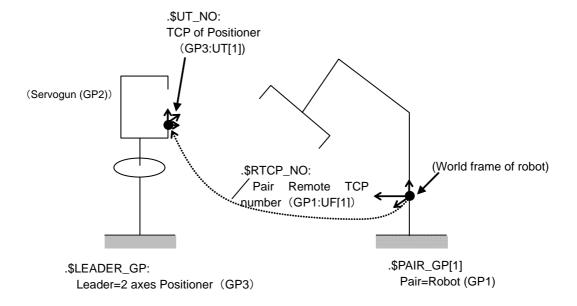
G.3   SETTING SYSTEM VARIABLE

Set the following system variable for using Variable Remote TCP.

Variable name	Example ($VRTCP[1])	Description
$VRTCP[1~4].$RTCP_NO	1	Remote TCP number to be variable (User frame number)
$VRTCP[1~4].$LEADER_GP	3	Group number of Leader (Positioner)
$VRTCP[1~4].$PAIR_GP[1]	1	Group number of Pair 1 (Robot)
$VRTCP[1~4].$PAIR_GP[2]	0	Group number of Pair 2 (none)
$VRTCP[1~4].$UT_NO	1	Tool frame number of Leader (Positioner)

> **NOTE**
>   Please do NOT change other system variables in $VRTCP[1~4].

Following figure shows the above settings ($VRTCP[1]).

G.4 USING VARIABLE REMOTE TCP
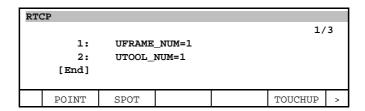
Confirm the followings before proceeding to the next section.
- Calibration of the positioner must be completed.
- Setup of system variable for Variable Remote TCP must be completed.

G.4.1 Selecting Frame Number
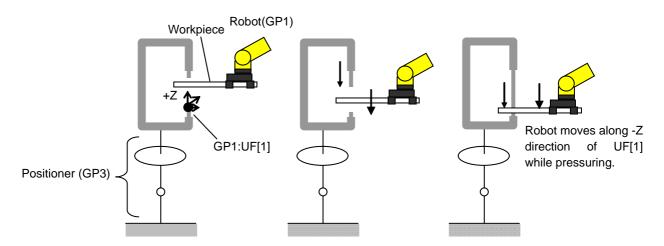
Select User frame number of Pair group (Robot) as $VRTCP[].$RTCP_NO. And select Tool frame number of Leader group as $VRTCP[].$UT_NO. To select frame number, FRAME instruction is recommended.

Example) Group mask : [1, 1, 1, *, *, *, *, *]

```
RTCP
                                            1/3
         1:      UFRAME_NUM=1
         2:      UTOOL_NUM=1
      [End]


      POINT    SPOT               TOUCHUP   >
```

G.4.2 Setting up Servo Gun

Set the servo gun as a normal pedestal servo gun. For example, User frame number for the Variable Remote TCP is UF[1], and robot moves along –Z direction of the User frame while pressuring, set as following. Tip close direction (Robot) : UF[1] : -Z
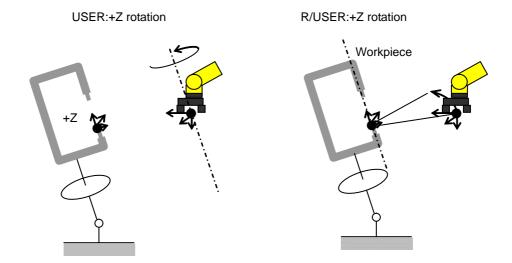
G.4.3 Jogging

Normal jogging, Normal remote tool jogging and Variable remote tool jogging are available.

Operation	Procedure
Switching JOG coordinate	Toggle [COORD] key.
Switching Remote Tool JOG	Press [FUNC] key, then select "TOGGLE REMOTE TCP"
Switching Remote Tool number	Press [FUNC] key, then select "CHANGE RTCP FRAME"

Example) Difference between Normal jogging and Remote TCP jogging

USER:+Z rotation   R/USER:+Z rotation

Workpiece

+Z

NOTE
Remote jogging between leader group and pair group is not available.

After jogging Leader group, the setting of Variable Remote TCP will be updated.

G.4.4   Teaching

Teach as usual. You can teach SPOT instruction as usual, too. RTCP option can be add to motion instruction.

NOTE
Please do not execute the motion instruction for moving both Leader group (Positioner) and Pair group (Robot) at the point where gun may collide with workpiece or robot hand.
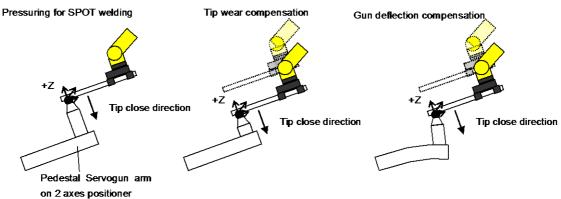
NOTE
You must execute SPOT instruction while Leader group is stopped.

G.4.5   Executing Program

Execute program as usual. When you execute a motion instruction with Variable Remote TCP, Pair group (Robot) uses the Variable Remote TCP calculated from the destination of Leader group (Positioner). Variable Remote TCP will be updated at stopped position.
When you execute SPOT instruction, pressuring and tip wear compensation will be done along Tip close direction defined on the Variable Remote TCP.
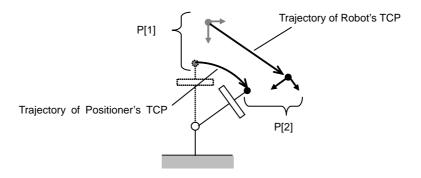
Pressuring for SPOT welding   Tip wear compensation   Gun deflection compensation

+Z

Tip close direction   +Z   Tip close direction   +Z   Tip close direction

Pedestal Servogun arm
on 2 axes positioner

G.4.6   Limitation
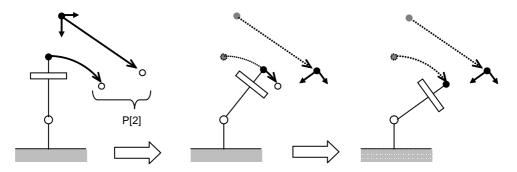
1. Coordinate motion is not supported.
   At a glance, Robot is coordinated with Positioner while executing TP program, actually they move as follows.

L P[2] 500mm/sec FINE

And it is not guaranteed that both reach to destination.

2. If you change TCP of Leader group (Positioner) for after deformation of gun, you must turn OFF-ON the power of Robot controller for updating Variable Remote TCP.

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REVISION RECORD

Edition	Date	Contents
05	May.,2019	Descriptions for Enhancement of Servo Tip Dresser Control, Servo Gun Temperature Compensation, and Pressure Profile Control function are added. Description for trouble shooting of tip wear compensation is updated and description for calibration motion type3 ~ 6 of gun change function is removed.
04	Jul.,2017	Description for software changing is added and changed for R-30iB and R-30iBplus
03	Sep.,2013	Description for 7DC2 is added.
02	Oct., 2012	Description for software changing is added and changed.
01	May, 2012	

B-83264EN/05