FANUC Robot series

R-30*i*B Plus CONTROLLER

AI Path Control

OPERATOR'S MANUAL

B-84134EN/02

- **Original Instructions**

Thank you very much for purchasing FANUC Robot.
Before using the Robot, be sure to read the "FANUC Robot series 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 describes the precautions which must be followed to enable the safe use of the robot. Before using the robot, be sure to read this chapter thoroughly.

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 series SAFETY HANDBOOK (**B-80687EN)**”.

1 PERSONNEL

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 safeguarded space

Maintenance technician:
- Operates the robot
- Teaches the robot inside the safeguarded space
- Performs maintenance (repair, adjustment, replacement)

- The operator is not allowed to work in the safeguarded space.
- The programmer or teaching operator and maintenance technician are allowed to work in the safeguarded space. Works carried out in the safeguarded space include transportation, installation, teaching, adjustment, and maintenance.
- To work inside the safeguarded space, the person must be trained on proper robot operation.

Table 1 (a) lists the work outside the safeguarded space. In this table, the symbol "○" means the work allowed to be carried out by the specified personnel.

Table 1 (a) List of work outside the Safeguarded Space

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

During robot operation, programming and maintenance, the operator, programmer, teaching operator and maintenance technician 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.

TABLE OF CONTENTS

1 GENERAL

1.1 CONTENTS OF THIS MANUAL

This manual explains how to start up and set up AI Path Control.
Chapter1: outlines this function.
Chapter2: explains the startup procedure when introducing this function. Follow this procedure to proceed with launching the function.
Chapter3 and later explain detailed setting methods and notes that were not explained in Chapter2. Please read as necessary.

1.2 OVERVIEW

APC (AI Path Control) is a function that realizes high path accuracy motion, by utilizing an accelerometer. A robot learns the path deviation measured by the accelerometer and improves the path accuracy.
APC is an optional function.
Using the APC function requires the APC option (J574). Using the function also requires that your model supports the APC function. If your model does not support APC, you cannot use it.
Shape Generation 3(R801) is recommended to be installed at the same time.

> ⚠ **CAUTION**
> The robot base plate needs to be fixed with anchors so that APC measures the path when the robot is in motion. Check the robot is fastened.

> **NOTE**
> Please contact FANUC for the specific robot model support list.

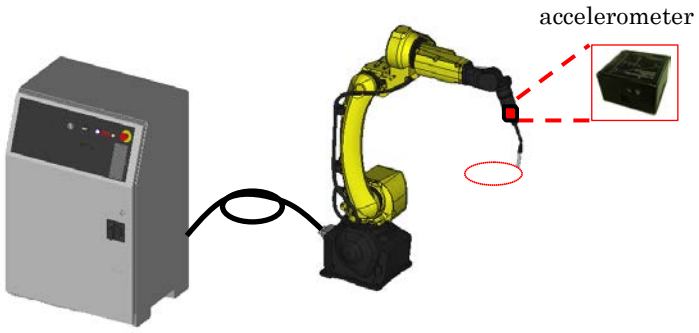


Fig. 1.2(a) APC Configuration

1.3 TERMINOLOGY

This chapter contains the terminology for this function. Please understand the terminology before setting up this function, creating and executing TP programs with APC instructions.

- APC command
  The following two commands are APC commands. Chapter 7 explains them more in detail.
  - APC_START: This is the command that starts learning mode or playback mode.
  - APC_END: This is the command that stops learning mode or playback mode.

- Learning percentage
  This is the parameter for learning percentage, whose range is 0 - 100%. 100% means learning process is completed.

- APC data
  This is the compensation data to improve the path accuracy. It is applied to the motion lines between APC_ START and APC_END.

- Learning mode, Learning motion
  APC is in learning mode when the learning percentage is between 0 - 99%. The motion in the learning mode is defined as learning motion.
  When APC_START is executed with learning percentage of 0%, the data measured by the accelerometer and other motion data is recorded in memory up to APC_END. APC data is calculated at APC_END.
  When APC_START is executed with learning percentage of 1 - 99%, the data measured by the accelerometer and other motion data is recorded in memory up to APC_END. The TP program is executed again with APC data, which was updated at APC_END of previous iteration.

- Playback mode, Playback motion
  Playback mode is defined as program execution when the learning percentage is 100%. The motion in the playback mode is defined as playback motion.
  When APC_START is executed with learning percentage of 100%, the motion data is not recorded in the memory. TP programs are executed with stored APC data. Accelerometer is not required in the Playback mode.

2 PROCEDURE

This chapter explains an example of the start-up procedure. Please read the explanation of Chapter 3 and later when making detailed settings.

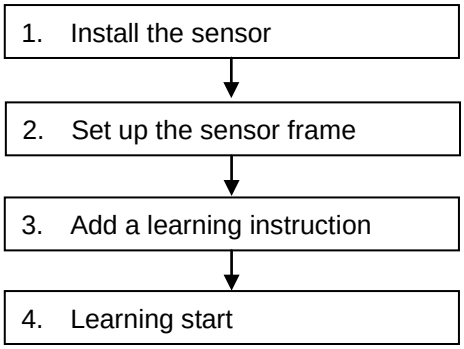


Fig. 2(a) Procedure for starting up APC

1 Install the sensor.

1-1 In the case of a wired accelerometer, please connect the wired accelerometer cable to the accelerometer and the JD17 slot of R-30*i*B Plus controller. And connect the sensor cable ground to the controller (Fig. 2(b)).
In the case of a wireless accelerometer, please connect the USB receiver to the teach pendant and turn on the wireless accelerometer (Fig. 2(c)). The wireless accelerometer can turn off/on when press and hold the power button on the LED1 for 2 seconds (Fig. 2(d)).

> ⚠ **CAUTION**
> Please turn off the power when you connect or disconnect an accelerometer cable.

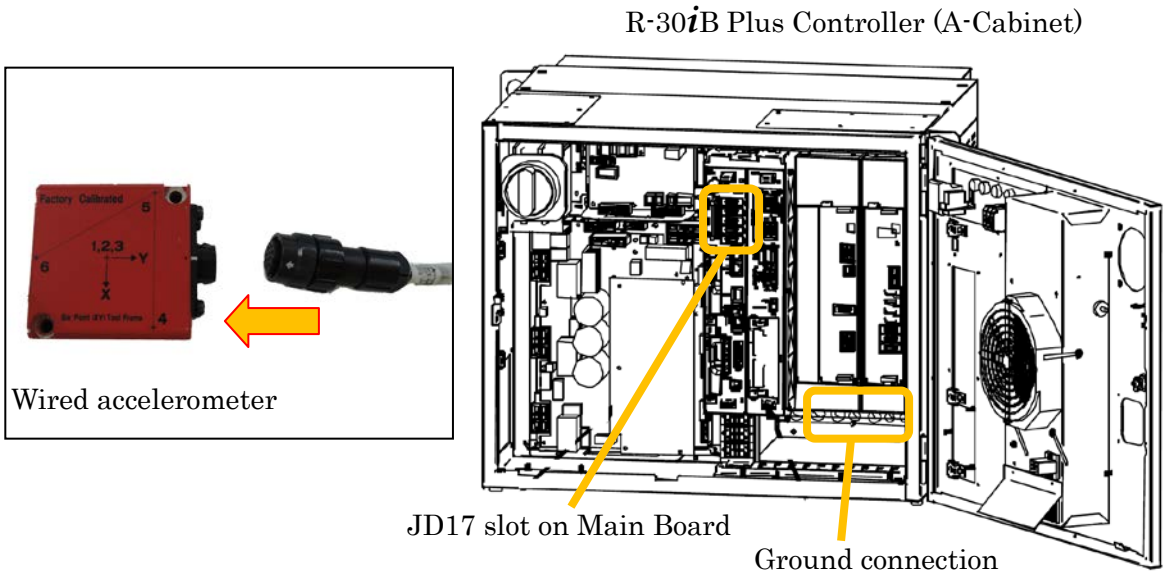


Fig. 2(b) Connection between Wired Accelerometer and Controller Cabinet

Fig. 2(c) Connection of the USB receiver

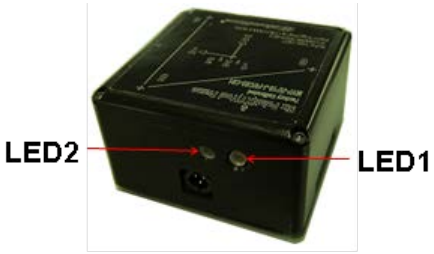


Fig. 2(d) LEDs on Accelerometer

1-2 Please mount the accelerometer near the TCP of the robot.

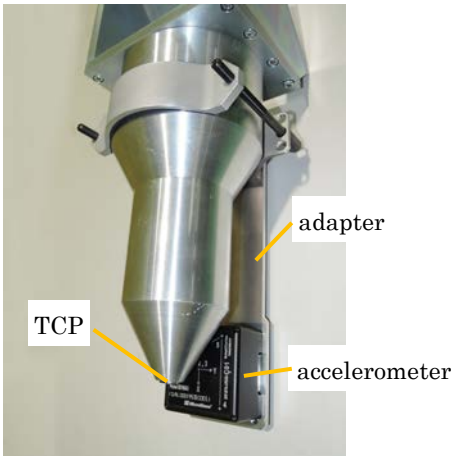


Fig. 2(e) Installation example of accelerometer

> ⚠ **CAUTION**
> Please don't attach the sensor to the tip of the part which operates independently of the robot's motion (e.g. height adjuster or equalizer), in order to measure the motion of the robot.

1-3 [MENU]→[6 Setup]→[APC] AI Path Control setting screen will be displayed.

1-4 Switch the "Sensor Type" item to wired or wireless. In the case of a wireless accelerometer, you can check the current data by enable "Wireless Confirm Mode:" (please change this item to "DISABLED" when APC instruction is executed).

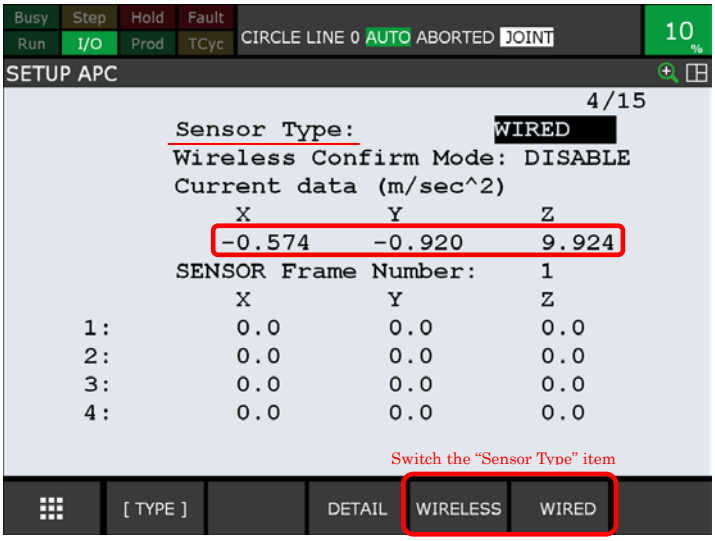


Fig. 2(f) Current acceleration data

2 Set up the sensor frame (sensor position and orientation).

2-1 [MENU]→[6 Setup]→[APC] AI Path Control setting screen will be displayed.

2-2 Please set the sensor frame number to use in the "SENSOR Frame Number:" item.

2-3 After setting the sensor frame number, move the cursor to the desired sensor frame and press the F3 [DETAIL] key.

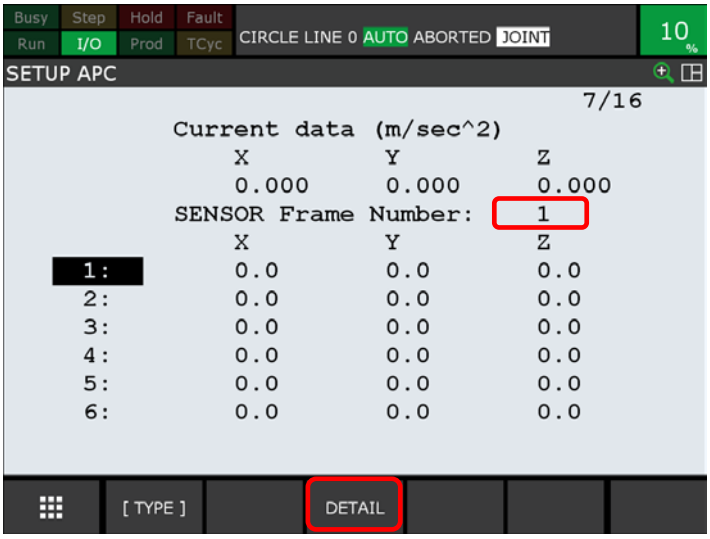


Fig. 2(g) APC setting screen

2-4 Press the [F->] key, then "AutoSet" function keys are displayed.

2-5 Move the robot to the base position. Then hold down the [SHIFT] key and press the F5 [RECORD] key.

2-6 Check the safety of the surroundings. Then reset the alarm and hold down the [SHIFT] key and press the F2 [Auto Set] key. Fast movements start after slow movements are completed. You can change the override during the slow movements but cannot change the override during the fast movements.

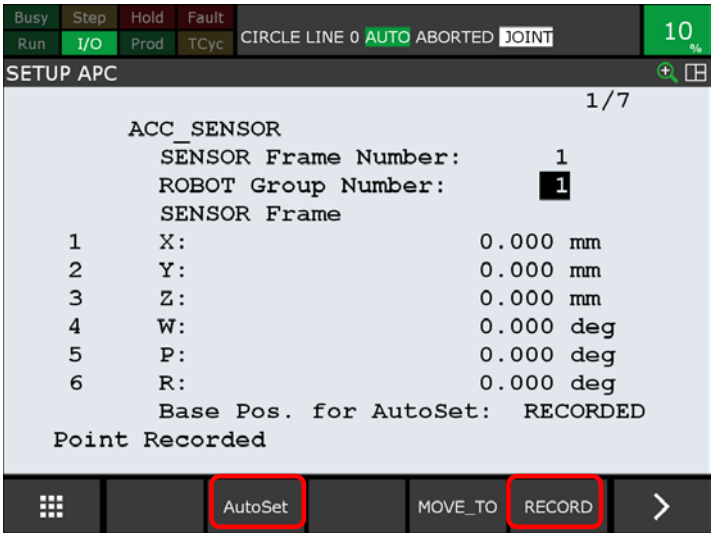


Fig. 2(h) Setting menu for sensor frame

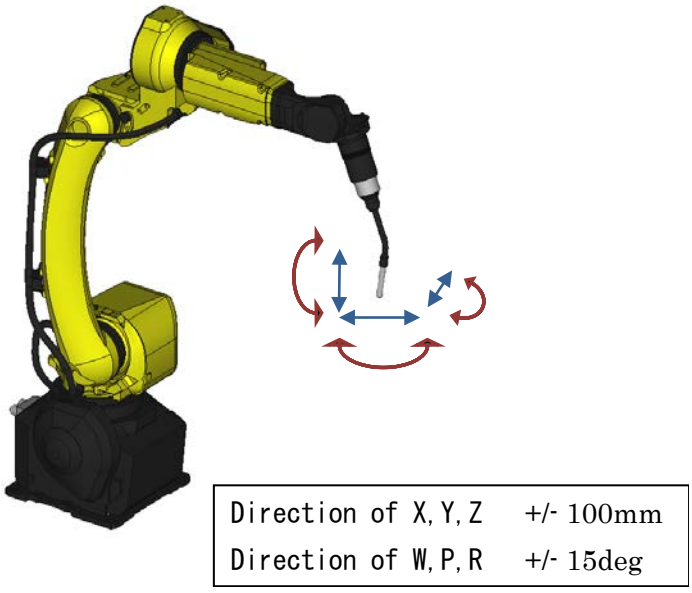


Fig. 2(i) Sensor Frame Automatic Setting

> ⚠ **CAUTION**
> For the base position of sensor frame autmatic setting function, refer to Subsection 4.1.2.

2-7 After the fast movements, if the message “Sensor frame setting is completed” is displayed, sensor frame automatic setting function is completed.

> **NOTE**
> If you use “Six Point Method” or “Direct List Method”, please refer to Chapter 4.

3 Add a learning instruction to the program you want to learn.

3-1 In the program select menu, move the cursor to a TP program and select it. The editor screen appears.

3-2 Press the F1 [INST] key and a menu for instructions appears. Select “APC” in the menu.

3-3 The APC instruction menu appears. Select “APC_START” or “APC_END”, and press the [Enter] key.
3-4 The APC instruction is added to the program line. Enclose the action statement you want to learn with “APC_START” and “APC_END” instruction.

> ⚠ **CAUTION**
> APC_START and WAIT instruction have to be taught after the motion line of CNT0/FINE. When the termination types of the motion line before APC_START or WAIT is CNT1-100, alarm “MOTN-538” might occur.

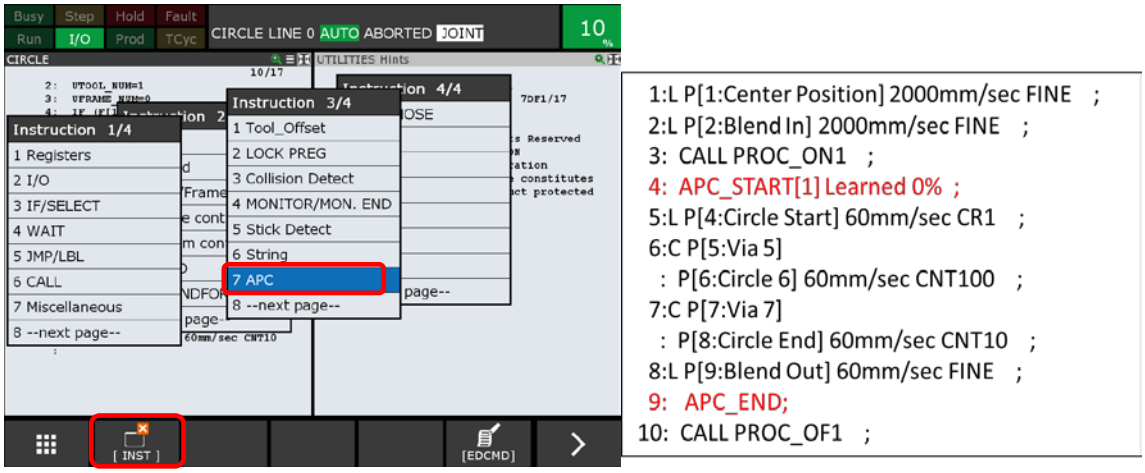


Fig. 2(j) Addition of APC instruction and Program example adding APC instruction

3-5 Enter data ID of APC data at * in “APC_START[*] Learned 0%”. [MENU]→[0 NEXT]→[3 DATA]→[APC] The APC data menu appears.

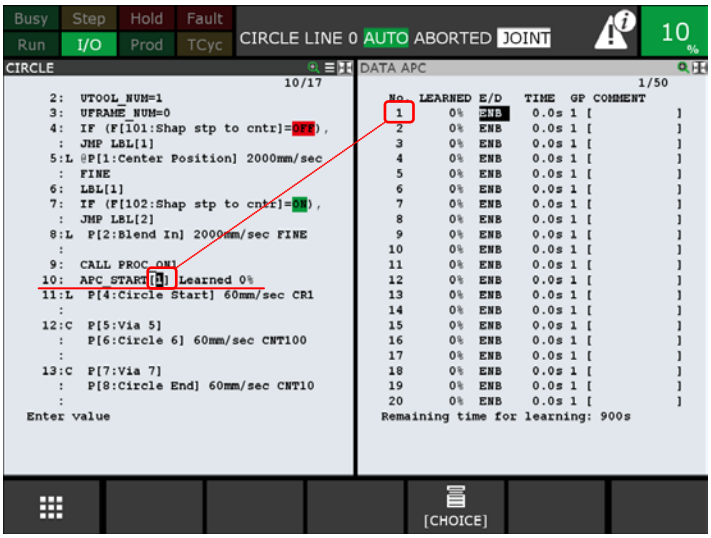


Fig. 2(k) ID in APC data

> **NOTE**
> Refer to Chapter 6 for APC data menu and Chapter 7 for learning programs.

4 Start the TP program and repeat running until the learning percentage becomes 100%.
4-1 When learning percentage reaches 100%, the learning process is complete.

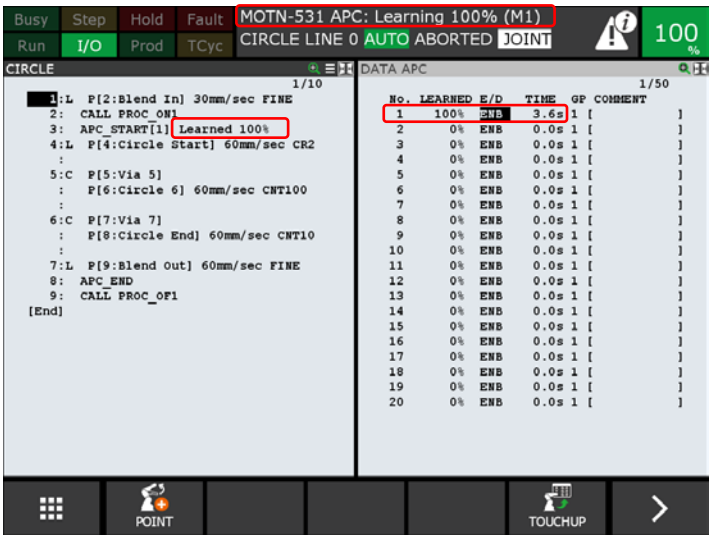


Fig. 2(l) Learning completion state

NOTE

When resuming program execution after the pause in path control section, APC becomes disable.

3 HARDWARE AND SOFTWARE

This chapter explains necessary hardware, necessary software, and software limitations for APC.

3.1 HARDWARE

APC requires the following hardware.

- 18MB available memory in F-ROM.
- Wired accelerometer or wireless accelerometer.

3.1.1 Wired Accelerometer

Sensor connection

Please connect a wired accelerometer cable to an accelerometer and the R-30*i*B Plus controller. Please refer to Fig. 3.1.1 (a).
Please connect to the controller's JD17 slot and connect the cable shield to ground.

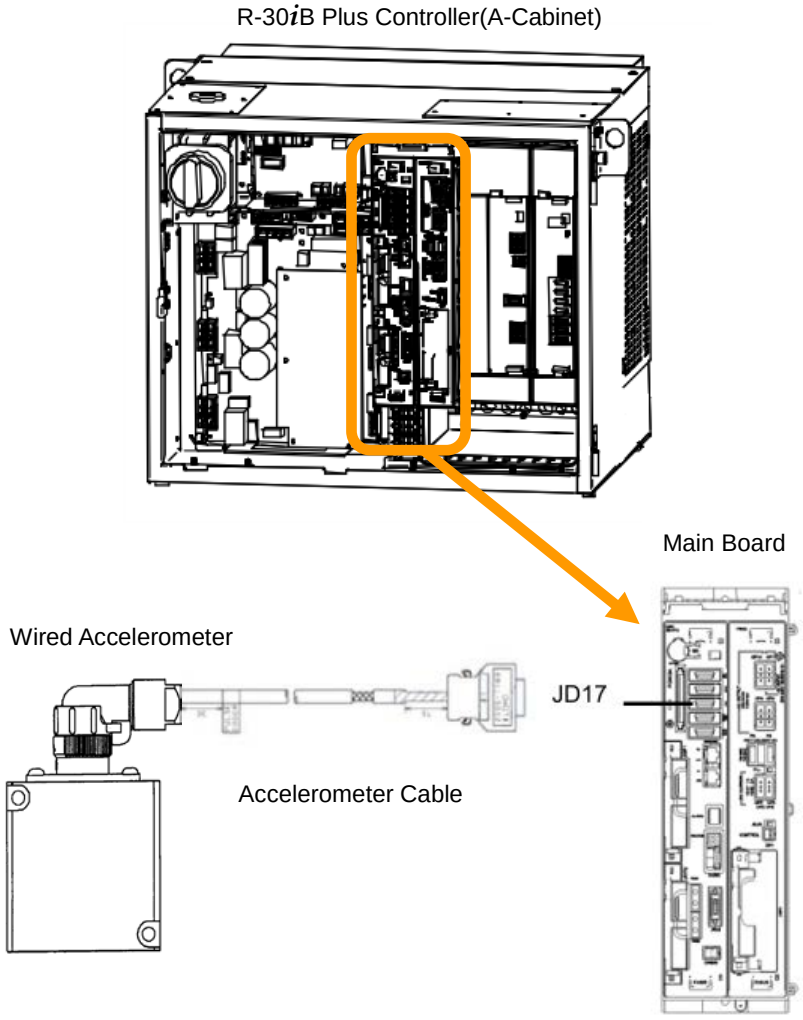


Fig. 3.1.1 (a) Connection between Wired Accelerometer and Controller Cabinet

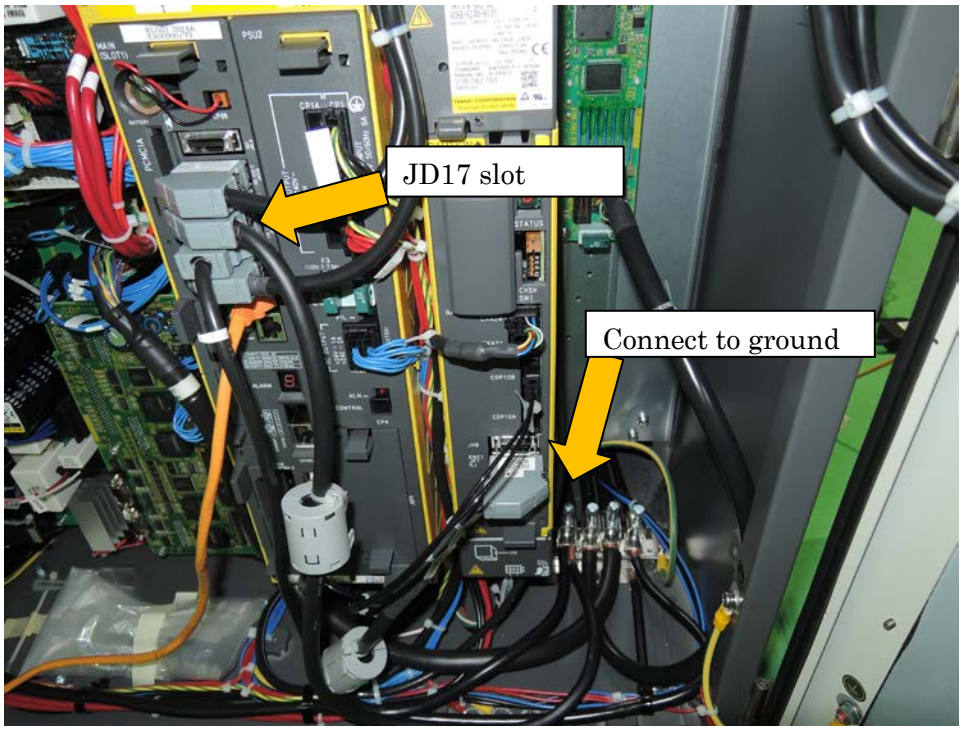


Fig. 3.1.1(b) Connection between Wired Accelerometer and Controller

> ⚠ **CAUTION**
> Please turn off the power when you connect or disconnect an accelerometer cable.

Sensor Installation

Please attach the accelerometer to the robot or tool. Install the accelerometer as close to the TCP as possible. Please choose a tool to attach accelerometer as rigid as possible. Please be careful that a cable of the accelerometer is not pulled to manage it. There are the following ways to install.

- Adapter kit for APC
  Mount the wired accelerometer on the adapter kit and tighten the bolts to secure the two together as shown in Fig. 3.1.1 (c). After that, attach the accelerometer to an end-of-arm tool.
  The adapter kit may not be attached to all tools. You may produce a sensor adapter to a tool to use. Please be careful about the following points on this occasion.
  - Accelerometer can set up near the tool tip.
  - Being as rigid adapter as possible.
  - Robot doesn’t interfere with the device around.
  - Attach the accelerometer and the adapter to the part which doesn’t work independent of movement of the Robot.

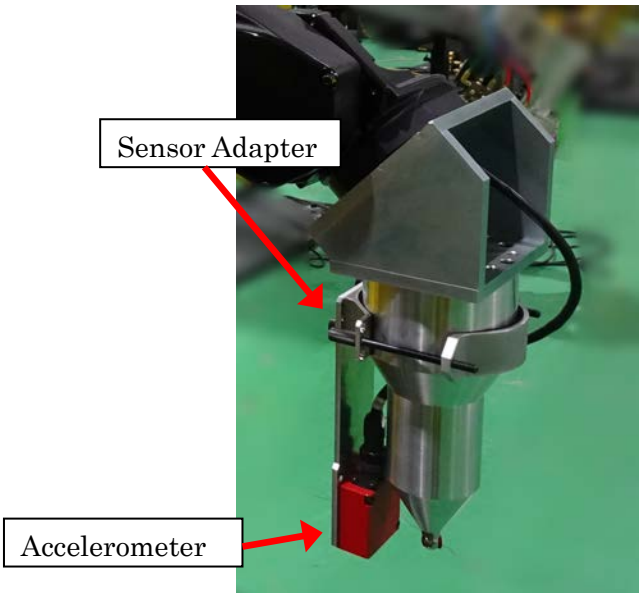


Fig. 3.1.1(c) Sensor Adapter Kit

- Magnetic Adapter kit
  Mount the wired accelerometer on the adapter kit and tighten the bolts to secure the two together as shown in Fig. 3.1.1 (d). Fit the accelerometer to an end-of-arm tool, and turn on the adapter switch.

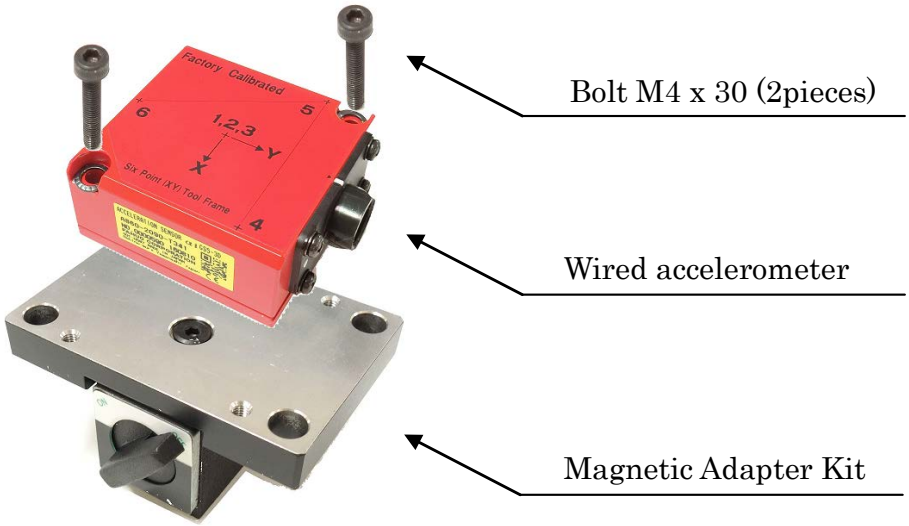


Fig. 3.1.1 (d) Magnetic Adapter Kit for Wired Accelerometer

- C-clamp Adapter kit
  Mount the wired accelerometer on the adapter kit and tighten the bolts to secure the two together as shown in Fig. 3.1.1 (e). After that, attach the accelerometer to an end-of-arm tool by clamping the plate of the kit with a C-clamp, as shown in Fig. 3.1.1 (f).

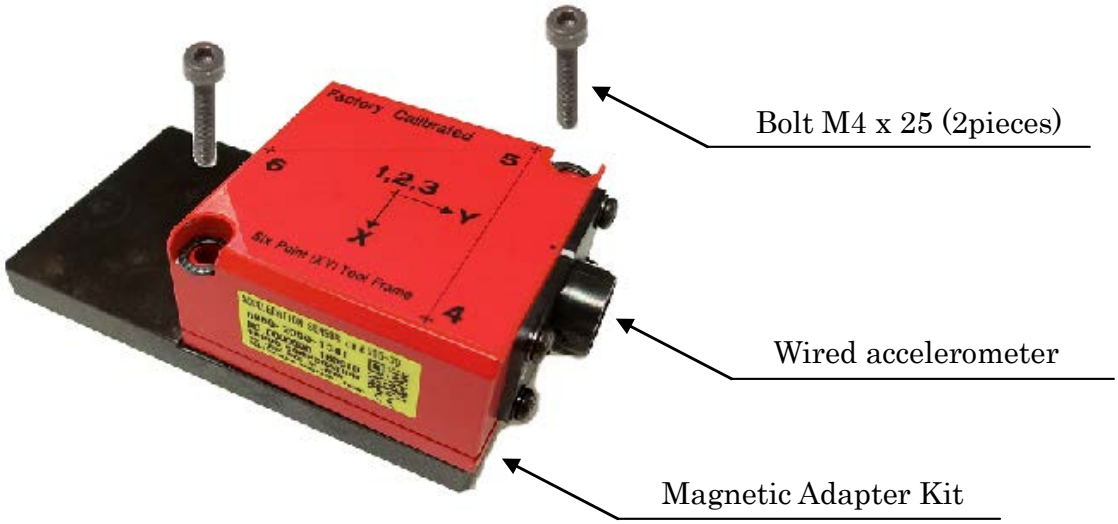


Fig. 3.1.1 (e) C-clamp Adapter Kit for Wired Accelerometer

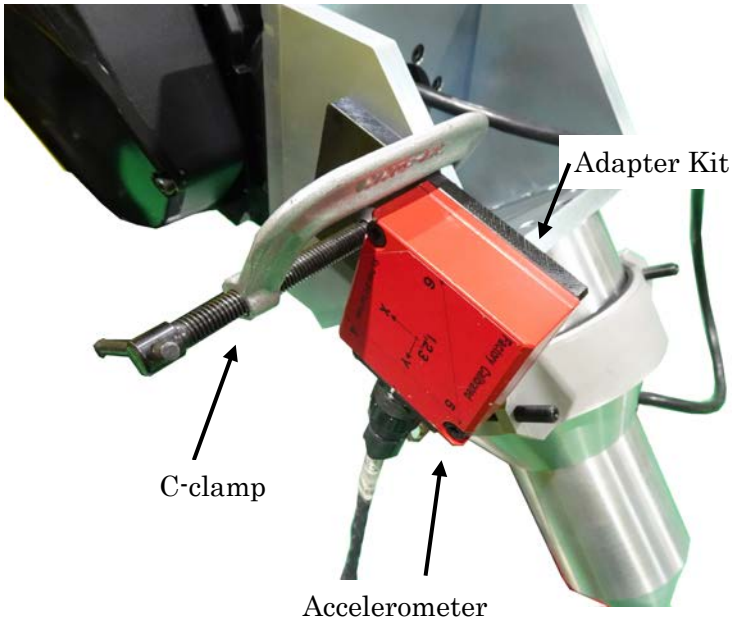


Fig. 3.1.1 (f) Clamping an Accelerometer with a C-clamp Kit

⚠ CAUTION

- Please mount the accelerometer at the location where path deviation control is needed. (e.g. locations close to Tool Center Point.) Attach the accelerometer to a relatively stiff part of the end-of-arm tool in order to measure the path deviation correctly.
- Please don't attach the sensor to the tip of the part which operates independently of the robot's motion (e.g. height adjuster or equalizer), in order to measure the motion of the robot.
- Clamping an accelerometer directly with a C-clamp may deform the accelerometer and cause sensor failure.
- If welding is enabled with clamping an accelerometer, it may cause the damage to the accelerometer. Please execute APC instruction in tryout mode.

Specification

The specification and dimension of the wired accelerometer are shown in Table 3.1.1(b) and Fig. 3.1.1(g).

Table 3.1.1 (a) APC Part Number Quick Reference

Part number	Description
A860-2090-T341	ACC SENSOR
A05B-1410-K102	ACC SENSOR CABLE KIT (25m)
A05B-1410-K031	SENSOR ADAPTOR
A05B-1410-K001	ACC MAGNETIC SENSOR ADAPTOR
A05B-1410-K002	ACC C-CLAMP SENSOR ADAPTOR

Table 3.1.1 (b) Wired Accelerometer Sensor Specification

Item	Specification
Supply Voltage	5V-5% to 5V+5%
Current Consumption	80mA or less
Shock durability (Sensor)	5000G (≈50000m/s^2)
Operation temperature	0℃ to 60℃
Measurement directions	X, Y, Z 3-orthogonal axes
Measurement range	-5G (≒-49m/s^2) to +5G (≒+49m/s^2)
Resolution	0.15 to 0.25mG(≒1.5 to 2.5mm/s2)
Offset	+/- 50mV
Frequency response	To 1kHz
Interface	FANUC Serial Interface
Structure	Waterproof (IP67 at mating)
Weight	Approximately 130g

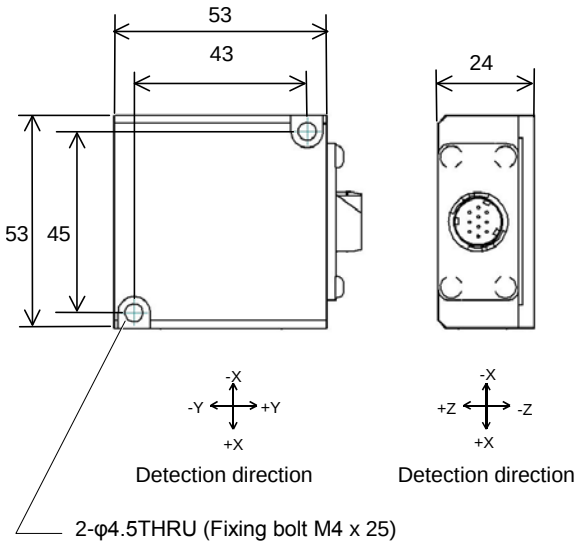


Fig. 3.1.1 (g) Dimensions of the Wired Accelerometer

3.1.2 Wireless Accelerometer

Sensor connection

Please connect the USB receiver to the teach pendant as shown in Fig. 3.1.2 (a).

Fig. 3.1.2 (a) Connection of the USB receiver

The wireless accelerometer can turn off/on when press and hold the power button for 2 seconds (The power button is LED1. Please refer to Fig. 3.1.2 (b)).
When pairing the accelerometer and the USB receiver is completed, LED1 turns on blue as shown in Table 3.1.2 (a) and blink Connect LED on the USB receiver as shown in Table 3.1.2 (c). As for the confirmation of wireless communication, please refer to Section 5.5.

Fig. 3.1.2 (b) LEDs on Accelerometer

The wireless accelerometer has 2 buttons as shown in Fig 3.1.2 (b). LED1 is a power button. LED2 is a reset button.
The status of the accelerometer indicated by LED1 and LED2 is shown in Table 3.1.2 (a) and (b).

Table 3.1.2(a) LED1 on Accelerometer

Status	Red light	Blue light
Power off	Off	
Power on (pairing incomplete)	On at 1-second interval	Off
Power on (pairing completed)	Off	On
Connecting	Off	Blink
Power on (the battery is low)	On at 0.5-second interval	Depend on connection status (On/Off/Blink)
Power on (the battery is zero)	On for 1 minute then turn off	Off

NOTE
- Pairing means the wireless connection between the accelerometer and the USB receiver.
- However the wireless accelerometer can be used up to several tens of minutes when its battery is low, it is recommended using after charging the battery.
- Don't use the wireless accelerometer with charging the battery.

Table 3.1.2(b) LED2 on Accelerometer

Status	Green light
Non-charging	Off
During charging	On

USB receiver has three LEDs that indicate the status of receiver as shown in Fig. 3.1.2 (c).

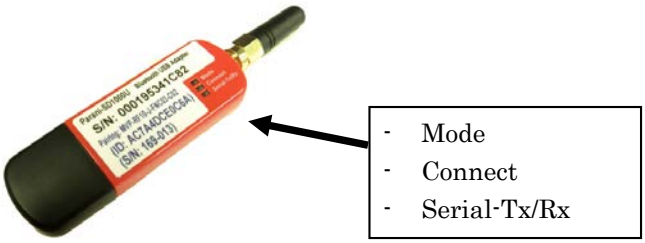


Fig. 3.1.2 (c) LED on USB receiver

The status of the USB receiver is shown in Table 3.1.2(c).

Table 3.1.2(c) LEDs on USB receiver

Status	Mode	Connect	Serial-Tx/Rx
Pairing incomplete	Blink	Off	Off
Pairing completed	Off	Blink	Off
Communicating	Off	Blink	Blink fast

⚠ CAUTION
- Don't turn off an accelerometer or disconnect a USB receiver during the communication of the data.
- The wireless accelerometer communicates with the USB receiver wirelessly. The communication may be unstable if there are Wi-Fi spots (2.4GHz band) or strong radio transmission source nearby. The communication between the wireless accelerometer and the USB receiver may affect the other wireless communications.
- Don't disassemble, repair nor remodel the wireless accelerometer and the USB receiver.
- The USB receiver is not available with tablet TP. Please connect *i*Pendant in using wireless accelerometer.

Sensor Installation

Please attach the accelerometer to the robot or tool. Install the accelerometer as close to the TCP as possible. Please choose a tool to attach accelerometer as rigid as possible. There are the following ways to install.

- Adapter kit for APC

Mount the wireless accelerometer on the adapter kit and tighten the bolts to secure the two together as shown in Fig. 3.1.2 (d). After that, attach the accelerometer to an end-of-arm tool.
The adapter kit may not be attached to all tools. You may produce a sensor adapter to a tool to use. Please be careful about the following points on this occasion.

- Accelerometer can set up near the tool tip.
- Being an adapter rigid as possible.
- When Robot works, don't clash with each other.
- Being able to attach it to the part which doesn't work independent of movement of the Robot.

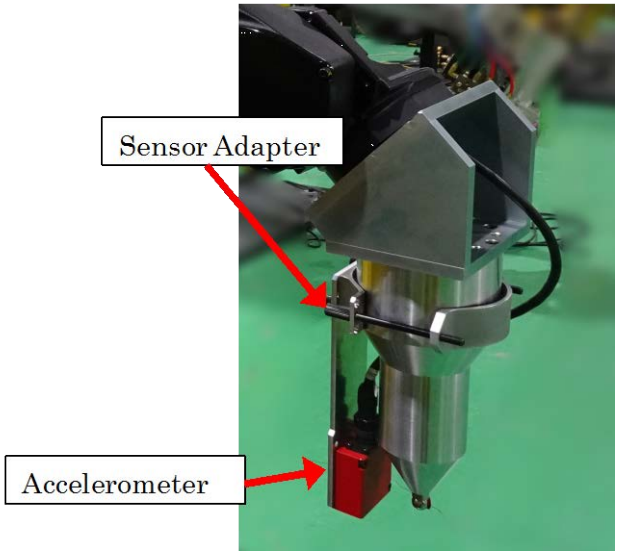


Fig. 3.1.2(d) Sensor Adapter Kit

- Magnet adapter
  The accelerometer can be attached by the magnet built in it, as shown in Fig. 3.1.2 (e).

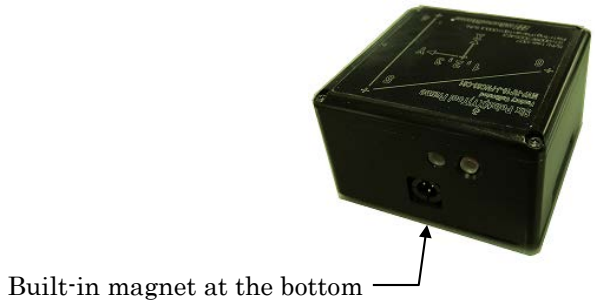


Fig. 3.1.2 (e) Magnet Adapter in Wireless Accelerometer

- C-clamp Adapter kit
  Mount the wireless accelerometer on the adapter kit and tighten the bolts with tightening torque 2.25Nm as shown in Fig. 3.1.2 (f). After that, attach the accelerometer to an end-of-arm tool or servo gun by clamping the plate of the kit with a C-clamp, as shown in Fig. 3.1.2 (g).

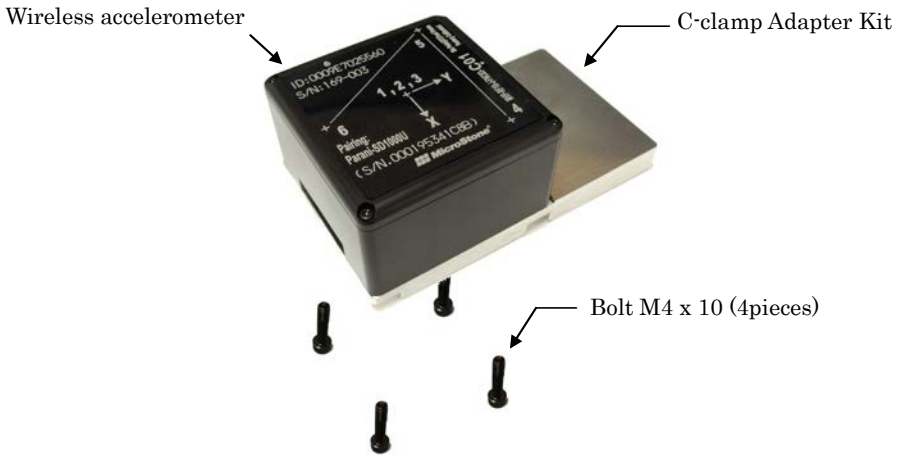


Fig. 3.1.2 (f) C-clamp Adapter Kit for Wireless Accelerometer

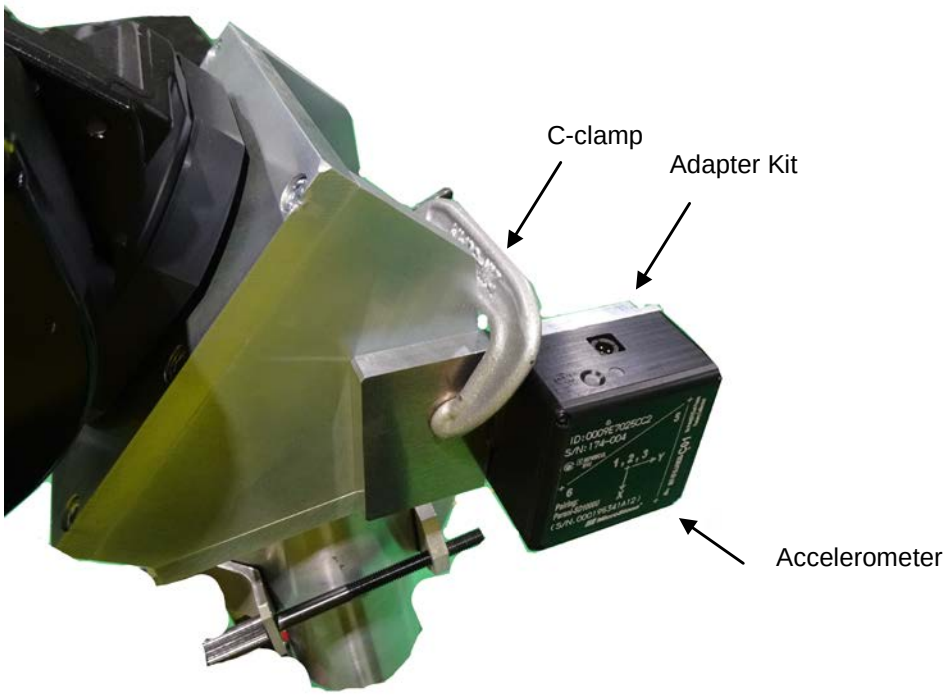


Fig. 3.1.2 (g) Clamping an Accelerometer with a C-clamp Kit

⚠ CAUTION

- Please mount the accelerometer at the location where path deviation control is needed. (e.g. locations close to Tool Center Point.) Attach the accelerometer to a relatively stiff part of the end-of-arm tool in order to measure the path deviation correctly.
- Please don't attach the sensor to the tip of the part which operates independently of the robot's motion (e.g. height adjuster or equalizer), in order to measure the motion of the robot.
- Clamping an accelerometer directly with a C-clamp may deform the accelerometer and cause sensor failure.
- If welding is enabled with clamping an accelerometer, malfunction or damage to accelerometer would occur. Please execute APC instruction in tryout mode.

Specification

The specification and dimensions of the wireless accelerometer are shown in Table 3.1.2 (e), 3.1.2 (f), Fig. 3.1.2 (h) and Fig. 3.1.2 (i).

Table 3.1.2 (d) APC Part Number Quick Reference

Part number	Description
A05B-1410-K201	Wireless ACC SENSOR KIT (for USA)
A05B-1410-K202	Wireless ACC SENSOR KIT (for Japan)
A05B-1410-K031	SENSOR ADAPTOR
A05B-1410-K211	ACC C-CLAMP SENSOR ADAPTOR for wireless ACC

NOTE

- Wireless ACC SENSOR KIT contains a wireless accelerometer, a USB receiver, and a charging cable.
- One Wireless accelerometer can be used with only one USB receiver which is pairing registered before shipment. You can check which accelerometer (receiver) matches for the receiver (accelerometer) by S/N (Serial Number) printed on label.

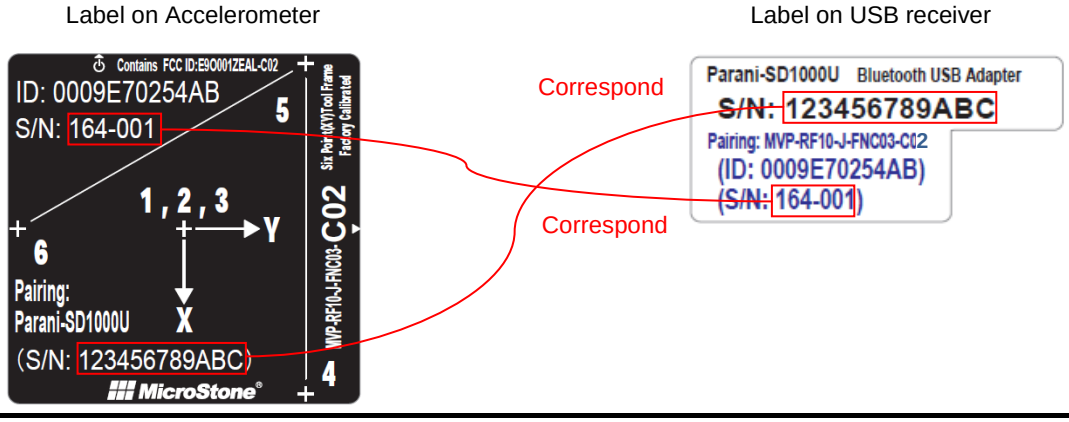


Table 3.1.2 (e) Wireless Accelerometer Sensor Specification

Item	Specification	
	For USA	For Japan
Part number	MVP-RF10-J-FNC03-C02 manufactured by MicroStone co. ltd	MVP-RF10-J-FNC03-C01 manufactured by MicroStone co. ltd
Operation temperature	0℃ to 40℃	

Item	Specification	
	For USA	For Japan
Measurement directions	X, Y, Z 3-orthogonal axes	
Measurement range	-6G (≒-58.8m/s^2) to +6G (≒+58.8m/s^2)	
Resolution	0.22mG (≒2.2mm/s^2)	
Frequency response	To 1kHz	
Structure	IP64	
Wireless standard	Bluetooth 2.1+EDR Class-2	Bluetooth 2.0+EDR Class-1
Communication distance(published value by MicroStone co. ltd)	Within 5m	Within 20m
Certification countries	USA, Japan	Japan
Communication protocol	Serial transmission	
Communication speed	460.8Kbps	
Battery	700mAh (Lithium polymer rechargeable battery)	
Battery duration	For 8 hours on end (At normal temperature)	
Charging time	For 2 hours (Charging from empty to full)	

NOTE

- Communication distance in Table 3.1.2(e) is under the condition of the good visibility. It would be changed by environment. Please put the accelerometer and the USB receiver as close as possible to each other.
- If a wireless accelerometer is used only in Japan, please use it for Japan (A05B-1410-K202) because communication distance of a wireless accelerometer for Japan is longer than that for USA.
- Because the internal battery performance or service life will become low, do not store the product in the conditions that battery level is empty. As a guide, if you leave it unused for a long time, it is recommended to charge it fully every year.
- When the battery life is over, need to exchange it by manufacturer for profit. Please contact your local FANUC representative.
- The sensor contains a lithium polymer rechargeable battery. Please dispose of it properly without dismantling as an industrial waste in accordance with local regulations to prevent hazards for health and environment.

⚠ CAUTION

The sensor contains lithium polymer rechargeable battery. Although the sensor is not subject to the dangerous goods regulation or the prohibited exports regulations, the following items are required in case of packing 3 or more wireless accelerometers in a single package It is recommended sending 2 or less wireless accelerometers at the maximum in the same packing.

Lithium battery mark

Describing the necessary wording on the air waybill

Lithium ion batteries in compliance with Section II of PI967

Source: IATA Air Dangerous Goods Regulations 58th edition (2017)

- The mark is a rectangle hatched with diagonal lines.
- The minimum dimension of the mark is 120 mm (width) × 110 mm (height), the minimum width of hatching is 5 mm
- Hatching is red.
- Display UN3481 (United nation number)

Table 3.1.2 (f) USB Receiver Specification

Item	Description
Part number	Parani-SD1000U (manufactured by Sena Technologies, Inc)
Operation temperature	-20℃ to 70℃
Wireless standard	Bluetooth 2.0+EDR Class-1
Communication distance(published value by Sena Technologies, Inc)	300m
Certification countries	USA, Japan, Europe, South Korea, Canada
Communication protocol	Serial transmission
Communication speed	460.8Kbps

NOTE

- Communication distance in Table 3.1.2(f) is under the condition of the good visibility. It would be changed by environment. Please put the wireless accelerometer and the USB receiver as close as possible to each other.
- The part number of the USB receiver is the same when A05B-1410-K201 and A05B-1410-K202 is selected.

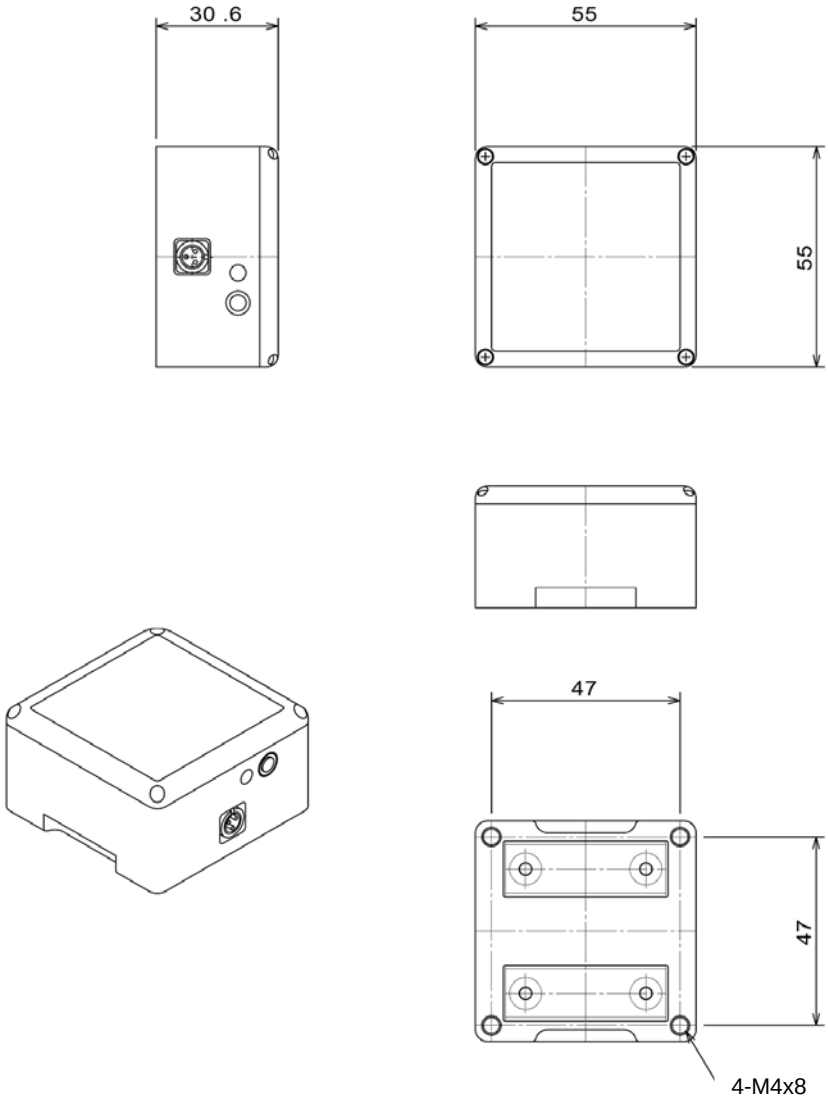


Fig. 3.1.2 (h) Dimensions of the Wireless Accelerometer

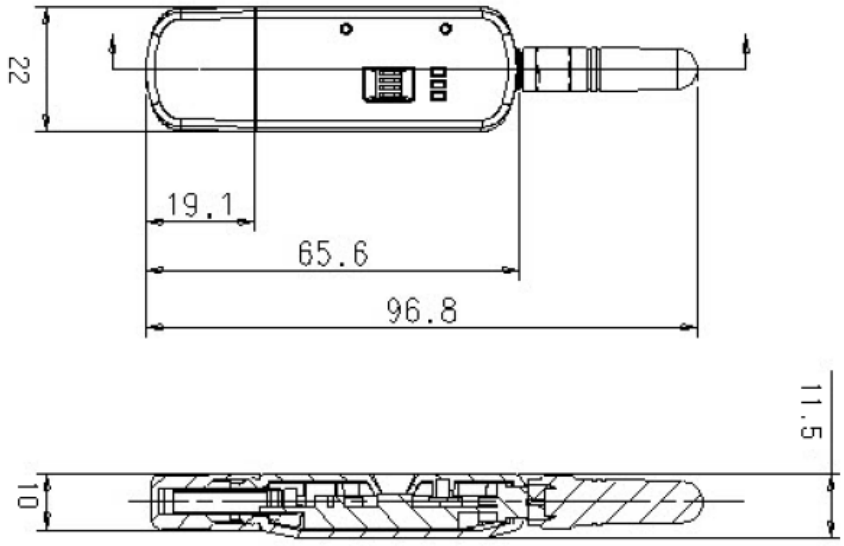


Fig. 3.1.2 (i) Dimensions of the USB receiver

3.2 SOFTWARE

3.2.1 Necessary Software Option

APC (J574) can be used in the R-30*i*B Plus controller with version as shown in Table 3.2.1(a).

Table 3.2.1(a) Software version APC (J574) can be used

Type of Controller	Type of accelerometer	Version
R-30*i*B Plus	Wired / Wireless	7DF1/17 or later
R-30*i*B Mate Plus	Wireless	7DF1/17 or later

The Constant Path option (R663) is necessary for APC, unless standard setting option (R651) is ordered. Shape Generation 3 (R801) is recommended to be installed when teaching circular motion etc.

3.2.2 APC Applicable System Configuration

APC is applicable to Laser application systems.

NOTE
Please contact your local FANUC representative for the specific robot model support list.

3.2.3 Limitations

Path accuracy can't be improved if the robot's performance limit has been reached by the pre-learning operation.

APC can be installed with the following options. However, APC instructions cannot be executed with those options' instructions at the same time. When they are executed at the same time, the alarm "MOTN-529 APC: This isn't allowed" is issued. (More detailed information about MOTN-529 can be found in Appendix A)

- External Path Optimization (J829)
- KAREL function (R632)
- Weaving (J504)
- Line tracking (J512)
- Touch Sensing (J536)
- Coordinated Motion Package (J686)
- Continuous Turn (J613)
- Softfloat(J612)
- Tracking function
  - Arc sensor (J511)
  - AVC(J526)
  - root pass memorization(J532)
  - Universal sensor interface (R691)
  - Dynamic Path Modification function (R739) etc.
- Touch Skip function (J921)
- Small Circle Accuracy Improvement (J644)
- Learning Vibration Control function (J573)

APC can be installed with *i*Rvision Core (J900). However, if motion changes by vision instructions in learning mode, the alarm MOTN-537 is issued.

APC can be installed with Independent Axis (H895) or Extended Axis Control (J518). However, APC instruction doesn't be executed if their axis moves during learning.

APC can be used with Space Check function. However, during learning, if the robot cannot enter the interference area and stops because of another robot or peripheral device located in the area, the robot stops with alarm, and learning does not work. In this cycle, the learning mode becomes disabled and the learning percentage does not increase. If the robot stops because of Space Check function, the alarm MOTN-538 occurs.

APC can be installed with ADV-Max Speed CTRL(R805). However, Process Speed function included in the ADV-Max Speed CTRL cannot be used.

NOTE
- APC requires the motion path to be the same during learning and playback mode. If there is the instruction that changes the path by external signals during APC instruction, an alarm may be posted and the robot stops.
- When Robot is set up by rail axis, prevent you from moving the rail axis in the path control order section.

The learning mode and playback mode become disabled under the following conditions. Normal robot motion is used or the robot stops with alarm:
- Less than 100% override
- APC status is disabled in the setup menu. (Please refer to Section 5.1)
- APC data is disabled in the APC data menu. (Please refer to Subsection 6.1.3)
- T1 mode
- Single step mode
- Backward mode
- Resumption of the robot motion after HOLD and ESTOP
- Execution of TP programs from the line between APC_START and APC_END
- Power failure handling

APC can support multi-arm system. However, a program that has multiple robot groups cannot run APC instructions. When multiple robots are run by multi-motion function with APC instructions, "MOTN-547 APC: Sync motion not supported" is issued. (More detailed information about MOTN-547 in Appendix A)

NOTE
Don't execute learning when the servo parameters are modified manually. If you want to learn, please turn back the servo parameters.

4 SETTING SENSOR FRAME

Set up the sensor frame (sensor position and orientation) after the accelerometer is connected.
The sensor frame is a fixed frame in mechanical interface coordinate system as shown Fig.4(a).

Fig.4(a) Sensor Frame (Left: Wired Accelerometer, Right: Wireless Accelerometer)

Please refer to Fig.4(b) for an example of setting the sensor frame.

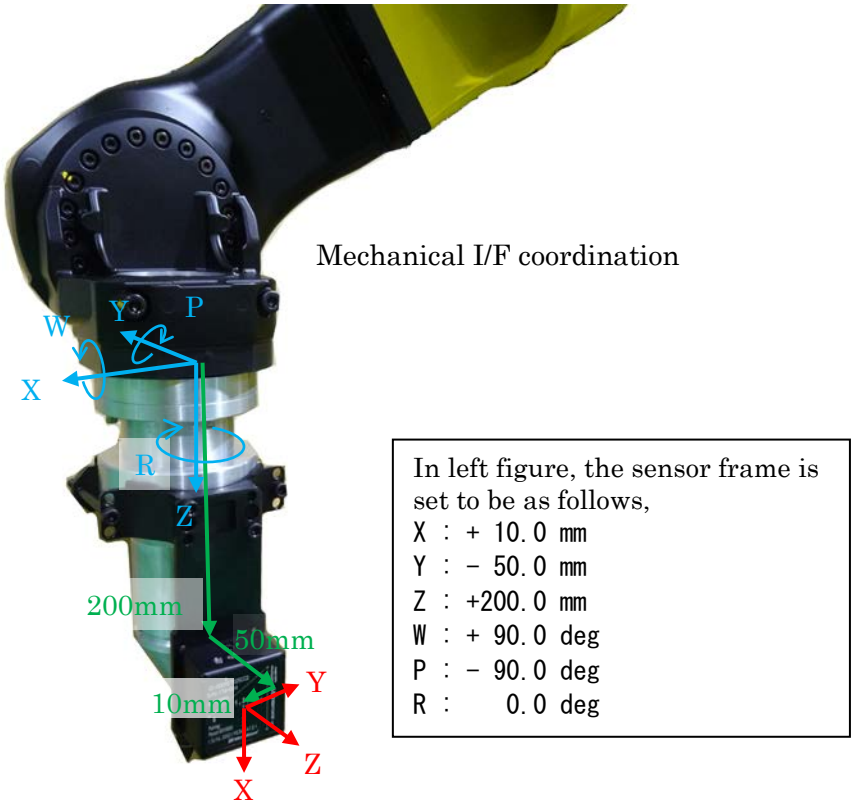


Fig. 4(b) Mechanical interface frame and sensor frame

To set the sensor frame, following methods can be used. The setting method is the same for wired acceleration sensors and wireless acceleration sensors.

1. Sensor frame automatic setting function
   Set the sensor frame automatically by the predetermined robot movements.

2. Six point method
   Set the sensor frame by touching a sharp instrument with six postures.
3. Direct list method
   Set the sensor frame by entering the values of X, Y, Z, W, P and R directly.
   If you know the sensor frame of a different robot on which the accelerometer is attached at the same place, you can enter these values directly.

To determine which method to be used, please refer to the following flowchart.

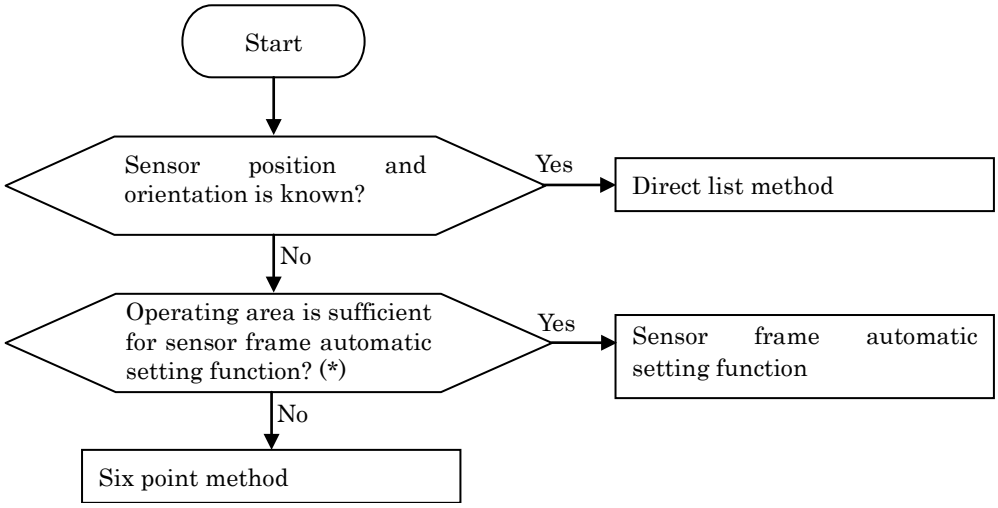


Fig.4(c) How to determine sensor frame setting method

About (*) in Fig.4(c):
Predetermined robot movements for sensor frame automatic setting function are reciprocating movements of +/- 100mm in each direction of X, Y, Z and +/- 15deg in each direction of W, P, R in mechanical interface frame. If you are not sure whether the operating area is sufficient for sensor frame automatic setting function or not, you can verify it by using sensor frame automatic setting function which will provide slow motion verification process.

> ⚠ **WARNING**
> When the sensor frame number is not set correctly, APC may generate incorrect data, which can result in poor APC performance. Also the incorrect frame may cause the robot to move in an unexpected way. Be careful to set the sensor frame and the sensor frame number correctly.

APC records 10 sets of sensor frame. When the program is executed, set the sensor frame number to use in the sensor frame number item.

4.1 SENSOR FRAME AUTOMATIC SETTING FUNCTION

4.1.1 Overview

Sensor frame automatic setting function is a function that sets the sensor frame automatically by predefined robot movements.
Predetermined robot movements for sensor frame automatic setting function are reciprocating movements of +/- 100mm in each direction of X, Y, Z and +/- 15deg in each direction of W, P, R.

4.1.2 Procedure

Perform the settings according to the sensor frame automatic setting function according to the following procedure.

Procedure4-1 Executing sensor frame automatic setting function

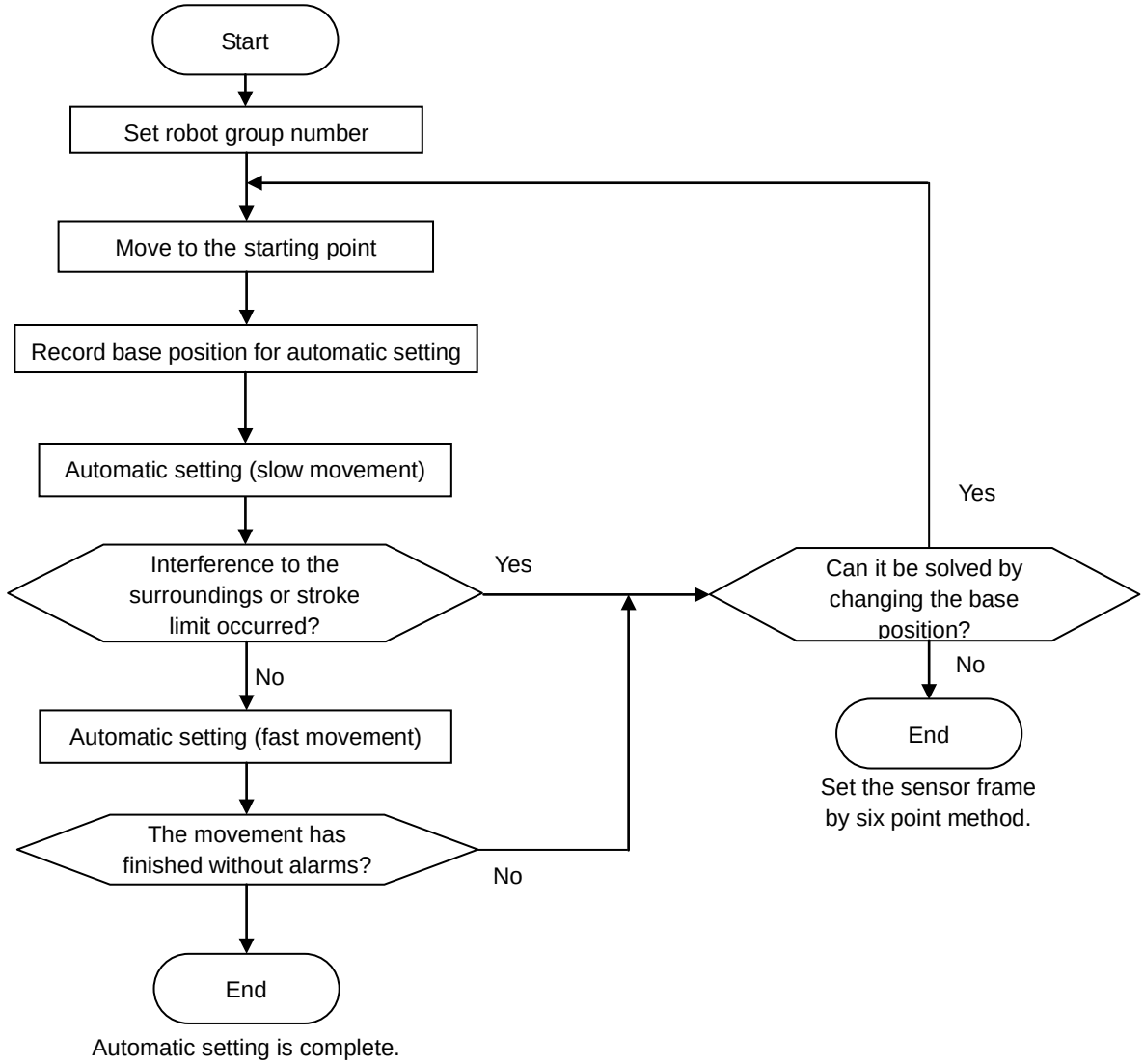
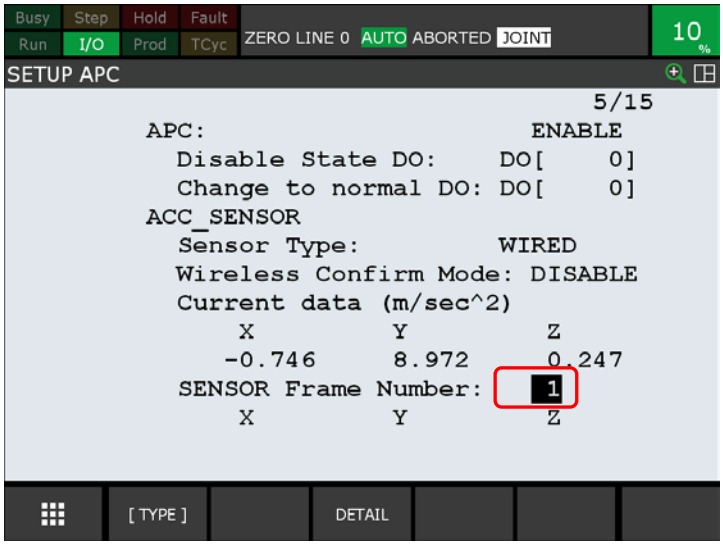
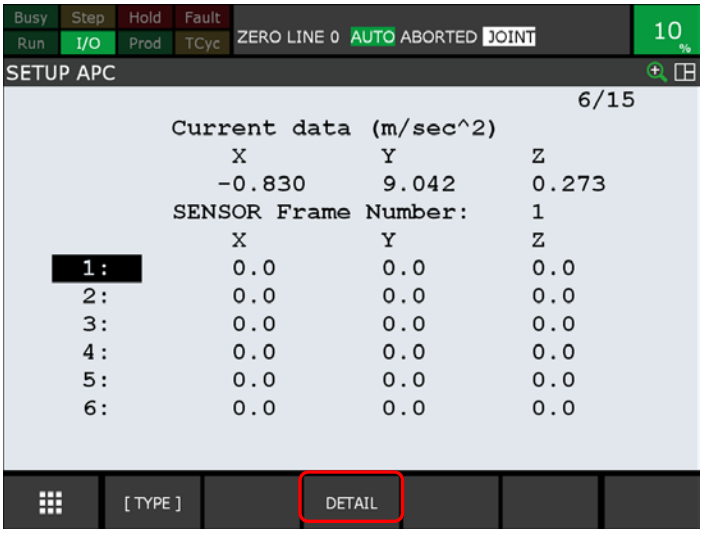


Fig.4.1.2(a) Procedure of automatic setting

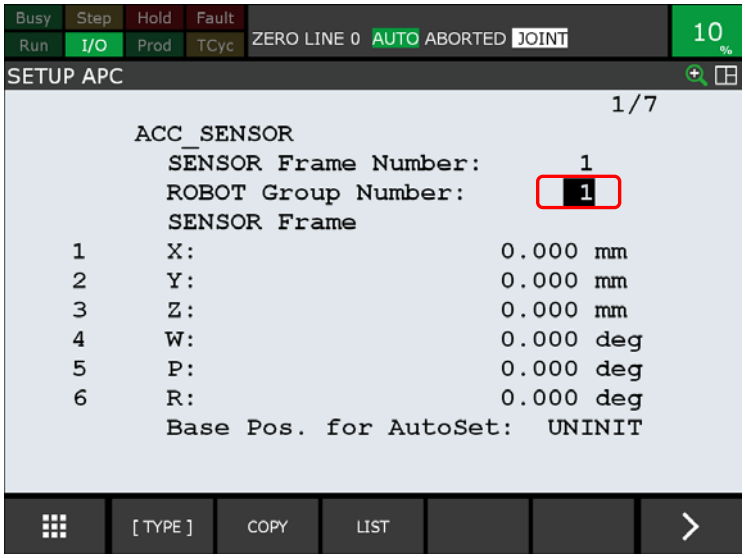
1 [MENU] - [6 SETUP] - [APC] AI Path Control setting screen will be displayed.
2 Please set the sensor frame number to use in the “SENSOR Frame Number” item.



3 After setting the sensor frame number, move the cursor to the desired sensor frame and press the F3[DETAIL] key.



4 Set robot group number in [Robot Group Number] item which accelerometer is attached to.



5 Move the robot to the starting point for automatic setting by using jog operation or executing the TP program.

Base position for automatic setting should be determined based on the following criteria.

A. Do not allow interference to the surroundings during movements for automatic setting.
B. For the accuracy of automatic setting, set the posture which has the moments acting on the robot wrist as small as possible.
C. For the accuracy of automatic setting set the posture so that the flange position is as close to the robot base as possible by setting the angle of J2 and J3 as small as possible.

NOTE
The criterion A is indispensable. The criteria B and C are not indispensable if the alarm does not occur after automatic setting.

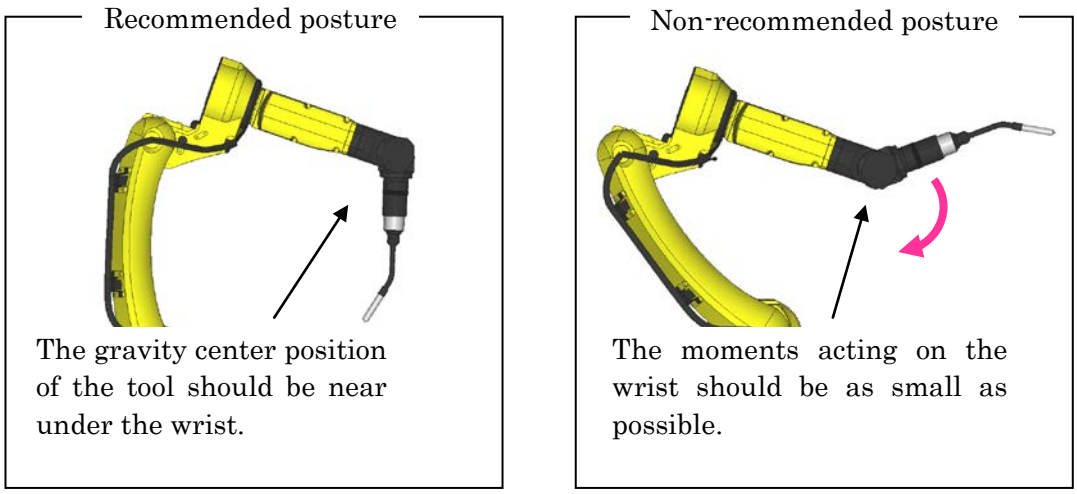


Fig. 4.1.2(b) Example 1 of recommended posture

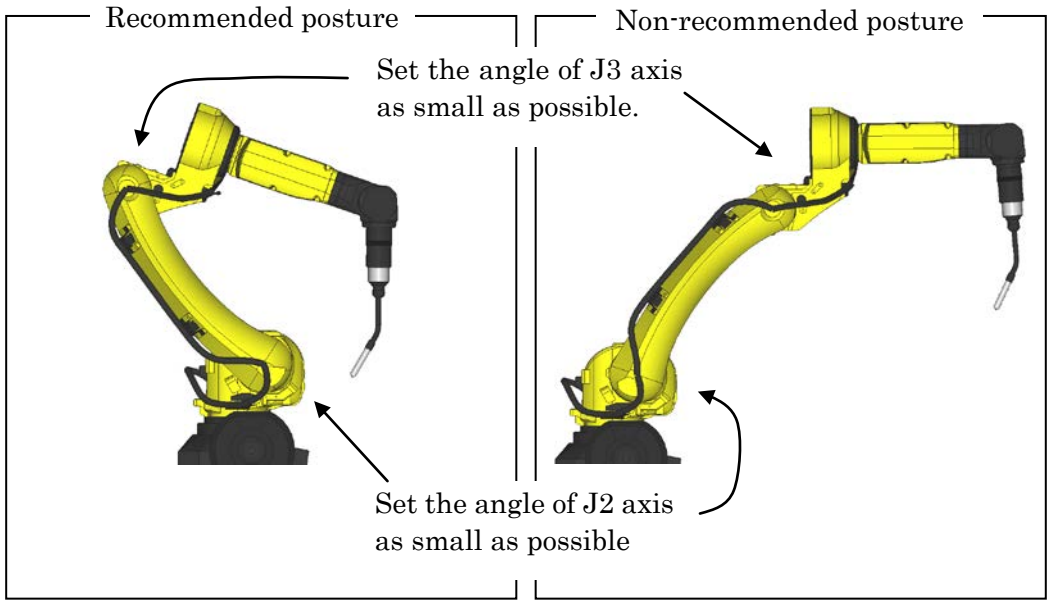
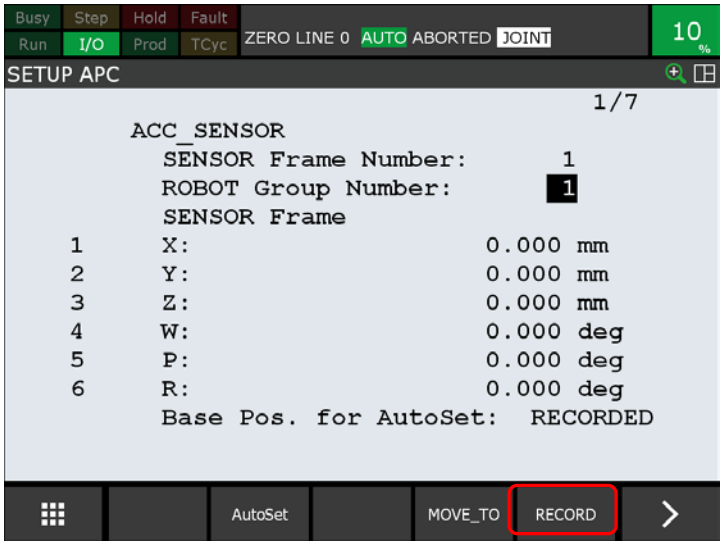


Fig. 4.1.2(c) Example 2 of recommended posture

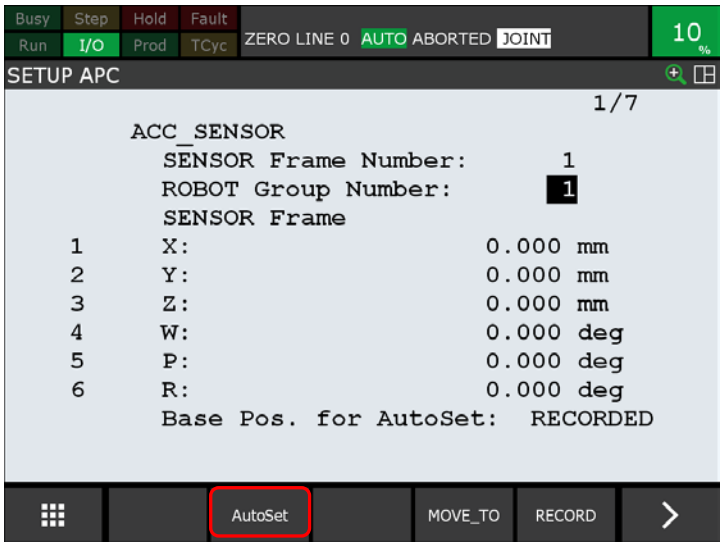
⚠ CAUTION
By setting the above recommended posture, the tool attached to the robot wrist may interfere with the robot arm. Please set close to the recommendation posture within the limits which do not have interference.

6 After moving to the starting position, press the [F->] key so that F5"RECORD" is displayed. Hold down the [SHIFT] key and press F5,"RECORD".



NOTE
If the message "Point Recorded" is not displayed, apply following procedure.
- If the message "Perform mastering" is displayed, perform mastering and retry automatic setting.

7 Check safety of the surroundings. Then reset the alarm and hold down the [SHIFT] key and press F2, "AutoSet".

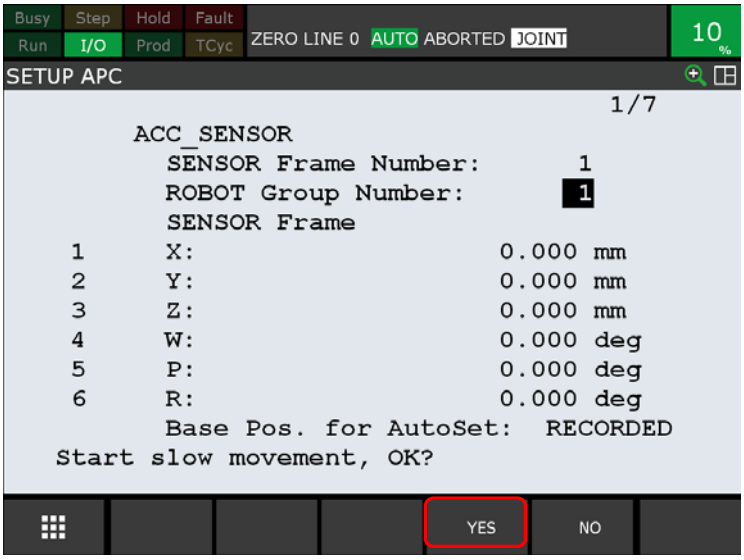


⚠ CAUTION
In T2 mode, the robot stops the movements for automatic setting if you release the [SHIFT] key. In Auto mode, you should press the [HOLD] key or the emergency stop button to stop the movements for automatic setting.

NOTE
If the movements for automatic setting do not start, apply following procedure.

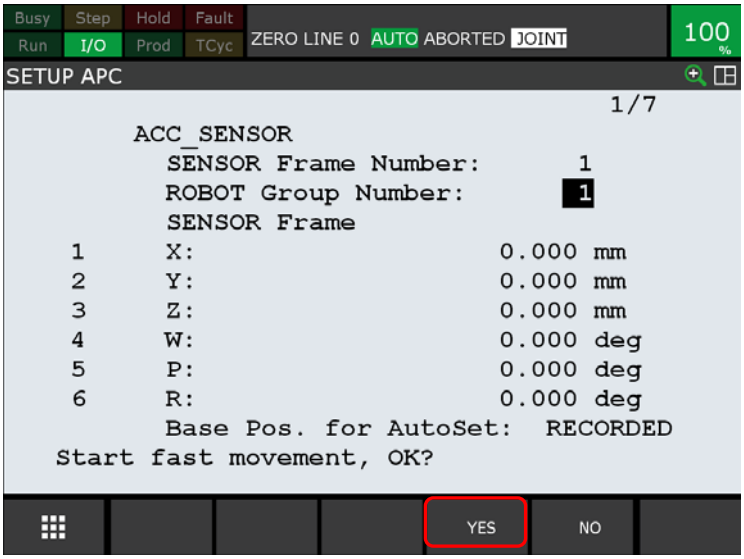
- If the message “This robot is not supported” is displayed, set the sensor frame by six point method.
- If the message “Switch to T2 or AUTO mode” is displayed, switch to T2 or AUTO mode and retry automatic setting.
- If the message “Perform mastering” is displayed, perform mastering and retry automatic setting.
- If MOTN-582 is occurred, correct Active PAYLOAD number or the value of PAYLOAD CENTER and PAYLOAD INERTIA of the active payload number. Then retry automatic setting.
- If the message “Base pos. is uninit. Cannot start” is displayed, teach the base position according to steps 5 and 6 and retry automatic setting.
- If the message “Enable APC” is displayed, enable APC according to Section 5.1 and retry automatic setting.
- If the message “This sensor is not supported” is displayed, verify sensor type according to Section 5.4. If sensor type is incorrect, correct it and retry automatic setting. If sensor type is correct, change sensor type to use and retry automatic setting or set the sensor frame by six point method.

8 Hold down the [SHIFT] key and press F2, “AutoSet”. Then confirmation message to start the slow movements are displayed. Press F4, “YES” to start the movements at 1% override. Press F5, “NO” to abort the movements. If there are no problems such as interference to the surroundings, you can change the override during the movements. Sensor frame is not set by the slow movements.



NOTE
If the alarm “INTP-105 (~LV_AUTOSET,1) Run request failed” is displayed, abort the program by selecting ABORT(ALL) from the function menu. Then retry automatic setting.

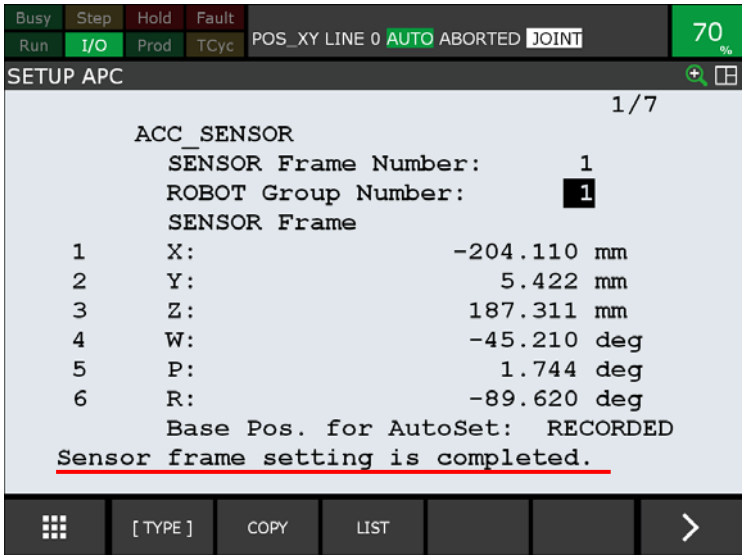
9 After the slow movements has finished, confirmation message to start the fast movements is displayed. If pressing F4, "YES", the program starts the same movements at higher than 30% override. If pressing F5, "NO", the program finishes.



NOTE

1 If the alarm "INTP-105 (~LV_AUTOSET, 1) Run request failed" is displayed, reset the alarm and retry automatic setting.
2 If you change the override during the fast movements, MOTN-584 occurs and the robot stops. Please do not change the override during the fast movements. Reset the alarm and then retry automatic setting.
3 If the alarm "MOTN-556 Wireless sensor timeout" or "MOTN-557 USB receiver removed" is displayed when the fast movements start with the wireless accelerometer, apply the following procedure.
- Reboot the accelerometer.
- Disconnect/Connect the USB receiver.
- Push LED2 reset button (please refer to Fig,3.1.2(b)) to turn off the wireless sensor, then restart sensor again.
- Reboot the controller.

10 After the fast movements have finished, if the accuracy of calculated sensor frame is satisfactory, the result and the message "Sensor frame setting is completed" are displayed. In the case, sensor frame automatic setting function is completed.



NOTE

1 If MOTN-583 occurs after the fast movements, apply following procedure and retry automatic setting.
- Verify whether the accelerometer is fixed firmly to an end-of-arm tool.
- Verify the active payload number.
- Verify the value of gravity center position, and inertia of active payload number.
- Set the base position for automatic setting as close to the recommended posture as possible.

If the problem could not be resolved with these procedures, set the sensor frame by six point method or three point method.
If the message for MOTN-583 includes “ER:1”, preform six point method. (For six point method, please refer to Section 4.2.)
If the message for MOTN-583 includes “ER:2”, set the sensor frame by six point method then input XYZ results into sensor frame. (For the procedure of three point method, please refer to OPERATOR’S MANUAL (Basic Operation)(B-83284EN) Subsection 3.9.1.)

2 If MOTN-581 occurs after the fast movements, apply following procedure and retry automatic setting. If the problem could not be resolved, set the sensor frame by six point method.
- Verify sensor type (wired or wireless) is selected correctly.
- Verify whether the accelerometer is fixed firmly to an end-of-arm tool.

NOTE

3 In the case of communication failure of the wireless accelerometer, INTP-698 occurs. If INTP-698 occurs, apply following procedure and retry automatic setting. If communication fails even after three executions, INTP-699 occurs.

- Put a sensor and a USB receiver as close as possible to each other.
- Set a sensor and a USB receiver with good visibility (such as a USB receiver can be seen from a sensor).
- Avoid setting sensor and USB receiver in the environment as follows.

- Put a sensor in the center of metallic part or enclosed by metal.
- Put the *i*Pendant with USB receiver on a metal such as a controller, or hang on the hook on the controller.
- Put a metal obstacle such as a fence between communication path sensor and a USB receiver.

- Avoid using Wi-Fi communication in 2.4GHz band (especially a large amount of data communication such as watching movie) and microwave near a sensor and a USB receiver.

If the problem could not be resolved, set the sensor frame by six point method.

4.1.3 Limitations

Sensor frame automatic setting function can be used in T2 mode or Auto mode and can't be used in T1 mode.
To use automatic setting function in T2 mode, you should keep holding dead man switch and holding down the [SHIFT] key during the movements.

4.1.4 Setting Menu

Automatic setting function can be executed from following screen.

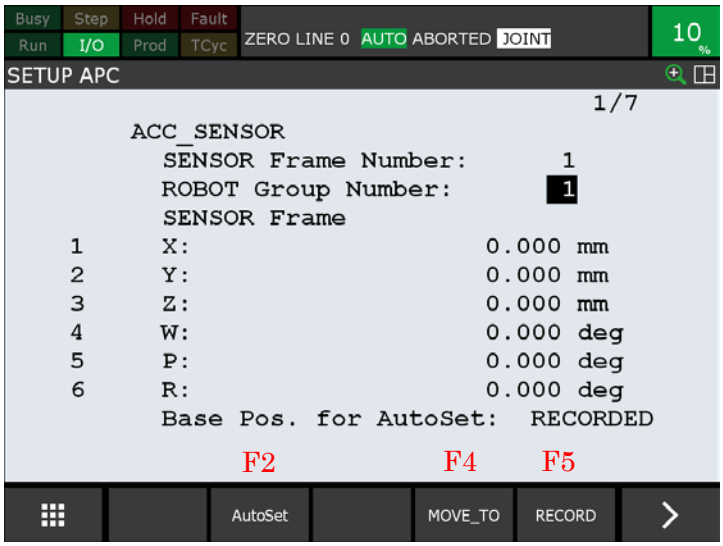


Fig. 4.1.4(a) Setting menu for sensor frame

Press the [F->] key, then following function keys are displayed. Function keys to be used are as follows.

Table 4.1.4(a) Automatic setting function keys

Key	Label	Description
F2	AutoSet	When hold down the [SHIFT] key and press this key, start the movements for automatic setting.
F4	MOVE_TO	When hold down the [SHIFT] key and press this key, move to the base position for automatic setting with joint motion.
F5	RECORD	When hold down the [SHIFT] key and press this key, teach the base position. Then Base Pos. for AutoSet item is turned from UNINIT into RECORDED.

⚠ WARNING
For safety, the above function keys must be pressed together with the [SHIFT] key.

4.1.5 Movements

Automatic setting performs the slow movements to check movements. Then it performs the fast movements to calculate the sensor frame. The slow movements and the fast movements are the same movements but the slow movements are performed at 1% override while the fast movements are performed at higher than 30% override. You can change the override during the slow movements but cannot change the override during the fast movements.

⚠ CAUTION
- The slow movements are used to verify whether there is interference or not by the movements for automatic setting. Therefore set the override to the extent that if interference is about to occur, HOLD stop or emergency stop can be applied before interference occurs.
- If the override is changed during the fast movements, MOTN-584 occurs and the robot stops.

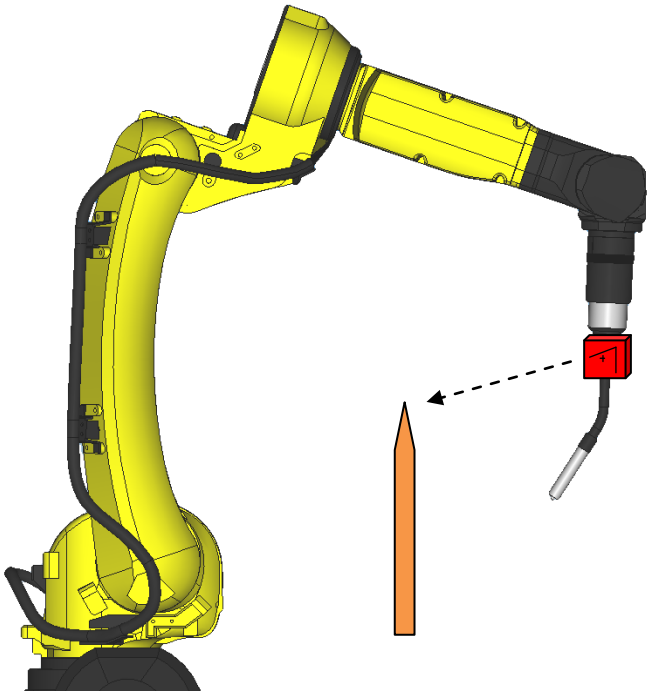
Contents of the slow movements and the fast movements are the following movements in mechanical interface frame with reference to the base position for automatic setting.
1. Reciprocating movements of +/- 100mm in direction of X.
2. Reciprocating movements of +/- 100mm in direction of Y.
3. Reciprocating movements of +/- 100mm in direction of Z.
4. Reciprocating movements of +/- 15deg in direction of W.
5. Reciprocating movements of +/- 15deg in direction of P.
6. Reciprocating movements of +/- 15deg in direction of R.

NOTE
Regardless of the selected tool frame, the movements for automatic setting are with respect to mechanical interface frame.

4.2 SIX POINT METHOD

4.2.1 Overview

Six point method calculates the sensor frame by moving the robot such that the accelerometer touches a sharp instrument with six postures. Set the sensor frame by the marks printed on the accelerometer and the Six Point(XY) method.



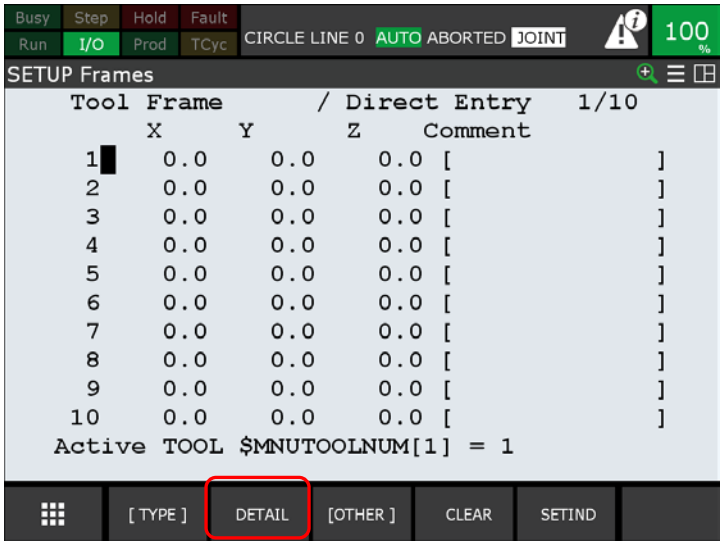
Fig, 4.2.1(a) Six point method

4.2.2 Procedure

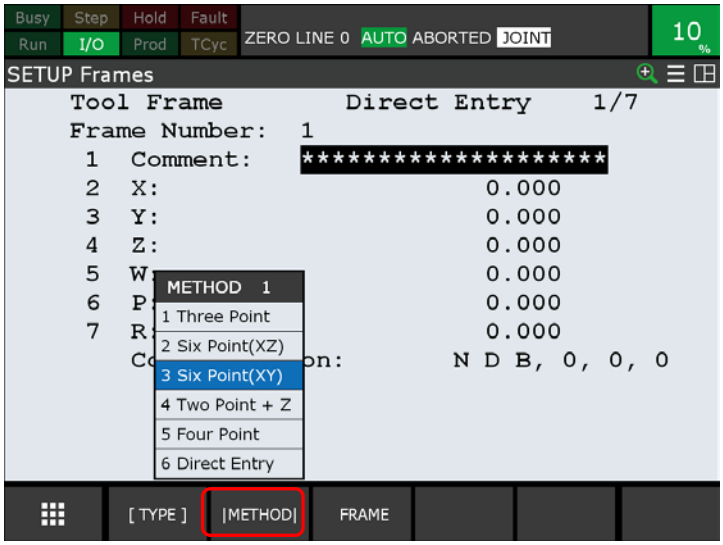
Set the sensor frame by six point method according to the following procedure.

Procedure 4-2 Setting by six point method

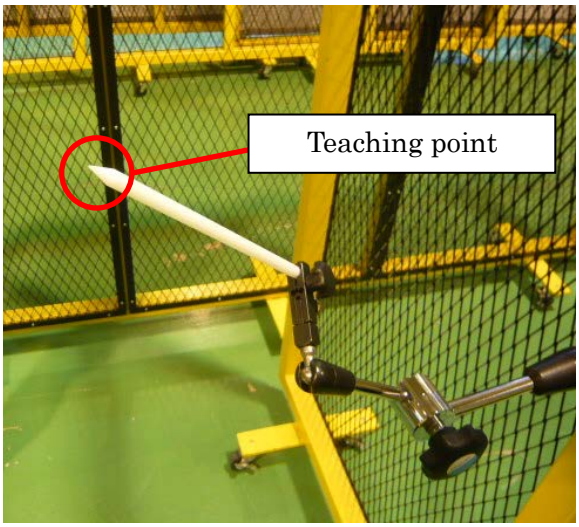
1 [MENU] - [6 SETUP] - [Frames] Frames setting screen will be displayed.
2 Please move the cursor to the line of the number of the tool frame to be used and press the F2[DETAIL] key.



3 Press the F2 [METHOD] key and select “Six Point(XY)”.



4 Prepare a reference point to be used in the six point method. Use a pointed object and fix its tip as the teaching point.



5 According to numbers on the sensor label, instruct the “+” mark in the surface of the accelerometer as a reference point. Move robot so that a teaching point comes to “+” on the sensor label like figure 4.2.2(a). Hold down the [SHIFT] key and press F5 “RECORD”. Approach point comes to be recorded. Similarly, for approach point 2 and approach point 3, change a posture of the Robot, too and instruct it.

6 Use the “+” mark printed on the accelerometer near “4” for Orient Origin Point.
Use the “+” mark printed on the accelerometer near “5” for X Direction Point.
Use the “+” mark printed on the accelerometer near “6” for Y Direction Point.

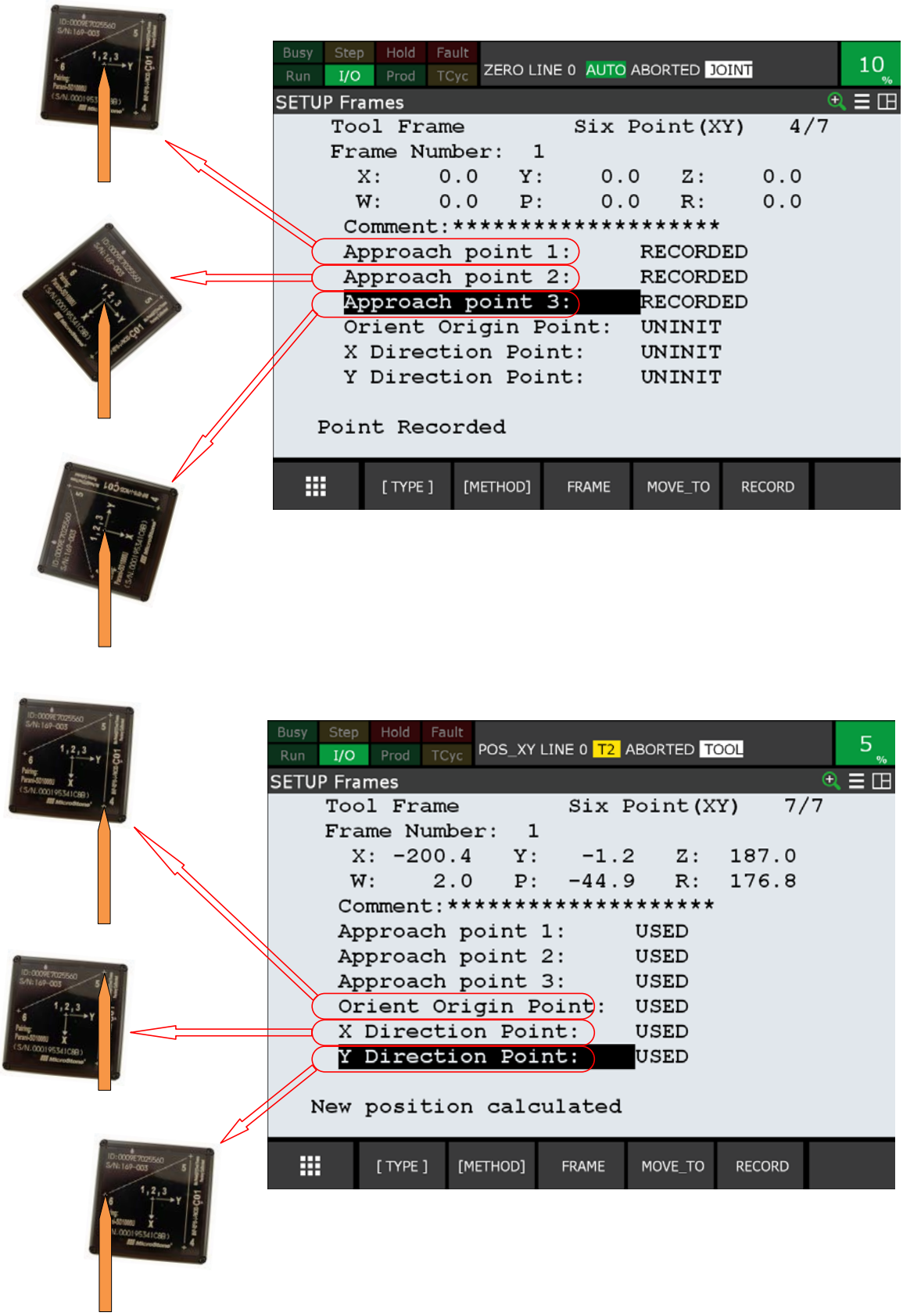
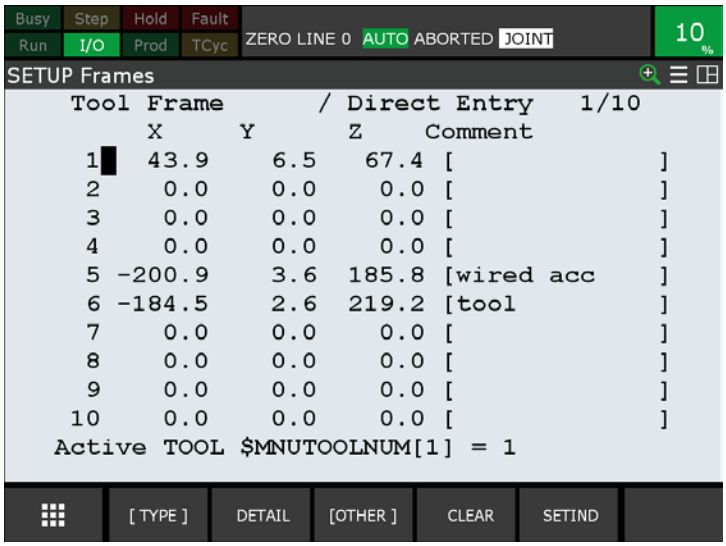


Fig. 4.2.2(a) Corresponding points between the top of the sensor and six point(XY) frame

7 When all positions are stored, the sensor frame is calculated.

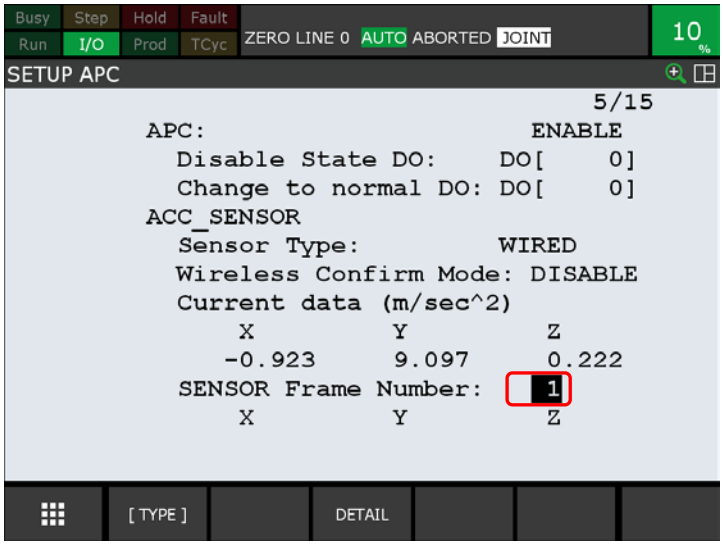
8 Make sure that the Utool frame is correct. Jog the robot in directions X, Y, and Z of the Utool frame, the robot move in direction of the frame that is printed on the accelerometer.



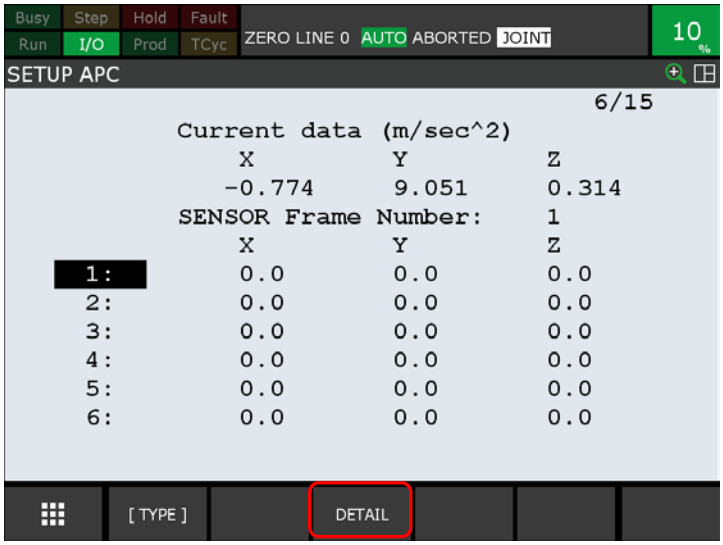
9 For example, when you jog the robot in direction X of the Utool frame, the robot move in direction of the X arrow on the accelerometer. Also check direction of rotation W, P, and R rotate around the origin point on the accelerometer.

> ⚠ **WARNING**
> Make absolutely sure that the sensor frame is correct. The incorrect sensor frame may cause the robot to move in an unexpected way. This is very dangerous.

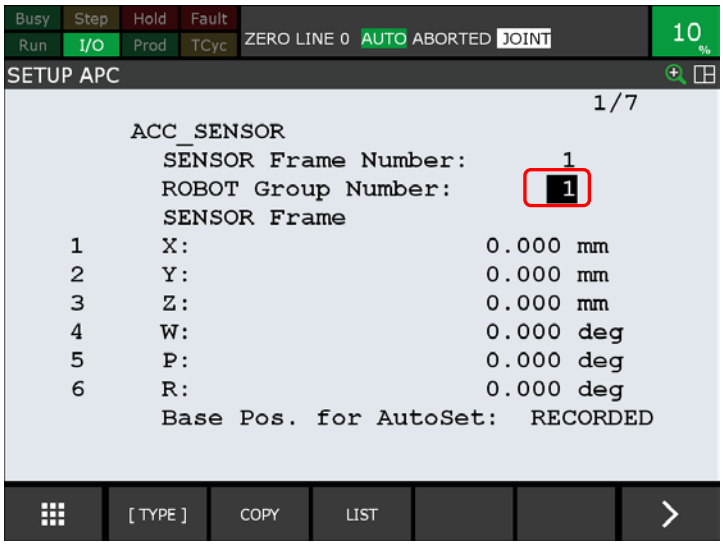
10 [MENU] – [6 SETUP] – [APC] AI Path Control setting screen will be displayed.
11 Please set the sensor frame number to use in the “SENSOR Frame Number” item.



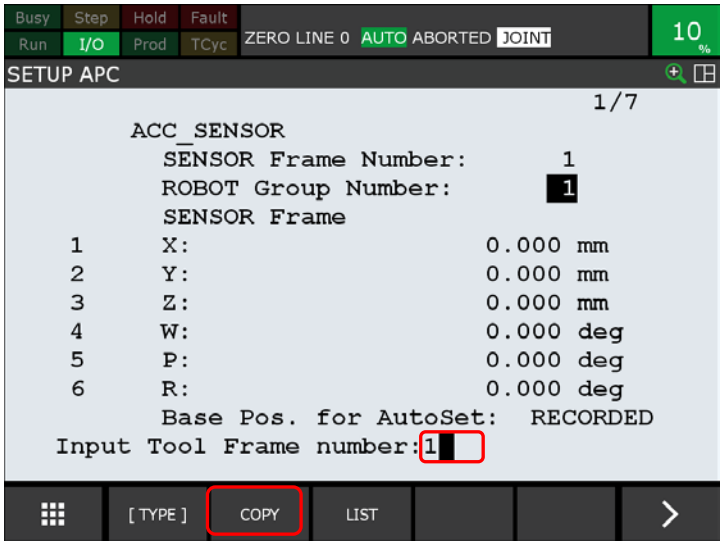
12 After setting the sensor frame number, move the cursor to the desired sensor frame and press the F3[DETAIL] key.



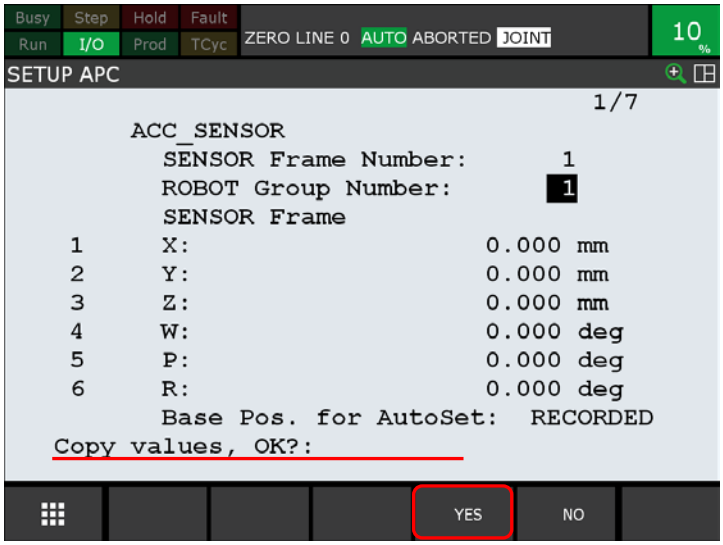
13 Set robot group number in [Robot Group Number] item which accelerometer is attached to.



14 Press F2 “Copy” then message “Input Tool Frame number” is displayed. Input Utool No. from which you would like to copy. (In multi-arm system, please also input robot group number after input Utool number.)



15 After input Utool No., message “Copy values, OK?” is displayed. If you would like to copy values, press F4, “YES”. Then sensor frame is copied from Utool frame.



16 Make sure that the sensor frame is correctly copied from Utool frame. After this, setting of sensor frame is complete and the Utool frame can be used for other purposes.

4.2.3 Setting Menu

Six Point Method can be executed from following screen.

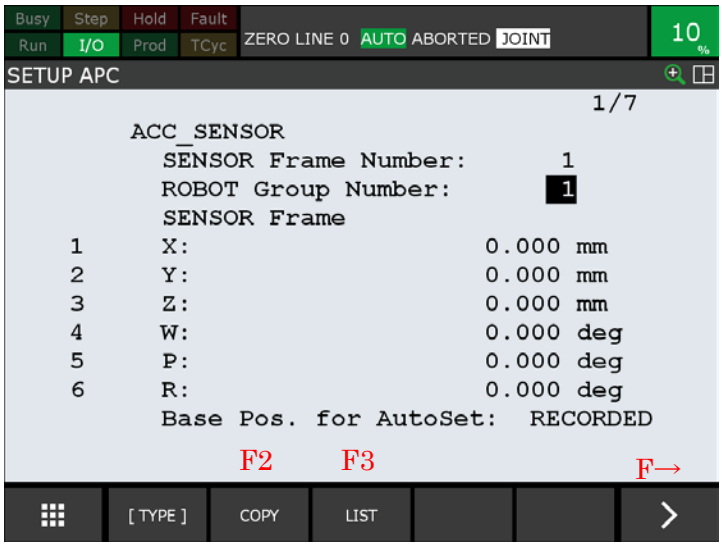


Fig. 4.2.3(a) Setting menu for sensor frame

Press the [F->] key, then following function keys are displayed. Function keys to be used are as follows.

Table 4.2.3(a) Function keys of Six point method

Key	Label	Description
F2	COPY	Copy from Utool frame.
F3	LIST	Return to the setting screen list.

4.3 DIRECT LIST METHOD

4.3.1 Overview

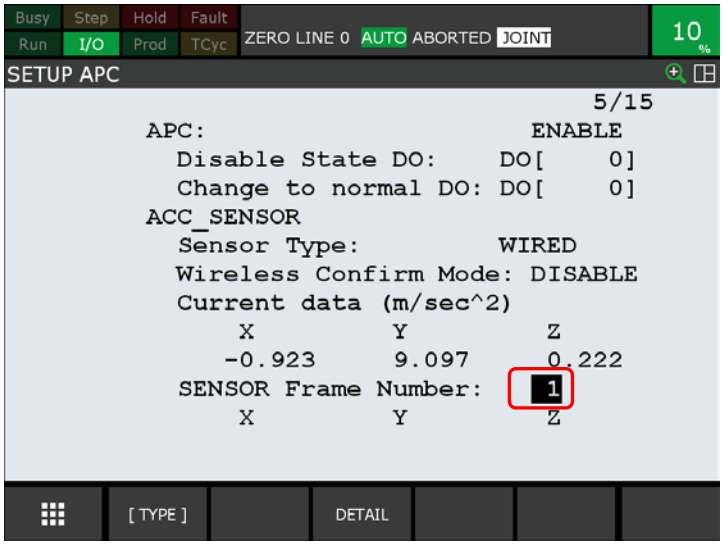
Direct list method is the way to directly enter the values of X, Y, Z, W, P, and R in the sensor frame. If you know the sensor frame of a different robot on which the accelerometer is attached on the same place, you can enter these values directly.

4.3.2 Procedure

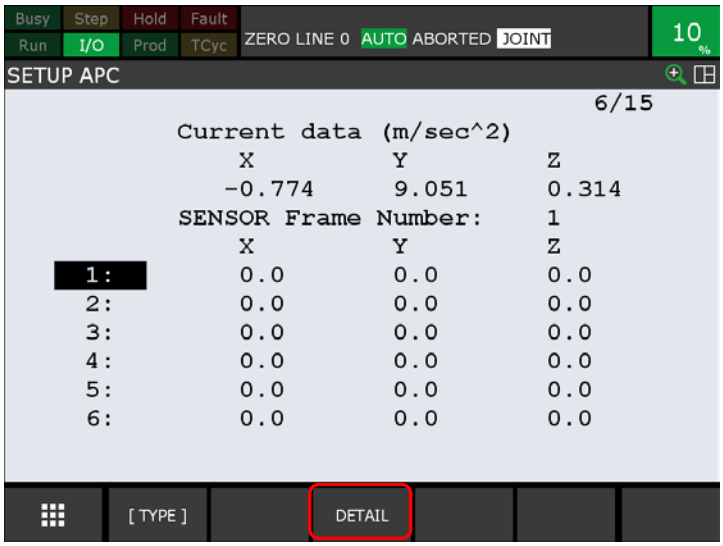
Set the sensor frame by direct list method according to the following procedure.

Procedure 4-3 Setting by direct list method

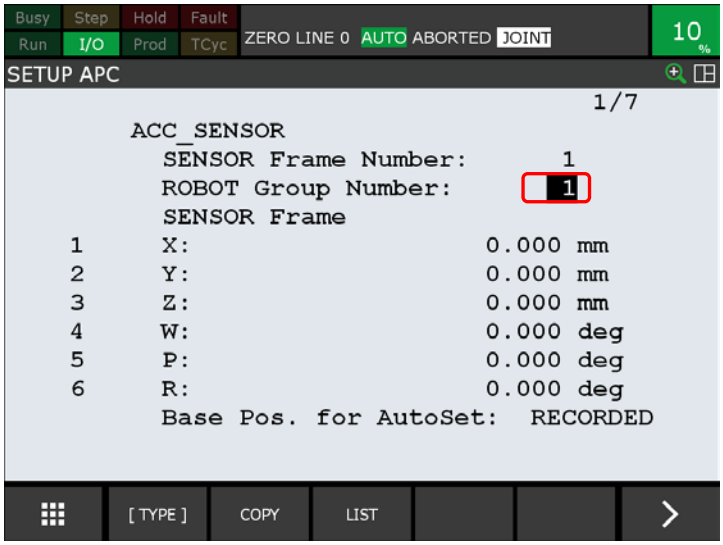
1 [MENU] – [6 SETUP] – [APC] AI Path Control setting screen will be displayed.
2 Please set the sensor frame number to use in the “SENSOR Frame Number” item.



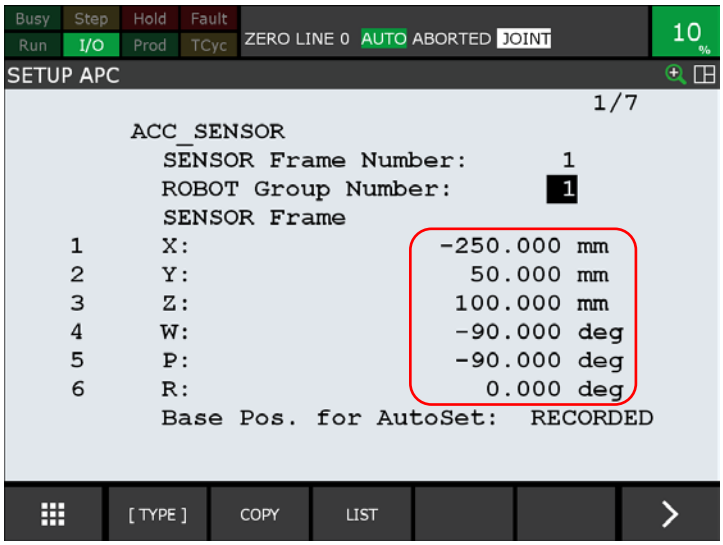
3 After setting the sensor frame number, move the cursor to the desired sensor frame and press the F3[DETAIL] key.



4 Set robot group number in [Robot Group Number] item which accelerometer is attached to.



5 Enter the values of X, Y, Z, W, P, and R which are relative to the robot faceplate frame.



6 Setting of sensor frame is complete.

5 SETTING APC

This chapter explains how to set up APC. APC muse be configured in the setup menu.
The following procedure is used to set up APC.

Procedure5-1 Displaying APC setup menu

1 Press the [MENU] key.
2 Select [6 SETUP].
3 Press F1, [TYPE] to display the screen, change menu, and select “APC”.
4 The following screen will be displayed.

The following items are explained in this chapter.

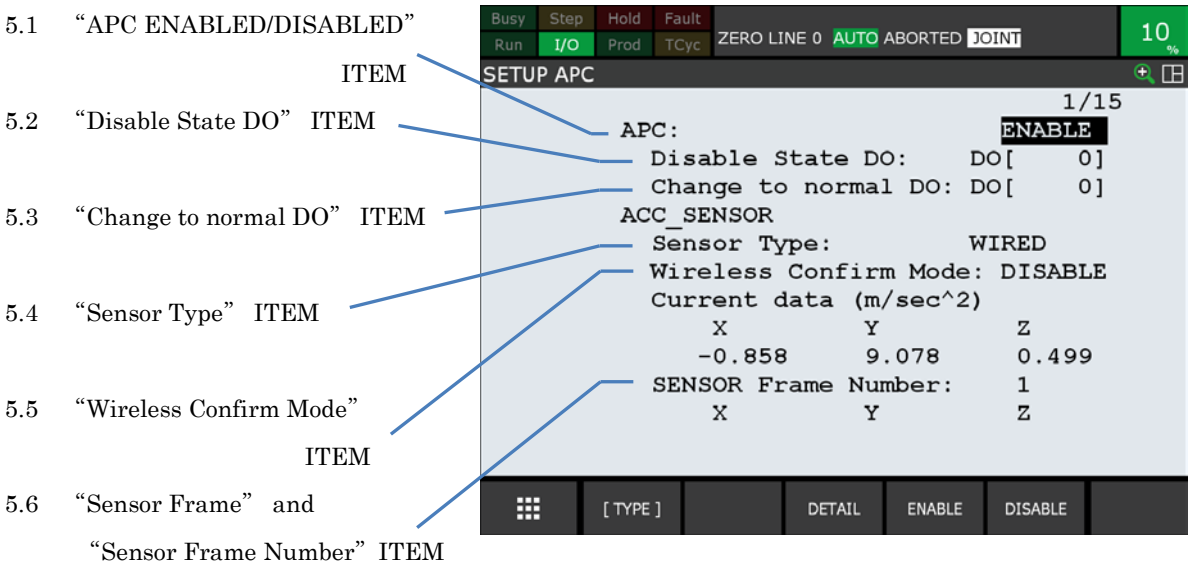


Fig. 5(a) APC Setting Screen

5.1 “APC ENABLED/DISABLED” ITEM

In the setup menu, APC status can be set to enabled/disabled. Initial setting for this item is “ENABLED”.
When this item is set to “ENABLED” and a TP program with APC instructions is executed, learning motion or playback motion is performed according to the learning percentage.
When this item is set to “DISABLED” and a TP program with APC instructions is executed, normal motion is performed with learning instructions disabled.

NOTE
In the following cases, APC cannot be enabled.
- Available memory size in D-RAM is less than that of the required memory for APC. Please confirm if MOTN-527or MOTN-528 is issued, when power is turned on. Please refer to Appendix A for MOTN-527 and MOTN-528 descriptions.
- The system configuration is not correct for an APC system. Please refer to Section 3.2 for supported system configurations. Please change the system configuration to support APC.

NOTE
When APC is disabled, the entire APC data in the data menu (Please refer to Chapter 6) is disabled.
In order to enable/disable APC data individually, enable APC status in the APC setup menu and select ENABLE/DISABLE for each data ID. (Please refer to Procedure 6-2-1)

5.2 "DISABLE STATE DO" ITEM

When APC data is disabled (Please refer to Subsection 6.2.1) in the data menu, learning motion or playback motion associated with the APC data also becomes disabled and normal motion is performed. In that case, if "Disable state DO" item is set to the DO number, the DO signal is set ON. "Disable state DO" output is ON when any of the APC data is disabled. When all APC data are enabled, "disable state DO" becomes OFF.
To use Disable state DO items, please follow these instructions:

- Move the cursor to the Disable State DO and enter the desired ID number.
- The type of the output signal is "DO".

5.3 "CHANGE TO NORMAL DO" ITEM

In playback mode, when a TP program with APC instructions is executed after touch-up is done, robot motion becomes normal motion in the modified motion lines. In that case, if "Change to normal DO" item is set to the DO number, the DO signal is set ON. When APC_START is executed, the DO signal turns OFF.
This item is usually invalid.
To use Change to normal DO items, please follow these instructions:

- Move the cursor to the Disable State DO and enter the desired ID number.
- The type of the output signal is "DO".

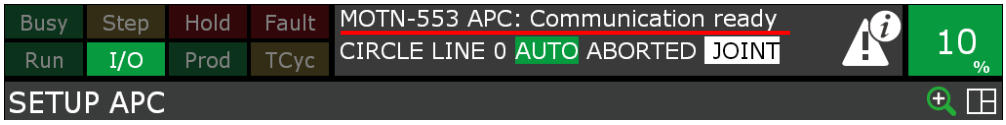
5.4 "SENSOR TYPE" ITEM

The setting of the sensor type can be changed by the following item.

- When this item is set to "WIRED", you can use a wired sensor.
- When this item is set to "WIRELESS" you can use a wireless sensor.

NOTE

- If "APC ENABLED/DISABLED" item is "ENABLED" and "SENSOR TYPE" item is "WIRED", the current value from accelerometer is displayed in the "Current data" item.
- If "APC ENABLED/DISABLED" item is "ENABLED" and "SENSOR TYPE" item is "WIRELESS", the following message is displayed after readying communication between the wireless accelerometer and the USB receiver.



- The current value from the accelerometer is displayed in the "Current data" item only when "WIRELESS CONFIRM MODE" item is "ENABLED".

5.5 "WIRELESS CONFIRM MODE" ITEM

It is the item to confirm whether communication between the sensor and controller is ready. When this item is set to "ENABLED" and wireless sensor can communicate, sensor data is displayed in "Current data". This item cannot be selected when "WIRED" is selected in "SENSOR TYPE" item.

NOTE

As for the connection of the wireless sensor, please refer to Subsection 3.1.2.
If the alarm "MOTN-553 Communication ready" doesn't appear over 30 seconds have passed since the wireless accelerometer is on and connect the USB receiver to the teach pendant, or if the alarm "MOTN-556 Wireless sensor timeout" or "MOTN-557 USB receiver removed" is displayed when communication start, apply the following procedure:

- Reboot the accelerometer.
- Disconnect/Connect the USB receiver.
- Push LED2 reset button (please refer to Fig.3.1.2(b)) to turn off the wireless sensor, then restart sensor again.
- Reboot the controller.

APC can't be used with wireless confirm mode enabled. Please change this item to "DISABLED" when APC instruction is executed.

5.6 "SENSOR FRAME AND SENSOR FRAME NUMBER" ITEM

Set up the sensor frame (sensor position and orientation) after the accelerometer is connected.
As for the setup the sensor frame, please refer to Chapter 4.

6 APC DATA

This chapter explains the overview of the APC data and the operation of the APC data menu.
The following procedure is used to display APC data menu.

Procedure6-1 Displaying APC data menu

1 Press the [DATA] key.
2 Press F11, [TYPE] to display screen change menu, and select “APC”.
3 The APC data menu appears.

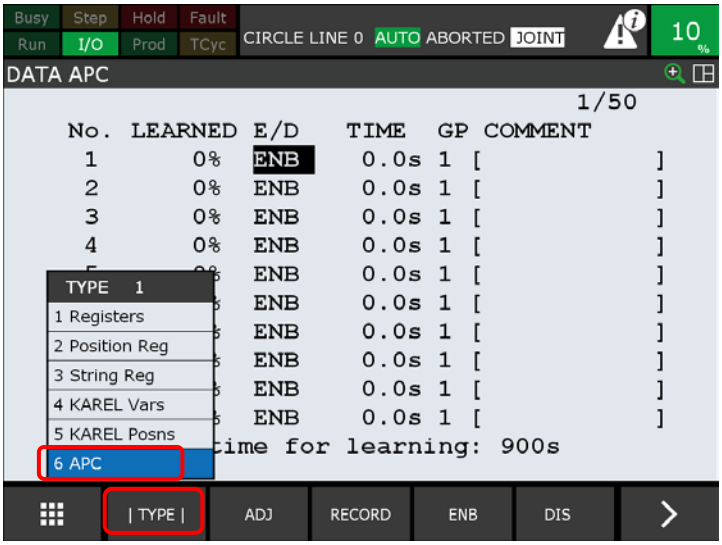


Fig. 6(a) APC data menu

6.1 APC DATA MENU

The following items are explained in this chapter.

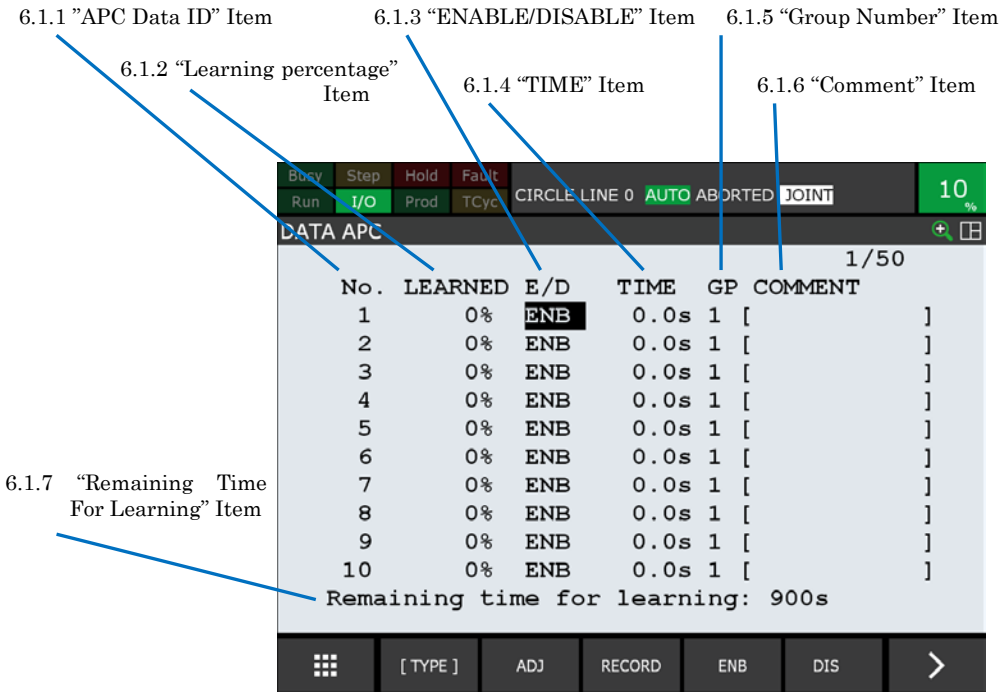


Fig 6.1(a) APC data items

6.1.1 APC Data ID

The ID in APC_START corresponds to the APC data ID in the APC data menu. For example, “APC_START[1] Learned 0%” status is shown in that of APC data No.1 in the APC data menu.

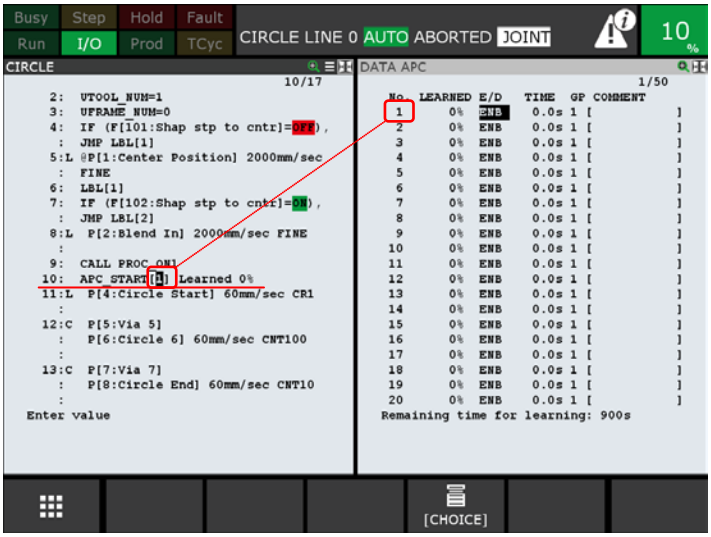


Fig 6.1.1(a) ID in APC data

6.1.2 Learning Percentage

This is the parameter for learning percentage, whose range is 0 to 100%. 100% means learning process is completed.

6.1.3 Enable / Disable

In this item, APC status can be set to enable/disable. When this item is set to “DISABLED” and TP program with APC instructions is executed, normal motion is performed with learning instructions disabled. When APC is disabled in APC setup menu, the entire APC data in the data menu is disabled. (Please refer to Section 5.1 for a detail.)

6.1.4 Time

The execution time of the learning instruction from APC_START to APC_END is displayed. The execution time of motion lines between APC instructions must be less than 180 seconds.

6.1.5 Group Number

In multi-arm system, the group number of APC data must be the same as the robot which is performing learning motion. If the group number of APC data is wrong, “MOTN-548 APC: Group number mismatch” is issued and the robot cannot start to learn.

NOTE
When the group number is changed, the learning percentage becomes 0% and re-learning is necessary.

6.1.6 Comment

Comments can be added to APC data ID in the APC data menu.
Follow the steps below to add a comment.

Procedure6-1-6 Procedure to change a comment

1 Go to the APC data menu. Move the cursor to the comment item in the APC data.
2 Press the [ENTER] key.
3 Words or letters can be used for the comment.
4 After writing comments in the blank, press the [ENTER] key.

6.1.7 Remaining Time for Learning

Remaining time available for all of APC data ID is displayed. The total learning time that can be saved for all APC data ID is within 900 seconds.

6.2 METHOD OF OPERATION

6.2.1 Enable / Disable

The switching procedure of enable/disable APC data ID is explained.

Procedure6-2-1 Re-enable APC data

1 Go to the APC data menu. Move the cursor to enable/disable item.
2 Press the [F->] key, then F4 [ENABLE] and F5 [DISABLE] keys are displayed.
3 Please press F4 [ENABLE] to enable APC data or press F5 [DISABLE] to disable APC data.

6.2.2 Adjustment

Additional learning will be performed on the 100% achieved APC data ID.
APC data is generated when APC instruction is finished after executing TP programs with APC instructions iterative.
Normally, path deviation from robot motion is reduced after learning is complete. However, sometimes the path deviation cannot be suppressed enough because more iterations of learning are needed. Then, it is necessary to repeat APC learning more to realize better performance.
Follow the steps below to adjust.

Procedure 6-2-2 Procedure for adjustment

1 Go to the APC data menu. Move the cursor to the APC data.
2 Press the [F->] key, then F2 [ADJ] key is displayed.
3 Press F2 [ADJ]. Press F4 [YES] to adjust, or press F5 [NO] to cancel.
4 Learning percentage becomes less than 100% and learning iteration can be executed more 3 times.

6.2.3 Record

The APC data in D-RAM is saved as APC data file (apc***.bin) in F-ROM. Please refer to Chapter 8 for a detailed description of stored APC data.

NOTE
When learning is complete, the learning percentage becomes 100%, and APC data in D-RAM is automatically saved in F-ROM when APC_END is executed. Afterwards, when a backup is performed, the APC data is saved in the external memory device.
However, the APC data is not saved in F-ROM when APC_END is executed during learning mode, so the APC data is not saved in the external memory device when backup is performed. If it is necessary to save the APC data during learning mode, press the [RECORD] key to save APC data in F-ROM and perform backup.

Follow the steps below to record.

Procedure 6-2-3 Procedure for record APC data

1 Move the cursor to the desired APC data.
2 Press the [F->] key, then F3 [RECORD] key is displayed.
3 Press F3 [RECORD]. Press F4 [YES] to adjust, or press F5 [NO] to cancel.
4 APC data is recorded to F-ROM.

6.2.4 Finish

The APC data ID in the middle of learning (learning percentage: 1% to 99%) become in the learning completion state.
The number of learnings is reduced from the default number.

Follow the steps below to finish learning.

Procedure 6-2-4 Procedure for finish APC learning

1 Move the cursor to the desired APC data (learning percentage: 1% to 99%).
2 Press the [F->] key, then F1 [FINISH] key is displayed.

3 Press F1 [FINISH]. Press F4 [YES] to finish, or press F5 [NO] to cancel.
4 Learning percentage of APC data ID become 100%.

6.2.5 Save / Load

APC data files in F-ROM are stored in the designated external memory device.
APC data file in the external memory device are loaded into F-ROM.

NOTE
The load operation copies APC data into F-ROM from the designated external memory device. However, APC data must be in D-RAM to be used for learned motion. Please cycle power to copy APC data from F-ROM to D-RAM after the load operation.

Follow the steps below to save/load APC data.

Procedure 6-2-5 Procedure for saving and loading APC data

1 Move the cursor to the desired APC data.
2 Press the [F->] key, then F2 [SAVE] and F3 [LOAD] keys are displayed.
3 When press the F2 [SAVE] key, APC data files in F-ROM are stored in the designated external memory device.
4 When press the F3 [LOAD] key, APC data file in the external memory device are loaded into F-ROM.
5 Cycle power.

6.2.6 Delete

The APC data being learned or completed is deleted. The learning percentage will be 0% if the APC data is erased.
Follow the steps below to delete.

Procedure 6-2-6 Procedure for deleting APC data

1 Move the cursor to the APC data to delete.
2 Press the [F->] key, then F4 [DELETE] keys are displayed.
3 Press F4 [DELETE]. Press F4 [YES] to delete the data or F5 [NO] to keep the data.
4 The APC data is deleted.

7 PROGRAM EXECUTION

This chapter explains how to teach, execute, and touch-up TP programs with APC instructions.

7.1 OVERVIEW

The flow chart (shown in Fig. 7.1(a)) explains the process flow for teaching, executing (learning motion and playback motion), and touch-up of TP programs.

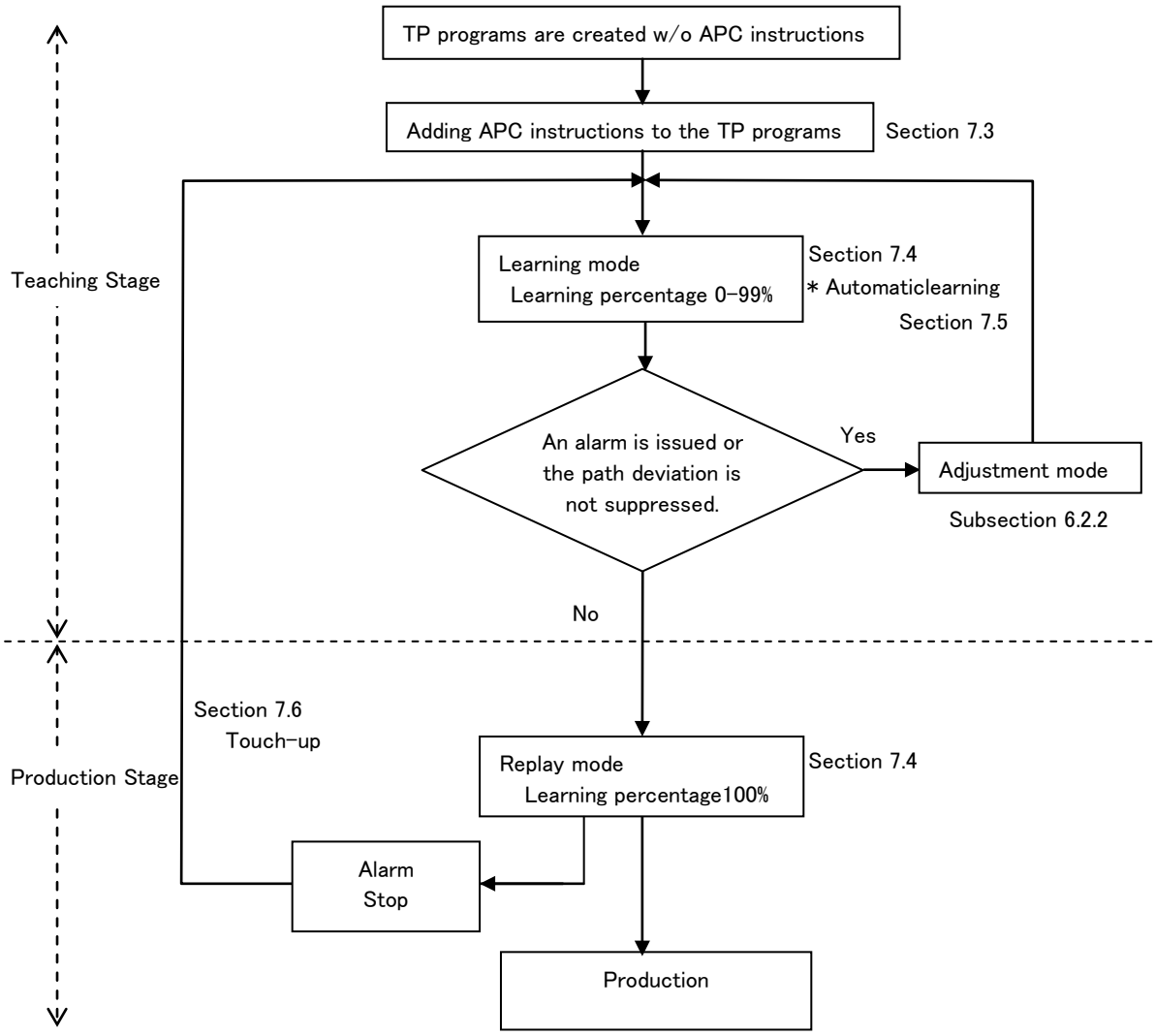


Fig. 7.1(a) Teaching, Execution, and Touch-up TP programs with APC instructions

7.2 LIMITATIONS

One APC instruction has limitations to the size of APC data stored in the memory as follows.

- The number of motion lines between APC instructions must be less than 1000.
- The execution time of motion lines between APC instructions must be less than 180 seconds.
- Each APC "Block" from (CNT0/FINE to CNT0/FINE) cannot exceed 15sec of motion.

When the execution time is over the limitation, the alarm MOTN-524 "APC: Full memory(M%d, %s, L%d,S%x)" or MOTN-542 "APC: Full memory(M%d,S%x)" or MOTN-532 "APC: Internal error 2(M%d, Id%d)" is issued. Please correct this issue in the following ways.

- Reduce the number of motion lines or logic commands between APC instructions.
- Break up the motion lines in one APC start/end block into the motion lines in two or more APC start/end blocks.

The following functions are not compatible with APC:

- APC_START command cannot be used between APC start/end instructions. When APC instructions were executed with APC_START command between APC start/end instructions, alarm "INTP-725 APC: APC_START in block" would occur.
- If override is under 100%, robot motion is normal motion.
- The total execution time of motion lines between APC instructions must be less than 900 seconds or less in all APC data.

7.3 APC INSTRUCTIONS

There are two APC instructions, APC_START and APC_END. These instructions apply the APC algorithm to motion lines between APC_START and APC_END. In order to select these instructions in the TP editor, press [INST] and select APC. These instructions menu for selecting APC_START and APC_END will appear.
Do not delete APC instructions after the learning process is completed. Also APC status needs to be enabled.
The following procedure is used to add APC instruction.

Procedure7-3 Generating and Executing TP programs with APC instructions

1 In the program select menu, move the cursor to a TP program and select it. The editor screen appears.
2 Move the cursor to the line to add an APC instruction.
3 Press F1 key, "[INST]" and a menu for instructions appear. Select APC in the menu.
4 The APC instruction menu appears. "APC_START" and "APC_END" can be selected.
5 Select APC_START or APC_END, and the APC instruction is added to the program line.

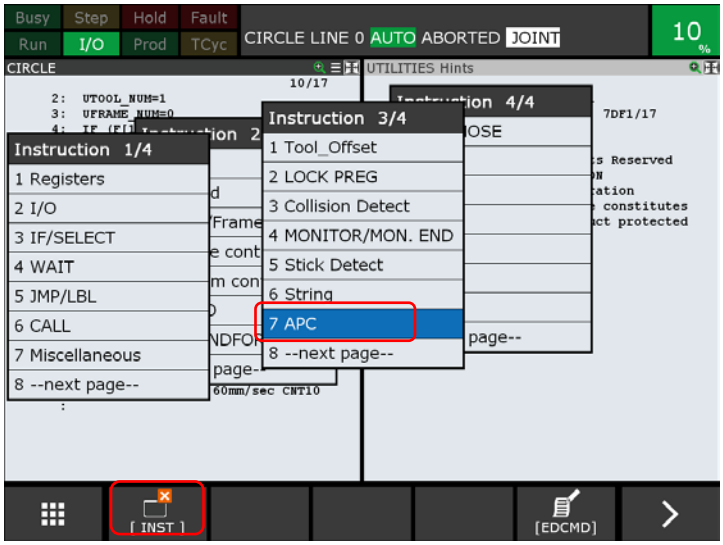


Fig. 7.3(a) Generating and Executing TP programs with APC instructions

NOTE
In the case that main program starts subprogram as a task by using the “RUN” instruction, subprogram cannot perform learning motion if APC instructions are only taught in main program. If the motion lines in subprogram are expected to perform learning motion, APC instructions must be added in subprogram. However, when using the “CALL” instruction, adding APC instructions only in main program is enough to perform learning of the subprogram.

7.3.1 APC _START

The APC_START command is displayed in TP programs as follows:

APC_START[x] Learned y%

APC_START starts learning mode or playback mode.
x is the data ID number. Select a number from 1-50.
y is learning percentage. 100% means the learning process is complete.
In the learning mode, the data measured by accelerometer and other motion data is recorded in memory.
In playback mode, the APC data is applied to the motion lines.

NOTE
Please instruct the termination types of the motion line in CNT0/FINE before APC_START.
Please don’t add wait instruction while CNT.

7.3.2 APC _END

The APC_END command is displayed in TP programs as follows:

APC_END

APC_END stops the learning mode or playback mode.
In the learning mode, motion data collection stops, and APC data is generated based on this recorded motion data. When the learning percentage becomes 100%, APC data is copied from D-RAM to F-ROM. (NOTE: Due to the intensive computation, it may take a minute to finish the APC_END command during learning.) As for the relationship between APC data memory device, please refer to Chapter 8.
APC data is applied to the motion lines in the playback mode without collecting motion data or updating APC data.

7.4 TP PROGRAM CREATION AND EXECUTION

Two modes of APC instructions are defined according to learning percentage:

- Learning mode (When learning percentage is 0-99%)
- Playback mode (When learning percentage is 100%)

In the learning mode, when APC_START is executed with learning percentage of 0%, the data measured by accelerometer and other motion data are recorded in memory up to APC_END. APC data is generated at APC_END.
When APC_START is executed with learning percentage of 1-99%, APC data from the previous iteration is applied to the motion, and the data measured by accelerometer and other motion data is recorded in the memory up to APC_END. APC data is regenerated at APC_END.
As the iteration number of TP program increases, the learning percentage increases. When learning percentage reaches 100%, the learning process is complete.
If the termination types of the aircut motion are CNT0/FINE, after the motion APC wait for a short while and record the data. So in the learning mode cycle time might be slightly longer. This wait is not executed in the playback mode.

NOTE
Learning motion and playback motion are performed in T2 mode or Auto mode, at 100% override when APC status and schedule is set to enable. Otherwise, learning motion and playback motion is not performed.

APC setup conditions

- Accelerometer and other hardware should be installed correctly. (Please refer to Chapter 3)
- The sensor frame and other necessary software settings for APC should be set up correctly.

NOTE
1 Confirm if the necessary hardware and software for APC are set up correctly.
2 If the alarm “MOTN-556 Wireless sensor timeout” or “MOTN-557 USB receiver removed” is displayed when communication start, apply the following procedure:
- Reboot the accelerometer.
- Disconnect/Connect the USB receiver.
- Push LED2 reset button (please refer to Fig. 3.1.2(b)) to turn off the wireless sensor, then restart sensor again.
- Reboot the controller.

The following procedure is used to create TP programs with APC instructions.

Procedure7-4 Creating and Executing TP programs with APC instructions

1 Create a TP program.
2 Insert APC_START just before motion lines to be learned, as shown in Fig. 7.4(a).
3 Enter data ID of APC data at * in “APC_START[*] Learned 0%”.
4 Insert APC_END just after motion lines to be learned, as shown in Fig, 7.4(a).
5 Start the TP program and repeat running until the learning percentage becomes 100%.

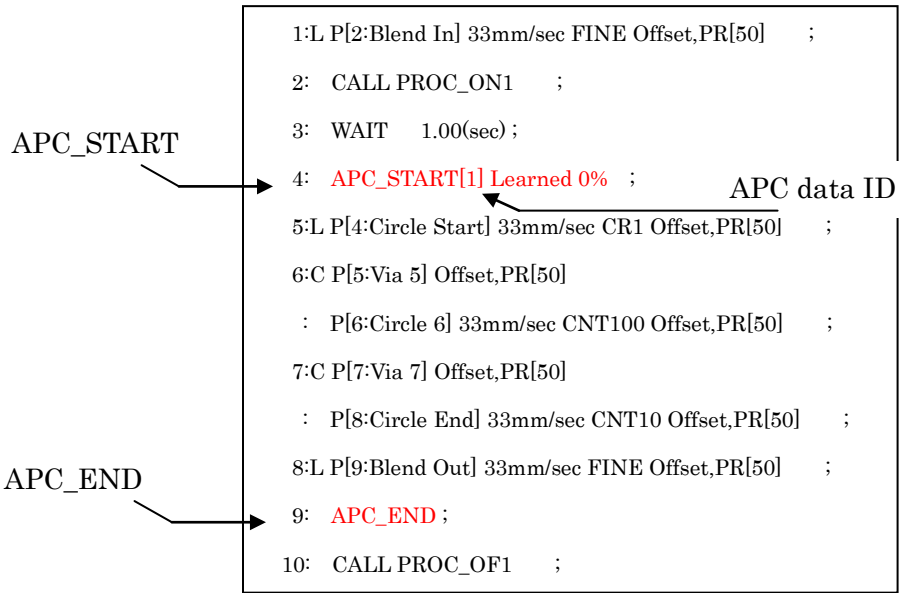


Fig. 7.4(a) An example TP program with Spot & APC instructions

Please refer to next section about automatic learning which allows TP programs to repeat automatically during learning.

7.5 AUTOMATIC LEARNING

Automatic learning allows TP programs with APC instructions to repeat automatically during learning. Automatic learning use system variable $APCFG.$LRN_DONE. $APCFG.$LRN_DONE is set to 0 in case of the learning non-completion and to 1 in case of learning completion at APC_END instruction. The following are the examples of automatic learning program depending on the number of data to learn.

Procedure7-5-1 Creating an automatic learning program (Learn one data)

1 Create a TP program (for example, APC_MAIN.TP) to call the TP program with APC instructions (for example, APC1.TP) until complete learning.
2 After execute APC_MAIN.TP, when the learning percentage becomes 100% in APC1.TP, the program will finish automatically.

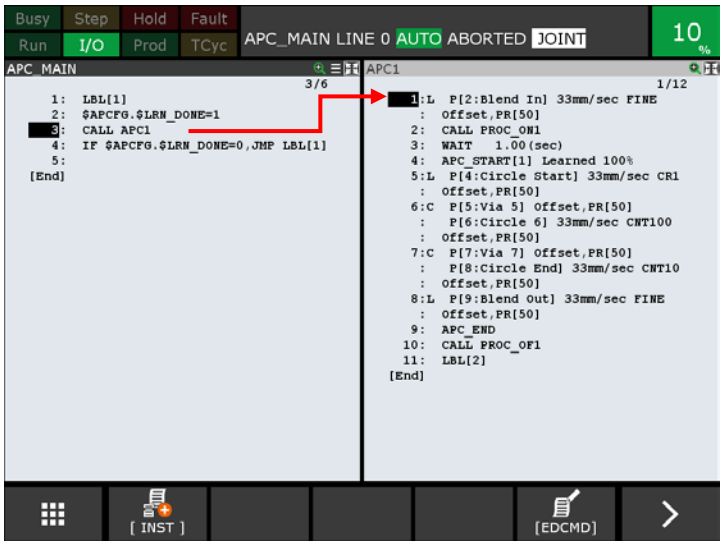


Fig. 7.5(a) An example of automatic learning program (Learn one data)

Procedure 7-5-2 Creating an automatic learning program (Learn two or more data)

1 Create a TP program to set to 1 in register when $APCFG.$LRN_DONE is not 1. The Register number uses an unused number (for example, CHK_LRN_DONE.TP).
2 In the TP program with APC instructions, call CHK_LRN_DONE.TP in the next line of each APC_END (for example, APC2.TP).
3 Create a TP program to call APC2.TP repeatedly while register is 1 (for example, APC_MAIN2.TP).
4 After execute APC_MAIN2.TP, when the learning percentage becomes 100% at all APC instructions in APC2.TP, the program will finish automatically.

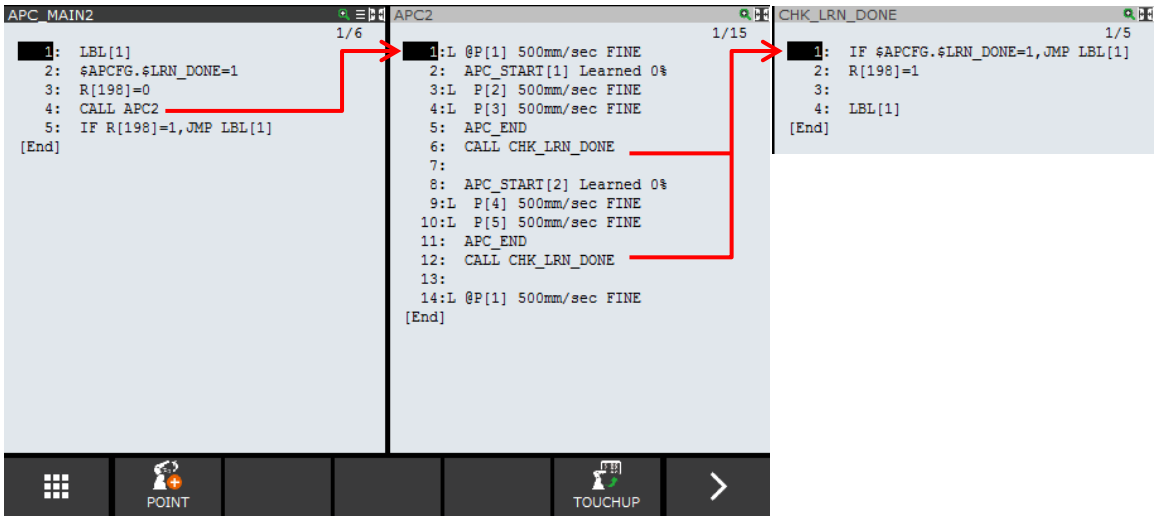


Fig. 7.5(b) An example of automatic learning program (Learn two or more data)

7.6 TOUCH-UP AND RE-LEARNING

APC data is associated with the measured path data and other motion data specific to a TP program with APC instruction. If touch-up modifies the motion after learning is complete, the generated APC data may not apply to the modified motion.

In learning mode, when a TP program with APC instruction is executed after touch-up is done, warning "MOTN-550 APC: Switched to normal motion" is posted for the modified motion lines. Alarm "MOTN-537 APC: Changed motion (M*,L*,P*)" is posted for APC_END instruction and the execution stops.

In playback mode, when a TP program with APC instructions is executed after touch-up is done, "MOTN-537 APC: Changed motion (M*,L*,P*)" is posted and robot motion stops.

There are three parameters for alarm MOTN-537 to indicate how the motion instruction has changed. M is learning data ID, L is line number, P represents cause of motion changed. Please refer to Appendix A for the contents of the alarm. If the motion instruction has changed other cause MOTN-538 or MOTN-539 will occur. (e.g. WAIT condition changed)

When it is necessary to execute learning motion or playback motion after MOTN-537, 538, or 539 occurs, follow these instructions:

- Re-enable the APC data, after restoring the teaching correction data.
- Delete the APC data, and relearn the TP program starting from learning percentage of 0%. (Please refer to Subsection 6.2.6)

7.7 CASES WHERE APC LEARNING AND PLAYBACK MOTION IS DISABLED

APC instructions are disabled in the following conditions. When APC is disabled, robot motion becomes normal motion. When the robot becomes normal motion in playback mode, it stops with alarm.

- Less than override 100%
- APC status is disabled in the set up menu.
- APC data is disabled in the APC data menu.
- T1 mode
- Single step mode
- Backward mode
- Resumption of the robot motion after HOLD and ESTOP
- Execution of a TP program from the line between APC instructions
- Power failure handling
- Touch-up modifies the motion after learning is complete.
- When the motion changes due to CNT motion.
- When the motion changes due to branch instruction.

When override is changed during learning motion or playback motion, Alarm “MOTN-538 APC: Changed motion” is posted for APC_END instruction and the execution stops.

When single step mode is enabled, the alarm “MOTN-534 APC: Input Single Step on APC” is issued. Afterwards, robot motion becomes normal motion.

When hold is enabled, the robot slows down and stops. Afterwards, robot motion becomes normal motion.

When emergency stop occurs during learning motion or playback motion, the robot stops. Afterwards, robot motion becomes normal motion.

8 APC BACKUP

This chapter explains APC backup.

8.1 GENERAL

APC data (apc***.bin) are stored in F-ROM after the learning process is completed. An “All files” backup or image backup can be performed to save the APC data to an external memory device.
In order to understand APC data save and data restore, it is necessary to understand data flow among D-RAM, F-ROM, and external memory device, such as memory cards.
The following figure shows the data flow.

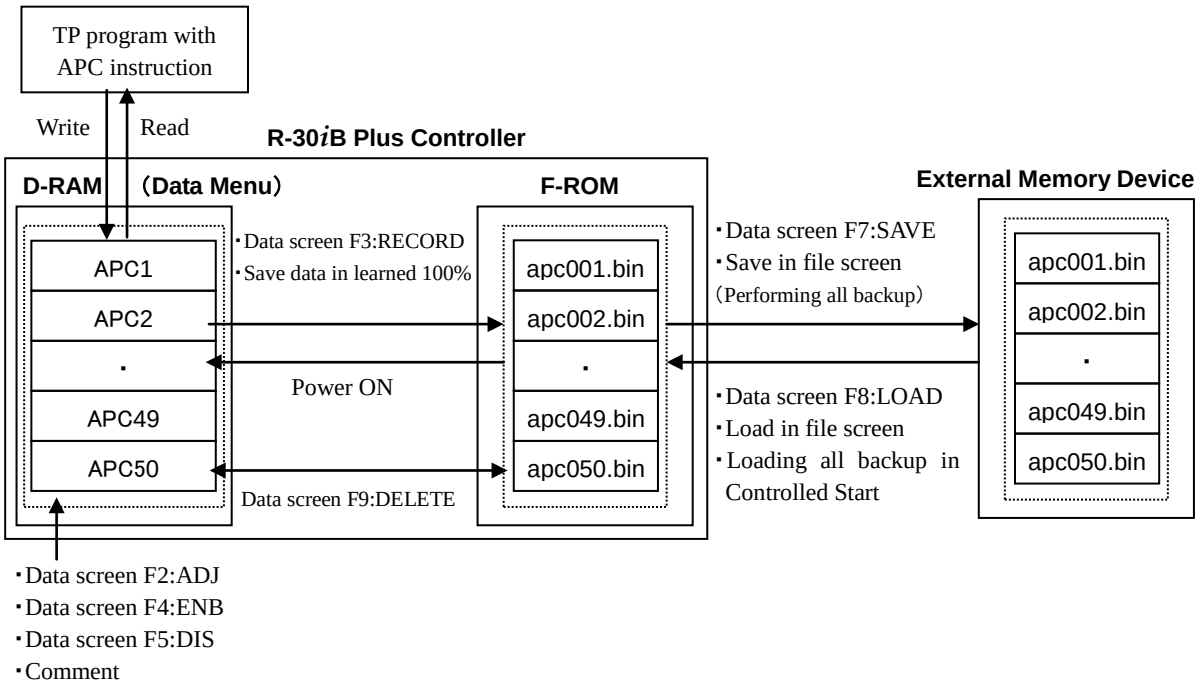


Fig. 8.1(a) Dependency diagram between function keys and memory device

8.2 All BACKUP

In the file menu, when choosing “All files” backup, all APC data stored in F-ROM are saved in the designated external memory device.
When restore is selected in the file menu at Controlled Start, the controller can load APC data to F-ROM.
Loading individual APC data files can also be performed in the file menu after cold start.

8.3 IMAGE BACKUP

An image backup consists of image files of F-ROM and S-RAM.
When APC data are in F-ROM, the APC data are stored in an image file by performing image backup.
When APC data are in the image file, the controllers can load the APC data to F-ROM.

8.4 SAVE AND LOAD IN DATA MENU

APC data files in F-ROM are stored in the designated external memory device when all backup is selected in the file menu.
APC data files in the external memory device are loaded into F-ROM when restore all is selected in the file menu after Controlled Start.
APC data files in the external memory device can be loaded into F-ROM file in the file menu after Controlled Start.
APC data files can be saved or loaded file by file between F-ROM and external device. (Please refer to Subsection 6.2.5)

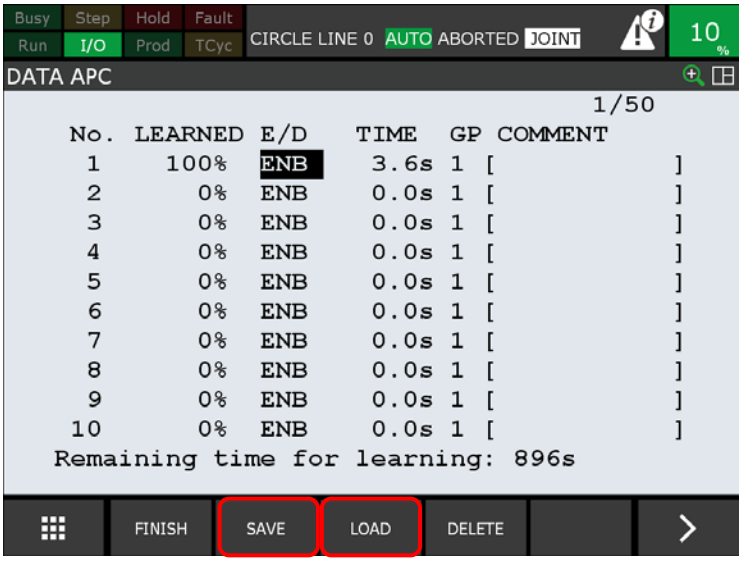


Fig. 8.4(a) Save and load APC data files

8.5 RECORDING IN THE APC DATA MENU

Go to APC data screen and press the [RECORD] key F3. The APC data in D-RAM is saved as APC data file in F-ROM.
Each APC data ID can be saved separately. (Please refer to Subsection 6.2.3)

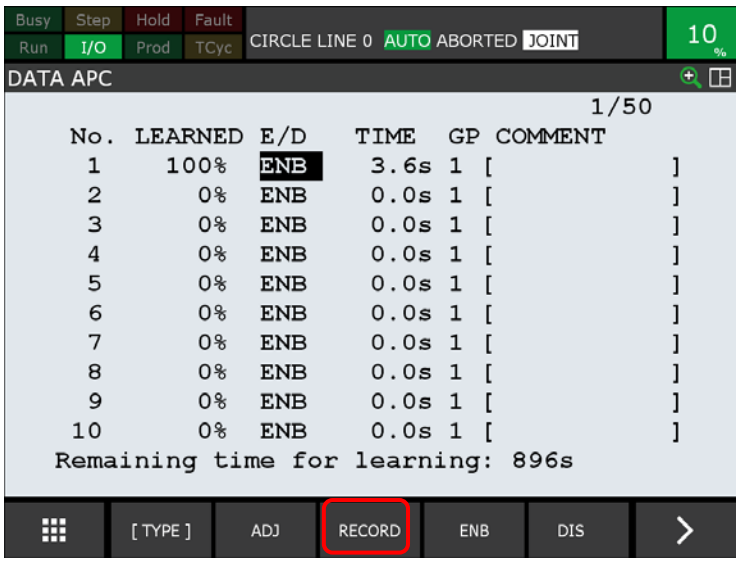


Fig. 8.5(a) Recording APC data files

APPENDIX

A ALARM CODES

This chapter contains warnings and alarms that may occur while using APC.

ATTENTION
When an alarm occurs, saving Diagnostic log is recommended. It is useful for investigating some abnormal status or issues. Please send the saved Diagnostic log to FANUC. More information about saving Diagnostic log, please refer to OPERATOR'S MANUAL (Basic Operation) (B-83284EN) Appendix D.

MOTN-524 APC: Full memory (M%d, %s, L%d, S%x)

Cause The APC data area on D-RAM is full, due to too much recorded motion data. M is the learning data ID. Second argument represents a program name that runs when MOTN-524 occurred and L represents line number of the program when MOTN-524 occurred. S represents type of APC data area.

Remedy Memory for APC data area is limited as follows:

- Standard motion lines are limited to about 600 lines. (Note: one spot-additional-instruction motion line is equivalent to 4 standard motion lines.)
- Total program execution time of APC learning must be within 180 seconds.

Apply following procedure after knowing above causes:

1. Reduce the number of motion lines or logic instructions within APC region.
2. Split the APC region into two or more APC regions, using multiple APC data indices.

MOTN-525 APC: Out of DRAM memory (M%d, Id%d)

Cause APC failed to acquire D-RAM data area. M is the data ID, and Id represents error type.
(Id=1) Failed to acquire D-RAM for calculation data area.
(Id=2) Failed to acquire D-RAM for data translation when APC_START executed.
(Id=3) Failed to acquire D-RAM data area for writing to F-ROM.
(Id=4) Failed to acquire D-RAM data area for reading from F-ROM.

Remedy It may be required to remove other options or reduce option memory configuration to use APC.

MOTN-527 APC: Failure of getting memory1

CauseAPC failed to acquire D-RAM for before-learning data area.
RemedyIt may be required to remove other options or reduce option memory configuration to use APC.

MOTN-528 APC: Failure of getting memory2

Cause APC failed to acquire D-RAM for after-learning data area.

Remedy It may be required to remove other options or reduce option memory configuration to use APC.

MOTN-529 APC: This isn't allowed (L%d, Id%d)

Cause The taught line contains a motion instruction that is incompatible with APC. L is line number, and ID represents instruction ID that conflicts with APC instruction. Refer to ID meaning in the below table.

ID	Instruction
1	External path optimization
2	KAREL
3	Weaving
4	Line Tracking
5	Touch Sensor
6	Coordinated Motion
7	Continuous Turn
9	Skip instruction are taught after the motion except FINE or CNT0
10	LVC or APC instruction is taught doubly
11	Soft Float Function
12	Tracking related function
13	Skip instruction

Remedy Remove either APC instruction or other instruction that is incompatible with APC.

MOTN-531 APC: Learning %d% (M%d)

Cause The APC learning percentage. The first argument is the learning percentage.
M is the data ID number of the learning data.

Remedy Informational message, no action required.

MOTN-532 APC: Internal error 2(M%d, Id%d)

Cause Internal error in APC calculation. M is the data ID number of the learning data. Id(=2-8) represents error type.
(id=2) The travel time of APC “Block” (CNT0/FINE to CNT0/FINE) exceeded 15sec.
(id=3to8) Others

Remedy 1. (Id=2) Reduce the number of motion lines or logic instructions within the APC “Block”.
2. (Id=3to8) Contact your local FANUC representative.

MOTN-537 APC: Changed motion (M%d, %s, L%d, P%d)

Cause A motion line in the APC region was modified by re-teaching. M is learning data ID, %s is program name, L is line number, P represents cause of Motion changed. Refer to P number at the table below.

P value	Cause	P value	Cause
1	motion type	65536	MAXSPEED instruction
2	start position	131072	RT_LD value or AP_LD value
4	destination position	262144	CR value
8	via position(circle motion only)	524288	RTCP instruction
16	taught speed	1048576	Simultaneous EV instruction
32	termination type	2097152	Independent EV instruction
64	CNT value	4194304	move time
128	tool frame	8388608	move time of aux axis
256	user frame	16777216	filter length
512	override	33554432	filter type
1024	payload	67108864	$MRR_GRP[g].$PRGOVERRIDE
2048	ACC value	134217728	group number
4096	PATH instruction	268435456	Break
8192	WJNT instruction	536870912	NORMAL_MOTION instruction
16384	INC instruction	1073741824	extended axis motion
32768	PSPD value		

Remedy 1. Undo the changes that were reported as cause.
2. Start APC learning again.

MOTN-538 APC: Changed motion (M%d, %s, L%d, P%d)

Cause Touch up was done in the motion lines between APC instructions. M is learning data ID, %s is program name, L is line number, P represents cause of motion changed. See the following table for the more detailed information of P number.

P	Instruction
1	Path changed
2	WAIT condition changed
4	Occurrence time of “SRVO-171 MotorSpd lim/DVC” alarm between APC instructions changed

Remedy 1. Undo the changes that were reported as cause.
2. Remove the learning data and re-learn again.
3. (P4) Touch up program to remove DVC alarm.

MOTN-539 APC: Changed motion (M%d, %s, P%d)

Cause Touch up was done in a motion line between APC instructions M is learning data ID, %s is program name, P represents cause of motion changed. See the following table for the more detailed information of P number.

P	Instruction
1	Motion-line which is before APC_END deleted
2	WAIT condition changed

Remedy 1. Undo the changes that were reported as cause.
2. Remove the learning data and re-learn again.

MOTN-540 APC: Internal error 1

Cause Internal error in APC function.
Remedy Contact your local FANUC representative.

MOTN-541 APC: Fatal error of memory (M%d, S%x)

Cause Internal error in APC function. M is learning data ID, S is section of APC data area.
Remedy Contact your local FANUC representative.

MOTN-542 APC: Full memory (M%d, S%x)

Cause The APC data area on D-RAM is full, due to too much recorded motion data. M is the learning data ID. S represents type of APC data area.
Remedy Memory for APC data area is limited as follows:
- Standard motion lines are limited to about 1000 lines. (Note: one spot-additional-instruction motion line is equivalent to 4 standard motion lines.)
- Total program execution time of APC learning must be within 180 seconds.

Apply following procedure after knowing above causes:
1. Reduce the number of motion lines or logic instructions within APC region.
2. Split the APC region into two or more APC regions, using multiple APC data indices.

MOTN-543 APC: No learned data (M%d, S%x)

Cause No APC data found while trying to load APC data from storage. APC learning process may not be done correctly. M is APC data ID. S represents type of APC data area.
Remedy 1. Re-do APC learning.
2. If the problem could not be resolved, contact your local FANUC representative.

MOTN-544 APC: Learned data empty (M%d, S%x)

Cause No APC data found while trying to load APC data from storage. APC process may not be done correctly, or Motion line may be inserted just before APC_END line while APC learning percentage larger than 0%.
M represents data ID number of learning data. S represents kinds of APC data area.
Remedy 1. If you are in the middle of the learning process, un-do any program changes to return program to the original state.
2. Re-do APC learning.
3. If the problem could not be resolved, contact your local FANUC representative.

MOTN-545 APC: Switched to normal motion (M%d, %s, L%d)

Cause APC motion switched to normal motion because learned motion was changed.
M represents data ID number of learning data. The second argument represents the program name. L is line number.
Remedy Informational message, no action required.

MOTN-546 APC: Restart learned motion (M%d, %s, L%d)

Cause APC motion restarted.
M represents data ID number of learning data. The second argument represents the program name. L is line number.
Remedy Informational message, no action required.

MOTN-547 APC: Sync motion not supported (M%d,L%d)

Cause APC cannot support synchronous motion in case that a program has two or more robot groups.
M represents data ID number of learning data. L is line number.
Remedy In playback mode, please use the “RUN” instruction in TP program to make two or more robots to perform learning motion in the same time.

MOTN-548 APC: Group number mismatch (M%d,G%d,L%d)

Cause Group number of the robot which is in learning is not match the setup in APC DATA setup screen.
M represents data ID number of learning data. G is group number. L is line number.
Remedy Please set the correct group number in APC DATA screen.

MOTN-549 APC: Multi data in learning (M%d,L%d)

Cause Only one robot group can be in learning mode at the same time.
M represents data ID number of learning data. L is line number.
Remedy Please perform and finish another. If multitasking motion is necessary, you can comment out other APC instructions or disable other the APC datas in APC DATA screen.

MOTN-550 APC: Switched to normal motion (M%d, %s, L%d)

Cause APC motion switched to normal motion.
M represents data ID number of learning data. The second argument represents the program name. L is line number.
Remedy Informational message, no action required.

MOTN-553 APC: Communication ready

Cause Communication between wireless sensor and USB receiver is ready.
Remedy Informational message, no action required.

MOTN-554 APC: Wireless data not enough

Cause The wireless sensor data is not recorded enough for APC during the learning.
Remedy Re-learn again. If the problem could not be resolved, contact your local FANUC representative.

MOTN-555 APC: Sensor battery error

Cause APC can’t be executed because the wireless sensor battery is almost empty.
Remedy Charge the sensor battery.

MOTN-556 APC: Wireless sensor timeout

Cause The wireless sensor has been failed to connect.
Remedy 1. Push LED at the left to turn off the wireless sensor, then start sensor again.
2. Restart the robot.

MOTN-557 APC: USB receiver removed

Cause The USB receiver has not been connected to the iPendant.
Remedy Disconnect/connect the USB receiver. The USB receiver is not available with tablet TP. Please connect *i*Pendant in using wireless accelerometer.

MOTN-558 APC: Sensor battery is low

Cause The battery of wireless sensor is weakening.
Remedy Charge the battery of wireless sensor.

MOTN-559 APC: Serial port timeout err

Cause The configuration of serial port is incorrect.
Remedy Verify the configuration of serial port.

MOTN-581 APC: Internal calc err (Er:%d)

Cause Sensor frame automatic setting function failed to calculate the sensor frame.

Remedy Apply the following procedure.

1. Make sure sensor type (wired or wireless) is selected correctly and retry sensor frame automatic setting function.
2. Make sure whether the accelerometer is fixed firmly to an end-of-arm tool or servo gun, and retry sensor frame automatic setting function.
3. Set the sensor frame by six point method.

MOTN-582 APC: Set payload set

Cause Sensor frame automatic setting function was executed with incorrect payload setting.

Remedy Apply the following procedure and retry the sensor frame automatic setting function.

1. Display “Motion Performance” screen by pressing [MENU] key - “0 NEXT” - “6 SYSTEM” - F1[TYPE] - “Motion”. Then press F5,[SETIND] and set active payload number to other than 0.
2. Display “Motion Performance” screen by pressing [MENU] key – “0 NEXT” – “6 SYSTEM” – F1,[TYPE] - “Motion”. Then move the cursor to the active payload number and press F3,”DETAIL”. Enter the correct value of weight, gravity center position of the load, and inertia about its gravity center.

MOTN-583 APC: Large calc err (Er:%d)

Cause In sensor frame automatic setting function, the accuracy of the calculated sensor frame is not sufficient.

Remedy Apply the following procedure and retry sensor frame automatic setting function. If the problem cannot be resolved, set the sensor frame by six point method.

1. Verify whether the accelerometer is fixed firmly to an end-of-arm tool.
2. Display “Motion Performance” screen by pressing [MENU] key – “0 NEXT” – “6 SYSTEM” – F1[TYPE] - “Motion”.
3. Verify the active payload number. Display “Motion Performance” screen by pressing [MENU] key – “0 NEXT” – “6 SYSTEM” – F1,[TYPE] – “Motion”. Then move the cursor to the active payload number and press F3,”DETAIL”. Verify the value of weight, gravity center position of the load, and inertia about its gravity center.
4. Set the base position for sensor frame automatic setting function as close to the recommended posture as possible.

MOTN-584 APC: Changed override

Cause The execution was interrupted because the override has been changed during the fast movements of sensor frame automatic setting function.

Remedy Retry sensor frame automatic setting function. Please do not change the override during the fast movements.

MOTN-585 APC: Set calibration data

Cause Calibration data for wireless accelerometer is wrong.

Remedy Contact your local FANUC representative.

MOTN-586 APC: Need Learning %d more time(s)

Cause Required learning iterations are insufficient to do this operation.

Remedy Execute more learning instruction.

MOTN-587 APC: Reboot controller

Cause The connect setting with the wireless sensor is not right.

Remedy Restart the robot.

MOTN-588 APC: Input SingleStep on APC

Cause STEP mode was entered during APC execution. APC does not work with single step.

Remedy Reset to clear alarm, and resume program. After resuming, normal motion takes place without APC function.

SRVO-098 ACC sensor DTERR alarm

Cause The acceleration sensor has not been connected. Otherwise, an error occurred during communication between the acceleration sensor and the main board.

Remedy

1. Check connection of the connector of the connecting cable.
2. Replace the above cable.
3. Replace the acceleration sensor.

SRVO-099 ACC sensor CRCERR alarm

Cause Data changed during transfer from the acceleration sensor.
Remedy Refer to the SRVO-098 Remedy.

SRVO-100 ACC sensor STBERR alarm

Cause A stop bit error of the data from the acceleration sensor occurred.
Remedy Refer to the SRVO-098 Remedy.

SRVO-108 ACC sensor livecode error

Cause An error occurred in communication of the force sensor.
Remedy Refer to the SRVO-098 Remedy.

SRVO-109 ACC sensor ID mismatch %d

Cause The possible cause may be determined as follows by the shown conflict ID number:
Conflict ID number 1: No pulse module unit.
Conflict ID number 2: A sensor other than accelerometer is detected.
Remedy 1. Secure connection between controller and ACC sensor.
2. Connect accelerometer sensor.

SRVO-110 ACC sensor disabled %d (G%d, A%d)

Cause The possible cause may be determined as follows by the shown error number:
1. Invalid number assigned for port number of tracking board.
2. Accelerometer sensor port number is disabled.
3. Assigned port number of Accelerometer conflicted with another purpose, such as line tracking or secondary encoders.
4. Setting of Accelerometer is incorrect.

Remedy Contact your local FANUC representative.

SRVO-470 Wireless sensor data error

Cause Wireless data sequence number is wrong.
Remedy Contact your local FANUC representative.

INTP-680 APC: GP No. in acc_frm mismatch

Cause Group number set in sensor frame is different from robot group which is in learning.
Remedy Please choose the correct sensor frame number whose group number is the same as learning group.

INTP-689 APC: Invalid SENSOR Frame (%s, L%d)

Cause The setup of ACC SENSOR Frame is not correct. SENSOR frame number is 0 or all the values of X, Y and Z are 0 in the configured SENSOR frame.
Remedy Please check ACC SENSOR Frame setup.

INTP-697 APC: Wireless Sensor CONFMOD

Cause APC_START cannot be executed while Wireless Confirm Mode is TRUE.
Remedy Please change Wireless Confirm Mode to FALSE then re-do APC learning.

INTP-698 APC: Numerous wireless data lost

Cause Data lost due to unstable wireless communication.
Remedy 1. Put a sensor and a USB receiver as close as possible to each other.
2. Set a sensor and a USB receiver with good visibility (such as a USB receiver can be seen from a sensor).
3. Avoid setting sensor and USB receiver in the environment as follows.
   - Put a sensor in the center of metallic part or enclosed by metal.
   - Put the iPendant with USB receiver on a metal such as a controller, or hang on the hook on the controller.
   - Put a metal obstacle such as a fence between communication path sensor and a USB receiver.
4. Avoid using Wi-Fi communication in 2.4GHz band (especially a large amount of data communication such as watching movie) and microwave near a sensor and a USB receiver.

INTP-699 APC: Cannot learn in this environment

Cause Data lost three times in a row due to unstable wireless communication.

Remedy
1. Put a sensor and a USB receiver as close as possible to each other.
2. Set a sensor and a USB receiver with good visibility (such as a USB receiver can be seen from a sensor).
3. Avoid setting sensor and USB receiver in the environment as follows.
   - Put a sensor in the center of metallic part or enclosed by metal.
   - Put the iPendant with USB receiver on a metal such as a controller, or hang on the hook on the controller.
   - Put a metal obstacle such as a fence between communication path sensor and a USB receiver.
4. Avoid using Wi-Fi communication in 2.4GHz band (especially a large amount of data communication such as watching movie) and microwave near a sensor and a USB receiver.

INTP-725 APC: APC_START in block

Cause An APC_START instruction is started while another LVC_START or APC_START instruction is executed.

Remedy Delete one of LVC_START or APC_START instructions.

TPIF-256 USB receiver is not supported in this TP.

Cause The firmware for the *i*Pendant does not support wireless accelerometer for APC.

Remedy Updating the firmware is necessary. If F-ROM size is 64MB or more, update by the following procedure.
1. For safety, make sure that the E-stop button is pressed down, then power off the controller.
2. Confirm that MC card and USB memory are NOT inserted to the controller.
3. Power on the controller with pressing PREV and NEXT.
4. After displaying CONFIGURATION MENU, select [3.Controlled start] to perform Controlled Start.
5. After displaying Controlled Start Menu, press FCTN and select [1 START(COLD)] to perform Cold Start.
6. Updating the firmware starts. Updating the firmware takes several minutes. Never power off while updating.

INDEX

REVISION RECORD

Edition	Date	Contents
02	Apr., 2021	• Specification has been modified in some functions. • Some errors in writing have been corrected.
01	Jan., 2020	

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