FANUC Robot series

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

DeviceNet

OPERATOR'S MANUAL

Before using the Robot, be sure to read the "FANUC Robot Safety Manual (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 have tried as much as possible to describe all the various matters.

However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.

Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

SAFETY PRECAUTIONS

This chapter describes the precautions which must be followed to ensure 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.
In addition, refer to the "FANUC Robot SAFETY HANDBOOK (B-80687EN)".

1   DEFINITION OF USER

The user can be defined as follows.

Operator:
- Turns ON/OFF power to the robot
- Starts the robot program from the operator's panel

Programmer:
- Operates the robot
- Teaches the robot inside the safety fence

Maintenance engineer:
- Operates the robot
- Teaches the robot inside the safety fence
- Performs maintenance (repair, adjustment, replacement)

-    Operator is not allowed to work in the safety fence.
-    Programmers and maintenance engineers are allowed to work in the safety fence.   The work inside the safety fence includes lifting, setting, teaching, adjustment, maintenance, etc.
-    To work inside the safety fence, the person must receive a professional training for the robot.

During the operation, programming, and maintenance of your robotic system, the programmer, operator, and maintenance engineer should take additional care of their safety by wearing the following safety items.

-    Adequate clothes for the operation
-    Safety shoes
-    A helmet

2   DEFINITION OF SAFETY NOTATIONS

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

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

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

3   SAFETY OF THE USER

User safety is the primary safety consideration. Because it is very dangerous to enter the operating space of the robot during automatic operation, adequate safety precautions must be observed. The following lists the general safety precautions. Careful consideration must be made to ensure user safety.

(1) Have the robot system users attend the training courses held by FANUC.

FANUC provides various training courses.   Contact our sales office for details.

(2) Even when the robot is stationary, it is possible that the robot is still in a ready to move state, and is waiting for a signal.   In this state, the robot is regarded as still in motion.   To ensure user safety, provide the system with an alarm to indicate visually or aurally that the robot is in motion.
(3) Install a safety fence with a gate so that no user can enter the work area without passing through the gate.   Install an interlocking device, a safety plug, and so forth in the safety gate so that the robot is stopped as the safety gate is opened.

The controller is designed to receive this interlocking signal of the door switch. When the gate is opened and this signal received, the controller stops the robot (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type).   For connection, see Fig. 3 (b).

(4) Provide the peripheral equipment with appropriate earth (Class A, Class B, Class C, and Class D).
(5) Try to install the peripheral equipment outside the robot operating space.
(6) Draw an outline on the floor, clearly indicating the range of the robot operating space, including the tools such as a hand.
(7) Install a mat switch or photoelectric switch on the floor with an interlock to a visual or aural alarm that stops the robot when a user enters the work area.
(8) If necessary, install a safety lock so that no one except the user in charge can turn on the power of the robot.

The circuit breaker installed in the controller is designed to disable anyone from turning it on when it is locked with a padlock.

(9)   When adjusting each peripheral equipment independently, be sure to turn off the power of the robot.

(10) Operators should be ungloved while manipulating the operator panel or teach pendant. Operation with gloved fingers could cause an operation error.

(11) Programs, system variables, and other information can be saved on memory card or USB memories. Be sure to save the data periodically in case the data is lost in an accident. (refer to Controller OPERATOR'S MANUAL.)

(12) The robot should be transported and installed by accurately following the procedures recommended by FANUC. Wrong transportation or installation may cause the robot to fall, resulting in severe injury to workers.

(13) In the first operation of the robot after installation, the operation should be restricted to low speeds. Then, the speed should be gradually increased to check the operation of the robot.

(14) Before the robot is started, it should be checked that no one is inside the safety fence. At the same time, a check must be made to ensure that there is no risk of hazardous situations. If detected, such a situation should be eliminated before the operation.

(15) When the robot is used, the following precautions should be taken. Otherwise, the robot and peripheral equipment can be adversely affected, or workers can be severely injured.
    -   Avoid using the robot in a flammable environment.
    -   Avoid using the robot in an explosive environment.
    -   Avoid using the robot in an environment full of radiation.
    -   Avoid using the robot under water or at high humidity.
    -   Avoid using the robot to carry a person or animal.
    -   Avoid using the robot as a stepladder. (Never climb up on or hang from the robot.)
    -   Outdoor

(16) When connecting the peripheral equipment related to stop (safety fence etc.) and each signal (external emergency, fence etc.) of robot, be sure to confirm the stop movement and do not take the wrong connection.

(17) When preparing footstep, please consider security for installation and maintenance work in high place according to Fig. 3 (c). Please consider footstep and safety belt mounting position.
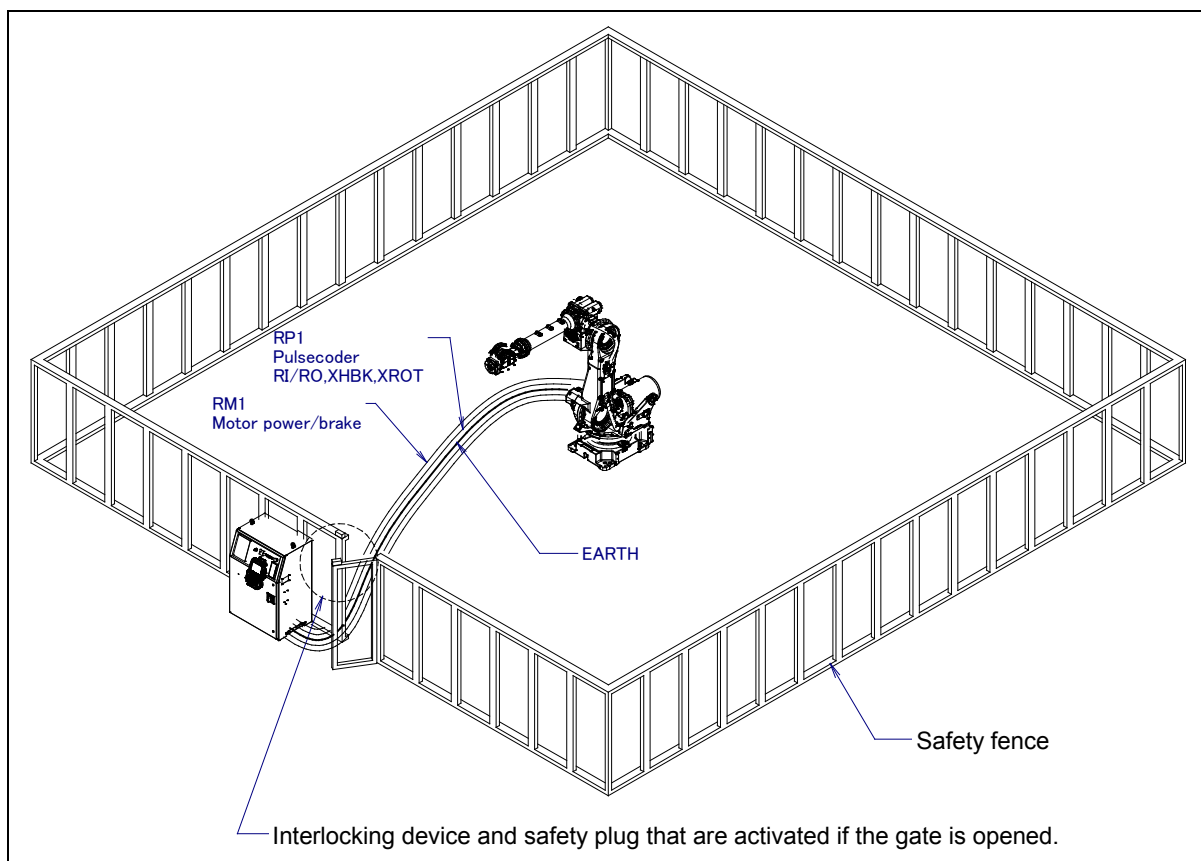
Fig. 3 (a) Safety fence and safety gate

> ⚠ **WARNING**
> When you close a fence, please confirm that there is not a person from all directions of the robot.
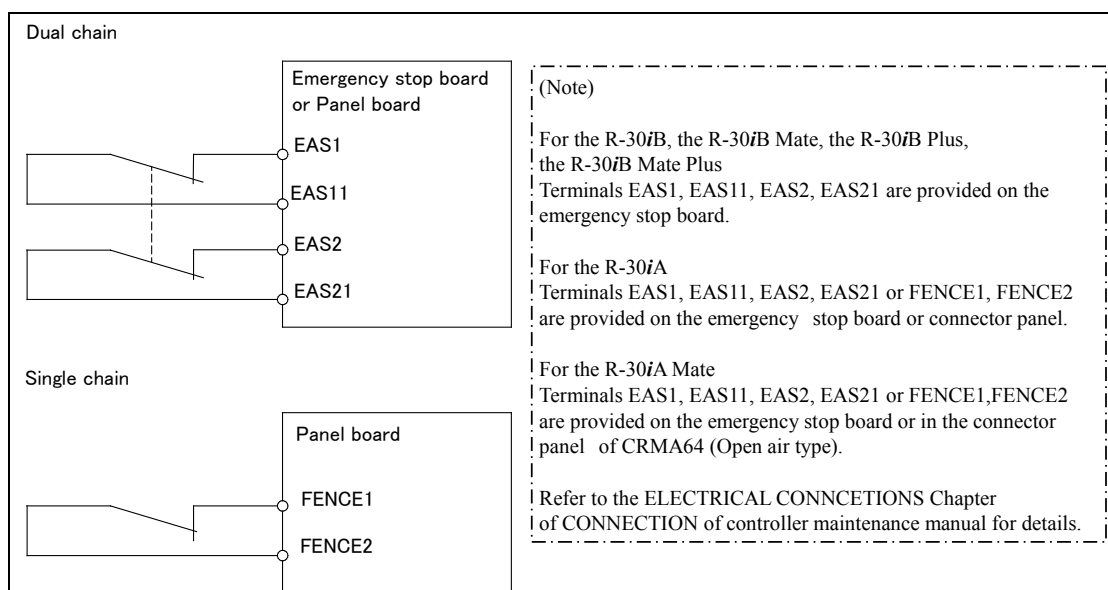

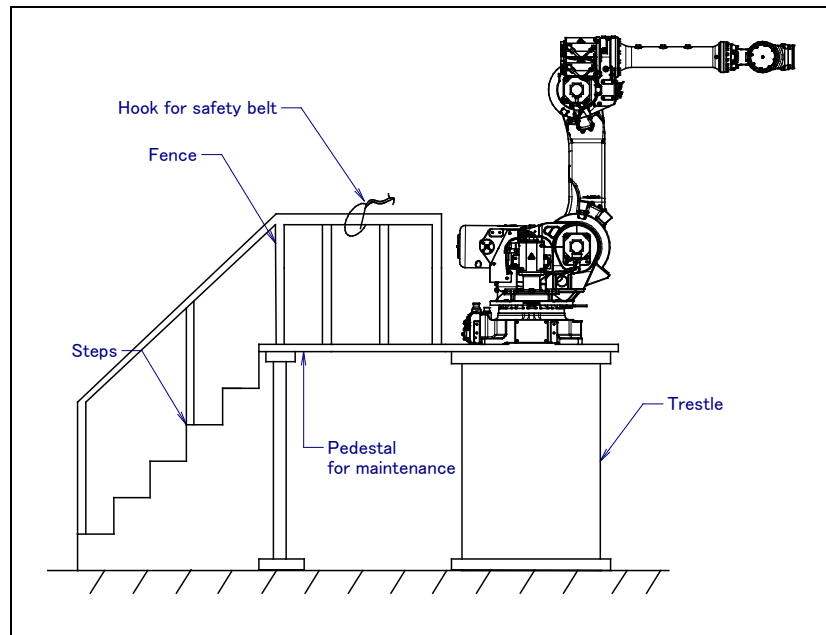**Fig. 3 (b) Connection diagram for the signal of safety fence**

Fig. 3 (c) Pedestal for maintenance

3.1 SAFETY OF THE OPERATOR

An operator refers to a person who turns on and off the robot system and starts a robot program from, for example, the operator panel during daily operation.
Operators cannot work inside of the safety fence.

(1) If the robot does not need to be operated, turn off the robot controller power or press the EMERGENCY STOP button during working.
(2) Operate the robot system outside the operating space of the robot.
(3) Install a safety fence or safety door to avoid the accidental entry of a person other than an operator in charge or keep operator out from the hazardous place.
(4) Install the EMERGENCY STOP button within the operator's reach.

> The robot controller is designed to be connected to an external EMERGENCY STOP button. With this connection, the controller stops the robot operation (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type) when the external EMERGENCY STOP button is pressed.   See the diagram below for connection.
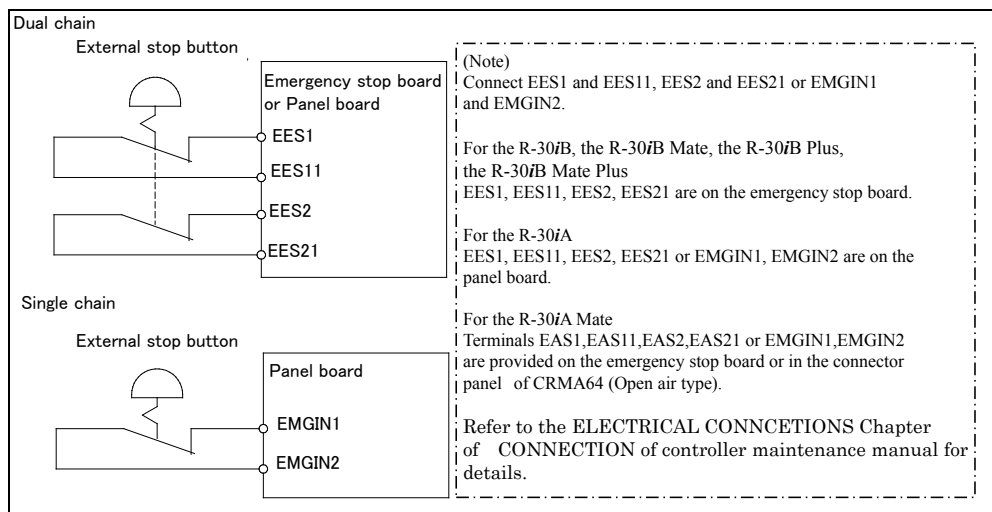

Fig. 3.1 Connection diagram for external emergency stop button

3.2   SAFETY OF THE PROGRAMMER

While teaching the robot, the operator may need to enter the robot operation area.   The programmer must ensure the safety   especially.

(1)   Unless it is specifically necessary to enter the robot operating space, carry out all tasks outside the operating space.
(2)   Before teaching the robot, check that the robot and its peripheral equipment are all in the normal operating condition.
(3)   If it is inevitable to enter the robot operating space to teach the robot, check the locations, settings, and other conditions of the safety devices (such as the EMERGENCY STOP button, the DEADMAN switch on the teach pendant) before entering the area.
(4)   The programmer must be extremely careful not to let anyone else enter the robot operating space.
(5)   Programming should be done outside the area of the safety fence as far as possible. If programming needs to be done inside the safety fence, the programmer should take the following precautions:
-    Before entering the area of the safety fence, ensure that there is no risk of dangerous situations in the area.
-    Be prepared to press the emergency stop button whenever necessary.
-    Robot motions should be made at low speeds.
-    Before starting programming, check the whole robot system status to ensure that no remote instruction to the peripheral equipment or motion would be dangerous to the user.

Our operator panel is provided with an emergency stop button and a key switch (mode switch) for selecting the automatic operation mode (AUTO) and the teach modes (T1 and T2).   Before entering the inside of the safety fence for the purpose of teaching, set the switch to a teach mode, remove the key from the mode switch to prevent other people from changing the operation mode carelessly, then open the safety gate.   If the safety gate is opened with the automatic operation mode set, the robot stops (Please refer to "**STOP TYPE OF ROBOT**" in SAFETY PRECAUTIONS for detail of stop type).   After the switch is set to a teach mode, the safety gate is disabled.   The programmer should understand that the safety gate is disabled and is responsible for keeping other people from entering the inside of the safety fence.

Teach pendant is provided with a switch to enable/disable robot operation from teach pendant and DEADMAN switch as well as emergency stop button. These button and switch function as follows:
(1)   Emergency stop button: Causes the stop of the robot (Please refer to "STOP TYPE OF ROBOT" in SAFETY PRECAUTIONS for detail of stop type) when pressed.
(2)   DEADMAN switch: Functions are different depending on the teach pendant enable/disable switch setting status.
   (a)   Enable: Servo power is turned off and robot stops when the operator releases the DEADMAN switch or when the operator presses the switch strongly.
   (b)   Disable: The DEADMAN switch is disabled.
   (Note)The DEADMAN switch is provided to stop the robot when the operator releases the teach pendant or presses the pendant strongly in case of emergency.   The R-30iB Plus/R-30iB Mate Plus /R-30iB/R-30iB Mate/R-30iA/R-30iA Mate employs a 3-position DEADMAN switch, which allows the robot to operate when the 3-position DEADMAN switch is pressed to its intermediate point.   When the operator releases the DEADMAN switch or presses the switch strongly, the robot stops immediately.

The operator's intention of starting teaching is determined by the controller through the dual operation of setting the teach pendant enable/disable switch to the enable position and pressing the DEADMAN switch.   The operator should make sure that the robot could operate in such conditions and be responsible in carrying out tasks safely.

Based on the risk assessment by FANUC, number of operation of DEADMAN switch should not exceed about 10000 times per year.

The teach pendant, operator panel, and peripheral device interface send each robot start signal.   However the validity of each signal changes as follows depending on the mode switch and the DEADMAN switch of the operator panel, the teach pendant enable switch and the remote condition on the software.

For the R-30*i*B Plus/R-30*i*B Mate Plus/R-30*i*B/R-30*i*B Mate/R-30*i*A Controller
or CE or RIA specification of the R-30*i*A Mate Controller

Mode	Teach pendant enable switch	Software remote condition	Teach pendant	Operator panel	Peripheral device
AUTO mode	On	Local	Not allowed	Not allowed	Not allowed
		Remote	Not allowed	Not allowed	Not allowed
	Off	Local	Not allowed	Allowed to start	Not allowed
		Remote	Not allowed	Not allowed	Allowed to start
T1, T2 mode	On	Local	Allowed to start	Not allowed	Not allowed
		Remote	Allowed to start	Not allowed	Not allowed
	Off	Local	Not allowed	Not allowed	Not allowed
		Remote	Not allowed	Not allowed	Not allowed

T1,T2 mode: DEADMAN switch is effective.

For the standard specification of R-30*i*A Mate Controller

Teach pendant enable switch	Software remote condition	Teach pendant	Peripheral device
On	Ignored	Allowed to start	Not allowed
Off	Local	Not allowed	Not allowed
	Remote	Not allowed	Allowed to start

(6)   (Only when R-30*i*B Plus/R-30*i*B Mate Plus/R-30*i*B/R-30*i*B Mate /R-30*i*A Controller or CE or RIA specification of R-30*i*A Mate controller is selected.) To start the system using the operator panel, make certain that nobody is in the robot operating space and that there are no abnormal conditions in the robot operating space.

(7)   When a program is completed, be sure to carry out the test operation according to the following procedure.

   (a)   Run the program for at least one operation cycle in the single step mode at low speed.

   (b)   Run the program for at least one operation cycle in the continuous operation mode at low speed.

   (c)   Run the program for one operation cycle in the continuous operation mode at the intermediate speed and check that no abnormalities occur due to a delay in timing.

   (d)   Run the program for one operation cycle in the continuous operation mode at the normal operating speed, and check that the system operates automatically without trouble.

   (e)   After checking the completeness of the program through the test operation above, execute it in the automatic operation mode.

(8)   While operating the system in the automatic operation mode, the teach pendant operator must leave the safety fence.

3.3   SAFETY OF THE MAINTENANCE ENGINEER

For the safety of maintenance engineer personnel, pay utmost attention to the following.

(1) During operation, never enter the robot operating space.

(2) A hazardous situation may arise when the robot or the system, are kept with their power-on during maintenance operations. Therefore, for any maintenance operation, the robot and the system should be put into the power-off state. If necessary, a lock should be in place in order to prevent any other person from turning on the robot and/or the system. In case maintenance needs to be executed in the power-on state, the emergency stop button must be pressed.

(3) If it becomes necessary to enter the robot operating space while the power is on, press the emergency stop button on the operator box or operator panel, or the teach pendant before entering the range.   The maintenance worker must indicate that maintenance work is in progress and be careful not to allow other people to operate the robot carelessly.

(4) When entering the area enclosed by the safety fence, the worker must check the whole robot system in order to make sure no dangerous situations exist. In case the worker needs to enter the safety area whilst a dangerous situation exists, extreme care must be taken, and whole robot system status must be carefully monitored.

(5) Before the maintenance of the pneumatic system is started, the supply pressure should be shut off and the pressure in the piping should be reduced to zero.

(6) Before the start of maintenance work, check that the robot and its peripheral equipment are all in the normal operating condition.

(7) Do not operate the robot in the automatic operation while anybody is in the robot operating space.

(8) When you maintain the robot alongside a wall or instrument, or when multiple users are working nearby, make certain that their escape path is not obstructed.

(9) When a tool is mounted on the robot, or when any movable device other than the robot is installed, such as belt conveyor, pay careful attention to its motion.

(10) If necessary, have a user who is familiar with the robot system stand beside the operator panel and observe the work being performed.   If any danger arises, the user should be ready to press the EMERGENCY STOP button at any time.

(11) When replacing a part, please contact your local FANUC representative. If a wrong procedure is followed, an accident may occur, causing damage to the robot and injury to the user.

(12) When replacing or reinstalling components, take care to prevent foreign material from entering the system.

(13) When handling each unit or printed circuit board in the controller during inspection, turn off the circuit breaker to protect against electric shock.
     If there are two cabinets, turn off the both circuit breaker.

(14) A part should be replaced with a part recommended by FANUC. If other parts are used, malfunction or damage would occur. Especially, a fuse that is not recommended by FANUC should not be used. Such a fuse may cause a fire.

(15) When restarting the robot system after completing maintenance work, make sure in advance that there is no person in the operating space and that the robot and the peripheral equipment are not abnormal.

(16) When a motor or brake is removed, the robot arm should be supported with a crane or other equipment beforehand so that the arm would not fall during the removal.

(17) Whenever grease is spilled on the floor, it should be removed as quickly as possible to prevent dangerous falls.

(18) The following parts are heated. If a maintenance user needs to touch such a part in the heated state, the user should wear heat-resistant gloves or use other protective tools.
     -    Servo motor
     -    Inside the controller
     -    Reducer
     -    Gearbox
     -    Wrist unit

(19) Maintenance should be done under suitable light. Care must be taken that the light would not cause any danger.

(20) When a motor, reducer, or other heavy load is handled, a crane or other equipment should be used to protect maintenance workers from excessive load. Otherwise, the maintenance workers would be severely injured.

(21) The robot should not be stepped on or climbed up during maintenance. If it is attempted, the robot would be adversely affected. In addition, a misstep can cause injury to the worker.

(22) When performing maintenance work in high place, secure a footstep and wear safety belt.

(23) After the maintenance is completed, spilled oil or water and metal chips should be removed from the floor around the robot and within the safety fence.

(24) When a part is replaced, all bolts and other related components should put back into their original places. A careful check must be given to ensure that no components are missing or left not mounted.

(25) In case robot motion is required during maintenance, the following precautions should be taken :
   - Foresee an escape route. And during the maintenance motion itself, monitor continuously the whole robot system so that your escape route will not become blocked by the robot, or by peripheral equipment.
   - Always pay attention to potentially dangerous situations, and be prepared to press the emergency stop button whenever necessary.

(26) The robot should be periodically inspected. (Refer to the robot mechanical manual and controller maintenance manual.) A failure to do the periodical inspection can adversely affect the performance or service life of the robot and may cause an accident

(27) After a part is replaced, a test execution should be given for the robot according to a predetermined method. (See TESTING section of "Controller operator's manual".) During the test execution, the maintenance worker should work outside the safety fence.

4   SAFETY OF THE TOOLS AND PERIPHERAL EQUIPMENT

4.1   PRECAUTIONS IN PROGRAMMING

(1) Use a limit switch or other sensor to detect a dangerous condition and, if necessary, design the program to stop the robot when the sensor signal is received.

(2) Design the program to stop the robot when an abnormality occurs in any other robots or peripheral equipment, even though the robot itself is normal.

(3) For a system in which the robot and its peripheral equipment are in synchronous motion, particular care must be taken in programming so that they do not interfere with each other.

(4) Provide a suitable interface between the robot and its peripheral equipment so that the robot can detect the states of all devices in the system and can be stopped according to the states.

4.2   PRECAUTIONS FOR MECHANISM

(1) Keep the component cells of the robot system clean, operate the robot where insulated from the influence of oil, water, and dust.

(2) Don't use unconfirmed liquid for cutting fluid and cleaning fluid.

(3) Adopt limit switches or mechanical stoppers to limit the robot motion, and avoid the robot from collisions against peripheral equipment or tools.

(4) Observe the following precautions about the mechanical unit cables. Failure to follow precautions may cause problems.

- Use mechanical unit cable that have required user interface.
- Do not add user cable or hose to inside of the mechanical unit.
- Please do not obstruct the movement of the mechanical unit when cables are added to outside of mechanical unit.
- In the case of the model that a cable is exposed, please do not perform remodeling (Adding a protective cover and fix an outside cable more) obstructing the behavior of the outcrop of the cable.
- When installing user peripheral equipment on the robot mechanical unit, please pay attention that the device does not interfere with the robot itself.

(5) The frequent power-off stop for the robot during operation causes the trouble of the robot. Please avoid the system construction that power-off stop would be operated routinely. (Refer to bad case example.) Please perform power-off stop after reducing the speed of the robot and stopping it by hold stop or cycle stop when it is not urgent. (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type.)

(Bad case example)

- Whenever poor product is generated, a line stops by emergency stop and power-off of the robot is incurred.
- When alteration is necessary, safety switch is operated by opening safety fence and power-off stop is incurred for the robot during operation.
- An operator pushes the emergency stop button frequently, and a line stops.
- An area sensor or a mat switch connected to safety signal operates routinely and power-off stop is incurred for the robot.
- Power-off stop is regularly incurred due to an inappropriate setting for Dual Check Safety (DCS).

(6) Power-off stop of Robot is executed when collision detection alarm (SRVO-050) etc. occurs. Please try to avoid unnecessary power-off stops. It may cause the trouble of the robot, too. So remove the causes of the alarm.

5 SAFETY OF THE ROBOT MECHANICAL UNIT

5.1 PRECAUTIONS IN OPERATION

(1) When operating the robot in the jog mode, set it at an appropriate speed so that the operator can manage the robot in any eventuality.
(2) Before pressing the jog key, be sure you know in advance what motion the robot will perform in the jog mode.

5.2 PRECAUTIONS IN PROGRAMMING

(1) When the operating spaces of robots overlap, make certain that the motions of the robots do not interfere with each other.
(2) Be sure to specify the predetermined work origin in a motion program for the robot and program the motion so that it starts from the origin and terminates at the origin. Make it possible for the operator to easily distinguish at a glance that the robot motion has terminated.

5.3 PRECAUTIONS FOR MECHANISMS

Keep the robot operation area clean, and operate the robot in an environment free of grease, water, and dust.

5.4 PROCEDURE TO MOVE ARM WITHOUT DRIVE POWER IN EMERGENCY OR ABNORMAL SITUATIONS

For emergency or abnormal situations (e.g. persons trapped in or pinched by the robot), brake release unit can be used to move the robot axes without drive power.
Please refer to controller maintenance manual and mechanical unit operator's manual for using method of brake release unit and method of supporting robot.

6 SAFETY OF THE END EFFECTOR

6.1 PRECAUTIONS IN PROGRAMMING

(1) To control the pneumatic, hydraulic and electric actuators, carefully consider the necessary time delay after issuing each control command up to actual motion and ensure safe control.
(2) Provide the end effector with a limit switch, and control the robot system by monitoring the state of the end effector.

7 STOP TYPE OF ROBOT (R-30*i*A, R-30*i*A Mate)

The following three robot stop types exist:

Power-Off Stop (Category 0 following IEC 60204-1)

Servo power is turned off and the robot stops immediately. Servo power is turned off when the robot is moving, and the motion path of the deceleration is uncontrolled.
The following processing is performed at Power-Off stop.
- An alarm is generated and servo power is turned off.
- The robot operation is stopped immediately. Execution of the program is paused.
Frequent Power-Off stop of the robot during operation can cause mechanical problems of the robot.
Avoid system designs that require routine or frequent Power-Off stop conditions.

Controlled stop (Category 1 following IEC 60204-1)

The robot is decelerated until it stops, and servo power is turned off.
The following processing is performed at Controlled stop.
- The alarm "SRVO-199 Controlled stop" occurs along with a decelerated stop. Execution of the program is paused.
- An alarm is generated and servo power is turned off.

Hold (Category 2 following IEC 60204-1)

The robot is decelerated until it stops, and servo power remains on.
The following processing is performed at Hold.
- The robot operation is decelerated until it stops. Execution of the program is paused.

⚠ **WARNING**
1 The stopping distance and time of Controlled stop is longer than those of Power-Off stop. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time is necessary when Controlled stop is used. Please refer to the operator's manual of a particular robot model for the data of stopping distance and time.
2 In multi arm system, the longest stopping distance and time of Controlled Stop among each robot are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the multi arm system.
3 In the system which has extended axis, the longer stopping distance and time of Controlled Stop among robot and extended axis are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the system which has extended axis. Please refer to the extended axis setup procedure of the controller operator's manual for considering the stopping distance and time of the extended axis.
4 In case of Controlled stop, motor power shutdown is delayed for a maximum of 2 seconds. In this case, a risk assessment for the whole robot system is necessary, including the 2 seconds delay.

When the emergency stop button is pressed or the FENCE is open, the stop type of robot is Power-Off stop or Controlled stop. The configuration of stop type for each situation is called *stop pattern*. The stop pattern is different according to the controller type or option configuration.

There are the following 3 Stop patterns.

Stop pattern	Mode	Emergency stop button	External Emergency stop	FENCE open	SVOFF input	Servo disconnect
A	AUTO	P-Stop	P-Stop	C-Stop	C-Stop	P-Stop
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop
B	AUTO	P-Stop	P-Stop	P-Stop	P-Stop	P-Stop
	T1	P-Stop	P-Stop	-	P-Stop	P-Stop
	T2	P-Stop	P-Stop	-	P-Stop	P-Stop
C	AUTO	C-Stop	C-Stop	C-Stop	C-Stop	C-Stop
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop

P-Stop: Power-Off stop
C-Stop: Controlled stop
-:   Disable

The following table indicates the Stop pattern according to the controller type or option configuration.

Option	R-30*i*A				R-30*i*A Mate		
	Standard (Single)	Standard (Dual)	RIA type	CE type	Standard	RIA type	CE type
Standard	B (*)	A	A	A	A (**)	A	A
Stop type set (Stop pattern C) (A05B-2500-J570)	N/A	N/A	C	C	N/A	C	C

 (*) R-30*i*A standard (single) does not have servo disconnect.
(**) R-30*i*A Mate Standard does not have servo disconnect, and the stop type of SVOFF input is Power-Off stop.

The stop pattern of the controller is displayed in "Stop pattern" line in software version screen. Please refer to "Software version" in operator's manual of controller for the detail of software version screen.

"Controlled stop by E-Stop" option

When "Stop type set (Stop pattern C) (A05B-2500-J570) option is specified, the stop type of the following alarms becomes Controlled stop but only in AUTO mode.   In T1 or T2 mode, the stop type is Power-Off stop which is the normal operation of the system.

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open. (R-30*i*A controller)
SRVO-194 Servo disconnect	Servo disconnect input (SD4-SD41, SD5-SD51) is open. (R-30*i*A controller)
SRVO-218 Ext.E-stop/Servo Disconnect	External emergency stop input (EES1-EES11, EES2-EES21) is open. (R-30*i*A Mate controller)
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.

Controlled stop is different from Power-Off stop as follows:
- In Controlled stop, the robot is stopped on the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.
- In Controlled stop, physical impact is less than Power-Off stop. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End Of Arm Tool) should be minimized.
- The stopping distance and stopping time of Controlled stop is longer than the stopping distance and stopping time of Power-Off stop, depending on the robot model and axis. Please refer to the operator's manual of a particular robot model for the data of stopping distance and stopping time.

For the R-30iA or R-30iA Mate, this function is available only in CE or RIA type hardware.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

> ⚠ **WARNING**
> The stopping distance and stopping time of Controlled stop are longer than the stopping distance and stopping time of Power-Off stop. A risk assessment for the whole robot system, which takes into consideration the increased stopping distance and stopping time, is necessary when this option is loaded.

8 STOP TYPE OF ROBOT (R-30iB, R-30iB Mate)

There are following four types of Stopping Robot.

Power-Off Stop (Category 0 following IEC 60204-1)
Servo power is turned off, and the robot stops immediately. Servo power is turned off when the robot is moving, and the motion path of the deceleration is uncontrolled.
"**Power-Off stop**" performs following processing.
- An alarm is generated, and then the servo power turns off. Instantly the robot stops.
- Execution of the program is paused.
Frequent Power-Off stop of the robot during operation can cause mechanical problems of the robot.
Avoid system designs that require routine or frequent Power-Off stop conditions.

Controlled stop (Category 1 following IEC 60204-1)
The robot is decelerated until it stops, and servo power is turned off.
"**Controlled stop**" performs following processing.
- The alarm **"SRVO-199 Controlled stop"** occurs along with a decelerated stop. The program execution is paused.
- An alarm is generated, and then the servo power turns off.

Smooth stop (Category 1 following IEC 60204-1)
The robot is decelerated until it stops, and servo power is turned off.
"**Smooth stop**" performs following processing.
- The alarm **"SRVO-289 Smooth Stop"** occurs along with a decelerated stop. The program execution is paused.
- An alarm is generated, and then the servo power turns off.

- In Smooth stop, the robot decelerates until it stops with the deceleration time shorter than Controlled stop.

Hold (Category 2 following IEC 60204-1)

The robot is decelerated until it stops, and servo power remains on.

"**Hold**" performs following processing.

- The robot operation is decelerated until it stops. Execution of the program is paused.

⚠ **WARNING**

5   The stopping distance and time of Controlled stop and Smooth stop are longer than those of Power-Off stop. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time is necessary when Controlled stop or Smooth Stop is used. Please refer to the operator's manual of a particular robot model for the data of stopping distance and time.

6   In multi arm system, the longest stopping distance and time of Controlled Stop or Smooth Stop among each robot are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the multi arm system.

7   In the system which has extended axis, the longer stopping distance and time of Controlled Stop or Smooth Stop among robot and extended axis are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the system which has extended axis. Please refer to the extended axis setup procedure of the controller operator's manual for considering the stopping distance and time of the extended axis.

8   When Smooth stop occurs during deceleration by Controlled stop, the stop type of robot is changed to Power-Off Stop.
    When Smooth stop occurs during deceleration by Hold, the stop type of robot is changed to Power-Off Stop.

9   In case of Controlled stop or Smooth Stop, motor power shutdown is delayed for a maximum of 2 seconds. In this case, a risk assessment for the whole robot system is necessary, including the 2 seconds delay.

When the emergency stop button is pressed or the FENCE is open, the stop type of robot is Power-Off stop, Controlled stop, or Smooth stop. The configuration of stop type for each situation is called *stop pattern*. The stop pattern is different according to the option configuration.

There are the following 3 Stop patterns.

Stop pattern	Mode	Emergency stop button	External Emergency stop	FENCE open	SVOFF input	Deadman switch (*)
A	AUTO	P-Stop	P-Stop	C-Stop	C-Stop	-
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop
C	AUTO	C-Stop	C-Stop	C-Stop	C-Stop	-
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop
D	AUTO	S-Stop	S-Stop	C-Stop	C-Stop	-
	T1	S-Stop	S-Stop	-	C-Stop	S-Stop
	T2	S-Stop	S-Stop	-	C-Stop	S-Stop

P-Stop: Power-Off stop
C-Stop: Controlled stop
S-Stop: Smooth stop
-:   Disable
 (*) The stop pattern of NTED input is same as Deadman switch.

The following table indicates the Stop pattern according to the controller type or option configuration.

Option	R-30*i*B/ R-30*i*B Mate
Standard	A(**)
Controlled stop by E-Stop (A05B-2600-J570)	C(**)
Smooth E-Stop (A05B-2600-J651)	D(**)

 (**)R-30*i*B Mate does not have SVOFF input.

The stop pattern of the controller is displayed in "Stop pattern" line in software version screen. Please refer to "Software version" in operator's manual of controller for the detail of software version screen.

"Controlled stop by E-Stop" option

When "**Controlled stop by E-Stop**" (A05B-2600-J570) option is specified, the stop type of the following alarms become Controlled stop but only in AUTO mode. In T1 or T2 mode, the stop type is Power-Off stop which is the normal operation of the system.

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.

Controlled stop is different from **Power-Off stop** as follows:
- In Controlled stop, the robot is stopped on the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.
- In Controlled stop, physical impact is less than Power-Off stop. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End Of Arm Tool) should be minimized.
- The stopping distance and time of Controlled stop is longer than those of Power-Off stop, depending on the robot model and axis.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

> ⚠ **WARNING**
> The stopping distance and time of Controlled stop are longer than those of
> Power-Off stop. A risk assessment for the whole robot system which takes into
> consideration the increased stopping distance and stopping time, is necessary
> when this option is loaded.

"Smooth E-Stop Function" option

When "**Smooth E-Stop Function**" (A05B-2600-J651) option is specified, the stop type of the following alarms becomes Smooth stop in all operation modes (AUTO, T1 and T2 mode).

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-003 Deadman switch released	Both deadman switches on Teach pendant are released.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-037 IMSTP input (Group: %d)	IMSTP input (*IMSTP signal for a peripheral device interface) is OFF.
SRVO-232 NTED input	NTED input (NTED1-NTED11, NTED2-NTED21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.
SRVO-410 DCS SSO NTED input	In DCS Safe I/O connect function, SSO[5] is OFF.
SRVO-419 DCS PROFIsafe comm. error	PROFINET Safety communication error occurs.

Smooth stop is different from **Power-Off stop** as follows:
- In Smooth stop, the robot is stopped along the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.
- In Smooth stop, physical impact is less than Power-Off stop. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End Of Arm Tool) should be minimized.
- The stopping distance and time of Smooth stop is longer than those of Power-Off stop, depending on the robot model and axis.

Smooth stop is different from **Controlled stop** as follows:
- The stopping distance and time of Smooth stop is normally shorter than those of Controlled stop, depending on the robot model and axis.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

> ⚠ **WARNING**
> The stopping distance and time of Smooth stop are longer than those of
> Power-Off stop. A risk assessment for the whole robot system which takes into
> consideration the increased stopping distance and stopping time, is necessary
> when this option is loaded.

9   STOP TYPE OF ROBOT (R-30*i*B Plus, R-30*i*B Mate Plus)

There are following three types of Stop Category.

Stop Category 0 following IEC 60204-1 (Power-off Stop)

Servo power is turned off, and the robot stops immediately. Servo power is turned off when the robot is moving, and the motion path of the deceleration is uncontrolled.

"**Stop Category 0**" performs following processing.

- An alarm is generated, and then the servo power turns off. Instantly the robot stops.
- Execution of the program is paused.

Frequent Category 0 Stop of the robot during operation can cause mechanical problems of the robot. Avoid system designs that require routine or frequent Category 0 Stop conditions.

Stop Category 1 following IEC 60204-1 (Controlled Stop, Smooth Stop)

The robot is decelerated until it stops, and servo power is turned off.

"**Stop Category 1**" performs following processing.

- The alarm **"SRVO-199 Controlled stop"** or **"SRVO-289 Smooth Stop"** occurs along with a decelerated stop. The program execution is paused.
- An alarm is generated, and then the servo power turns off.

In Smooth stop, the robot decelerates until it stops with the deceleration time shorter than Controlled stop. The stop type of Stop Category 1 is different according to the robot model or option configuration. Please refer to the operator's manual of a particular robot model.

Stop Category 2 following IEC 60204-1 (Hold)

The robot is decelerated until it stops, and servo power remains on.

"**Stop Category 2**" performs following processing.

- The robot operation is decelerated until it stops. Execution of the program is paused.

> ⚠ **WARNING**
> 1 The stopping distance and time of Stop Category 1 are longer than those of Stop Category 0. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time is necessary when Stop Category 1 is used. Please refer to the operator's manual of a particular robot model for the data of stopping distance and time.
> 2 In multi arm system, the longest stopping distance and time of Stop Category 1 among each robot are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the multi arm system.
> 3 In the system which has extended axis, the longer stopping distance and time of Stop Category 1 among robot and extended axis are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the system which has extended axis. Please refer to the extended axis setup procedure of the controller operator's manual for considering the stopping distance and time of the extended axis.
> 4 When Stop Category 1 occurs during deceleration by Stop Category 2, the stop type of robot is changed to Stop Category 0.
> 5 In case of Stop Category 1, motor power shutdown is delayed for a maximum of 2 seconds. In this case, a risk assessment for the whole robot system is necessary, including the 2 seconds delay.

When the emergency stop button is pressed or the FENCE is open, the stop type of robot is Stop Category 0 or Stop Category 1. The configuration of stop type for each situation is called *stop pattern*. The stop pattern is different according to the option configuration.

There are the following 3 Stop patterns.

Stop pattern	Mode	Emergency stop button	External Emergency stop	FENCE open	SVOFF input	Deadman switch (*)
A	AUTO	Category 0	Category 0	Category 1	Category 1	-
	T1	Category 0	Category 0	-	Category 1	Category 0
	T2	Category 0	Category 0	-	Category 1	Category 0
C	AUTO	Category 1	Category 1	Category 1	Category 1	-
	T1	Category 0	Category 0	-	Category 1	Category 0
	T2	Category 0	Category 0	-	Category 1	Category 0
D	AUTO	Category 1	Category 1	Category 1	Category 1	-
	T1	Category 1	Category 1	-	Category 1	Category 1
	T2	Category 1	Category 1	-	Category 1	Category 1

Category 0:   Stop Category 0
Category 1:   Stop Category 1
-:   Disable
 (*) The stop pattern of NTED input is same as Deadman switch.
The following table indicates the Stop pattern according to the controller type or option configuration.
The case R651 is specified.

Option	R-30*i*B Plus/ R-30*i*B Mate Plus
Standard	C(**)
Old Stop Function (A05B-2670-J680)	A(**)
All Smooth Stop Function (A05B-2670-J651)	D(**)

The case R650 is specified.

Option	R-30*i*B Plus/ R-30*i*B Mate Plus
Standard	A(**)
Stop Category 1 by E-Stop (A05B-2670-J521)	C(**)
All Smooth Stop Function (A05B-2670-J651)	D(**)

(**)R-30*i*B Mate Plus does not have SVOFF input.

The stop pattern of the controller is displayed in "Stop pattern" line in software version screen. Please refer to "Software version" in operator's manual of controller for the detail of software version screen.

"Old Stop Function" option

When "**Old Stop Function**" (A05B-2670-J680) option is specified, the stop type of the following alarms becomes Stop Category 0 in AUTO mode.

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.

Stop Category 0 is different from **Stop Category 1** as follows:
- In Stop Category 0, servo power is turned off, and the robot stops immediately. Servo power is turned off when the robot is moving, and the motion path of the deceleration is uncontrolled.
- The stopping distance and time of Stop Category 0 is shorter than those of Stop Category 1, depending on the robot model and axis.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

"All Smooth Stop Function" option

When "**All Smooth Stop Function**" (A05B-2670-J651) option is specified, the stop type of the following alarms becomes Stop Category 1 in all operation modes (AUTO, T1 and T2 mode).

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-003 Deadman switch released	Both deadman switches on Teach pendant are released.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-037 IMSTP input (Group: %d)	IMSTP input (*IMSTP signal for a peripheral device interface) is ON.
SRVO-232 NTED input	NTED input (NTED1-NTED11, NTED2-NTED21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.
SRVO-410 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[5] is OFF.
SRVO-419 DCS PROFIsafe comm. error	PROFINET Safety communication error occurs.

Stop Category 1 is different from **Stop Category 0** as follows:
- In Stop Category 1, the robot is stopped along the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.

- In Stop Category 1, physical impact is less than Stop Category 0. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End of Arm Tool) should be minimized.
- The stopping distance and time of Stop Category 1 is longer than those of Stop Category 0, depending on the robot model and axis.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

> ⚠ **WARNING**
> The stopping distance and time of Stop Category 1 are longer than those of Stop Category 0. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time, is necessary when this option is loaded.

"Stop Category 1 by E-Stop" option

When "**Stop Category 1 by E-Stop**" (A05B-2670-J521) option is specified, the stop type of the following alarms become Category 1 Stop but only in AUTO mode. In T1 or T2 mode, the stop type is Category 0 Stop which is the normal operation of the system.

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.

Stop Category 1 is different from **Stop Category 0** as follows:
- In Stop Category 1, the robot is stopped along the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.
- In Stop Category 1, physical impact is less than Stop Category 0. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End of Arm Tool) should be minimized.
- The stopping distance and time of Stop Category 1 is longer than those of Stop Category 0, depending on the robot model and axis.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

> ⚠ **WARNING**
> The stopping distance and time of Stop Category 1 are longer than those of Stop Category 0. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time, is necessary when this option is loaded.

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TABLE OF CONTENTS

1   SYSTEM OVERVIEW

1.1   OVERVIEW

The FANUC DeviceNet Interface is a Controller Area Network (CAN) BUS-based interface that provides a simplified method of connection between industrial actuators and sensors, and an I/O controller. The DeviceNet Interface consists of hardware and software components that allow a robot controller to connect to one or more DeviceNet networks.

The hardware component consists of a motherboard and, depending on the type of motherboard and your networking requirements, one to four daughterboards. Each board provides an interface to the DeviceNet network. The software component is the FANUC DeviceNet Interface software, which is installed as an option on the robot controller.

The DeviceNet Interface offers the following benefits:
- It offers you a better process solution through simplified I/O wiring and a reduction in interface hardware, which results in a communications system that is easier to develop and debug.
- Depending on your hardware configuration, it can offer you the ability to connect to up to four different networks. You can
  - Use one network for communications between a host and several controllers in a cell and a second network for all devices local to a single controller.
  - Use one network for devices that are located far from the controller and thus require the use of a lower baud rate. Use another network for devices that are closer to the controller and can use a higher baud rate.
- It allows you to use an open, industry-standard, networking protocol to communicate from the robot to a wide array of industrial devices, from simple photoelectric switches and proximity switches to programmable logic controllers (PLCs).

When installed properly, the DeviceNet Interface can be used in combination with any of the following:
- Process I/O boards
- Model A I/O modules
- Model B I/O modules
- Allen-Bradley Remote I/O
- Ethernet communications
- Profibus DP
- ControlNet

To give you a better idea of how to implement the DeviceNet Interface in your system, the following sections provide a physical and functional description of the DeviceNet Interface.

> **NOTE**
> For DeviceNet Safety function that exchanges safety signals on DeviceNet Interface, please read "R-30*i*A/R-30*i*A Mate controller Dual Check Safety Function (ISO 13849-1:2006 compliant) operator's manual (B-83104EN)" or "R-30*i*B/R-30*i*B Mate controller Dual Check Safety Function operator's manual (B-83184EN) in addition to this manual.

1.2 HARDWARE DESCRIPTION

The DeviceNet Interface hardware consists of the following components:
- A DeviceNet Interface motherboard, which provides the interface between the controller backplane and the PC/104 connection of the daughterboards. There are two kinds of motherboards:
    - The full-slot motherboard, shown in Fig. 1.2 (a) , which occupies a full-width slot on the controller backplane
    - The wide-mini motherboard, shown in Fig. 1.2 (b) , which occupies the wide-mini slot of the controller
- One to four DeviceNet daughterboards, which reside on the motherboards. The full-slot motherboard supports up to four daughterboards, while the wide-mini motherboard supports only a single daughterboard. The devices on the networks connected to the daughterboards are configured as racks 81 - 84 for I/O assignment purposes.
- A mini-slot DeviceNet DN4 board, which occupies a mini-slot or a wide-mini slot of the controller backplane, is composed of a mini-slot motherboard and a DeviceNet DN4 daughterboard. The mini-slot DeviceNet DN4 board is the only board used for DeviceNet master function in R-30*i*A Mate/R-30*i*B Mate controller since it has only mini-slot backplane.
- A DeviceNet slave board (mini-slot) that operates as a DeviceNet slave only. This board can be configured as rack 81. Only one DeviceNet slave board is supported on the robot. If there is a PC/104 board configured as rack 81 (Board 1), that board will be ignored and the slave board will be given priority.

NOTE
Only a maximum of four channels of DeviceNet are supported using any combination of single channel and dual channel boards. If a DeviceNet slave board is installed, three additional channels are supported.
Refer to Appendix A for more information about motherboards and daughterboards. Refer to Chapter 2 for hardware installation information.
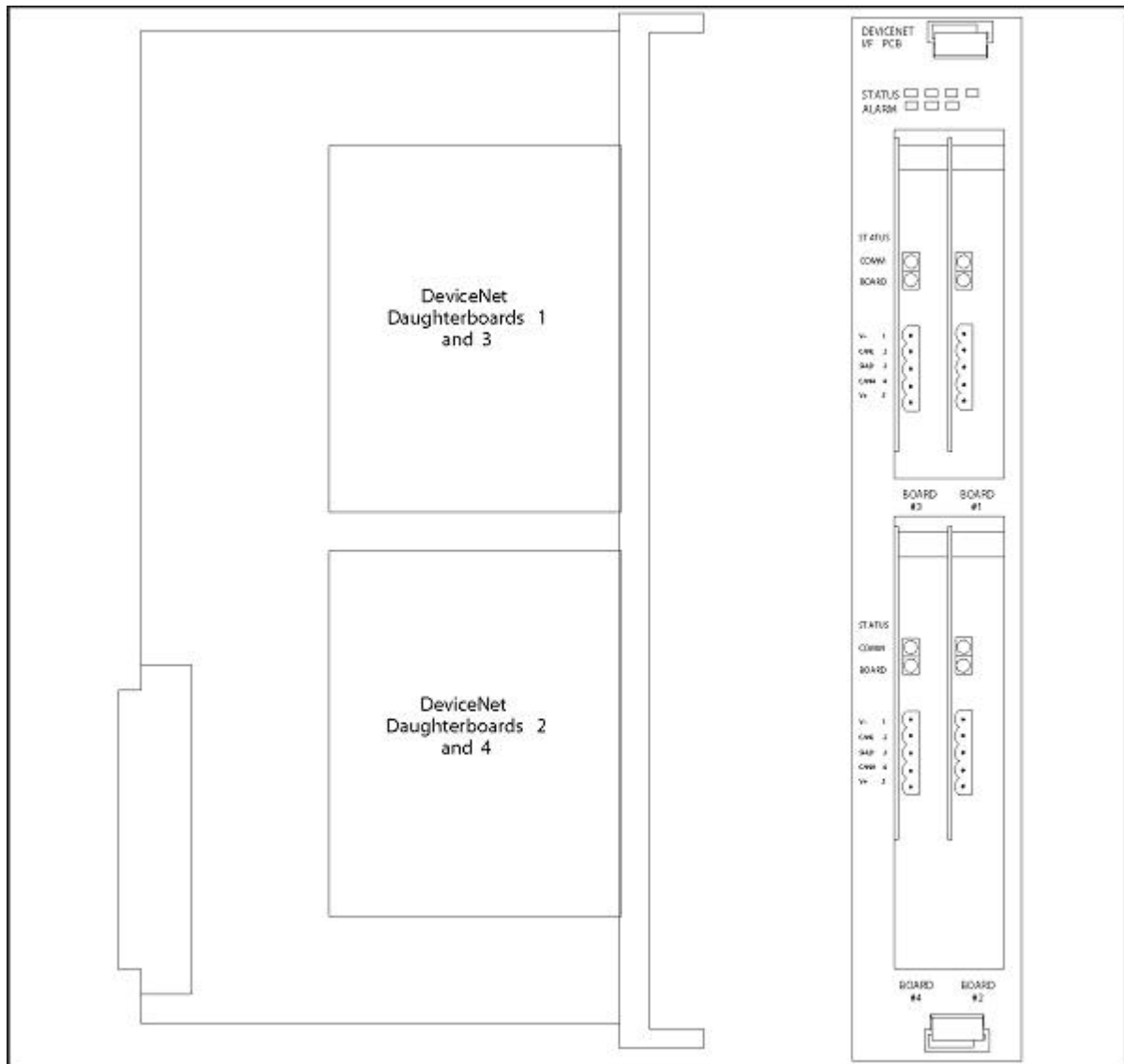
Fig. 1.2 (a)   DeviceNet I/O Interface Board - Full-slot Motherboard with DN Daughterboards
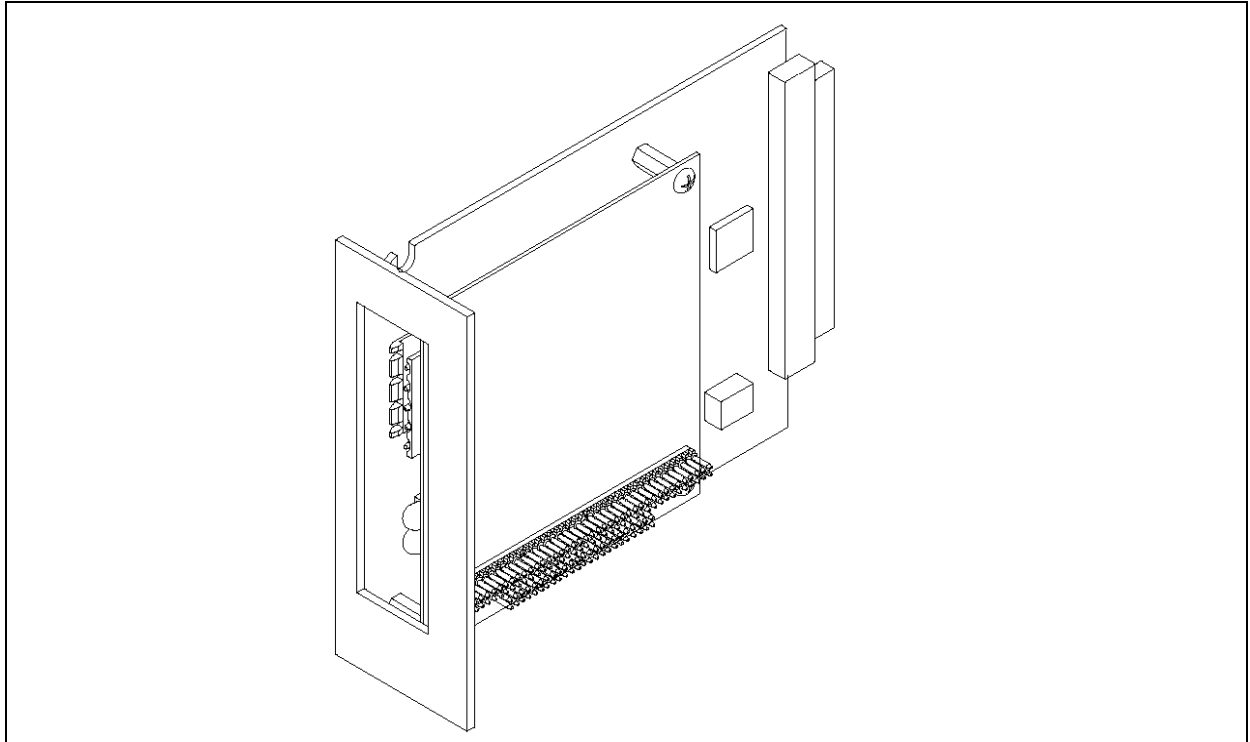
Fig. 1.2 (b)   DeviceNet I/O Interface Board --Wide-mini Motherboard with DN Daughterboard
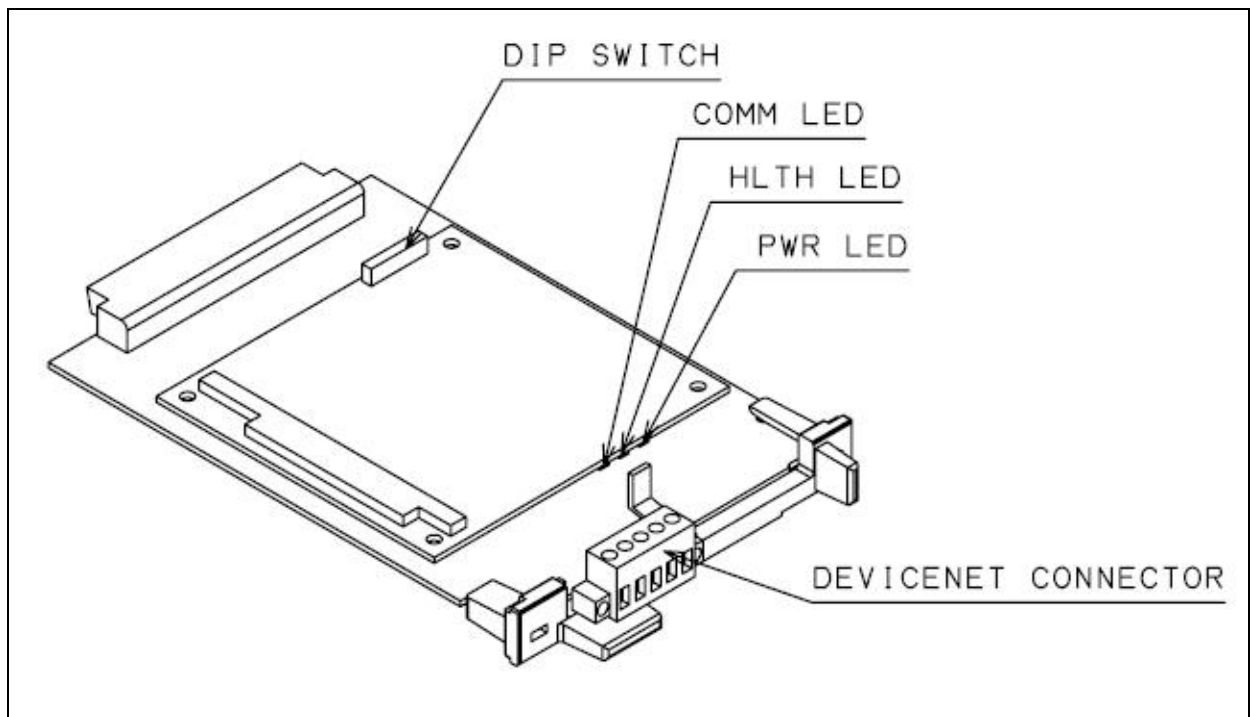
Fig. 1.2 (c)   Mini-slot DeviceNet DN4 board
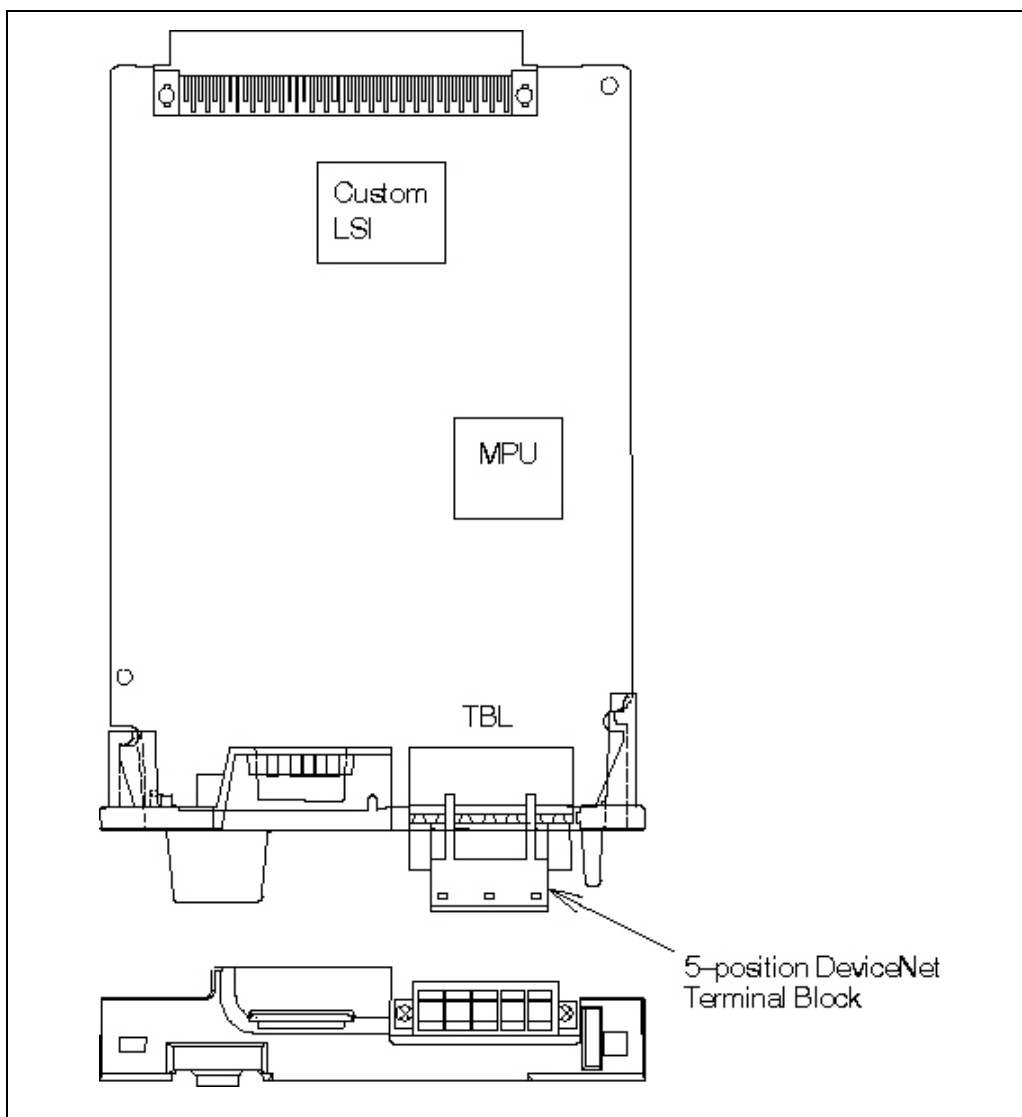
Fig. 1.2 (d)   DeviceNet slave board

DeviceNet Interface Network Connections

Each daughterboard connects to a DeviceNet network using a standard DeviceNet cable with a five-terminal Phoenix Combicon connector. See Fig. 1.2 (e).

The devices on the DeviceNet network that are connected to the four daughterboards are configured on teach pendant I/O screens as being on racks 81 - 84. Refer to Chapter 6 for more information on assigning I/O to DeviceNet devices.
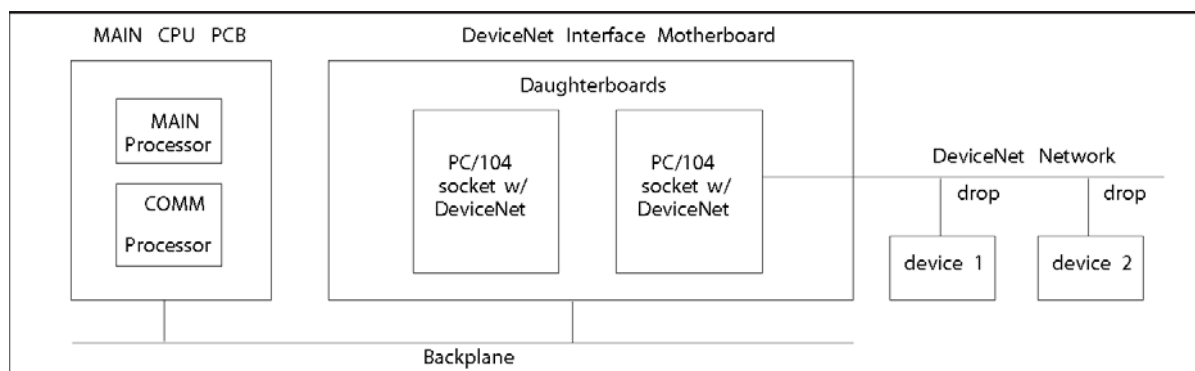
Fig. 1.2 (e)   DeviceNet I/O hardware connection block diagram

1.3   SOFTWARE DESCRIPTION

1.3.1   Overview

The DeviceNet Interface software is a FANUC software option.

1.3.2   Connections

DeviceNet Interface software running on the controller communicates with each DeviceNet daughterboard via a shared memory area to provide and receive I/O status, receive diagnostic information, and issue commands. See Fig. 1.3.2 .
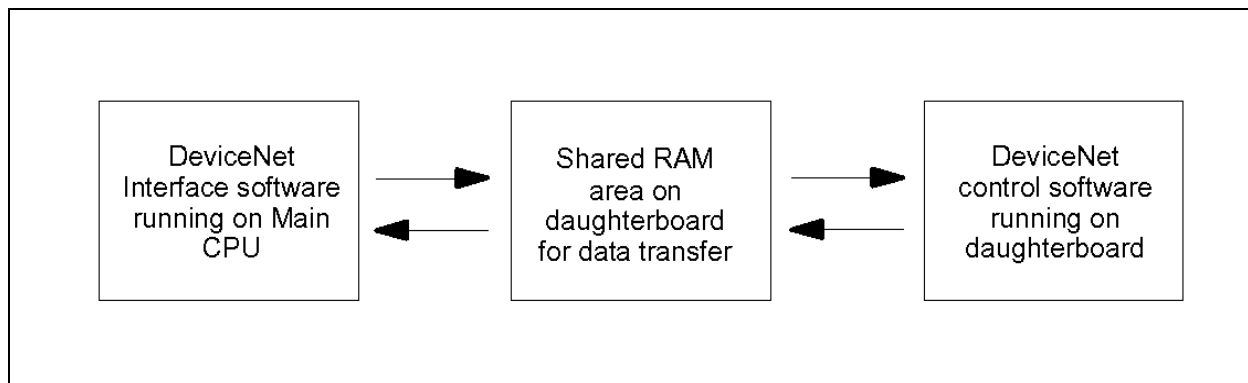
Fig. 1.3.2 DeviceNet interface software connection block diagram

1.3.3   Communication

Communications between the DeviceNet Interface and connected devices is based on the DeviceNet protocol. The DeviceNet Interface allows the controller to communicate simultaneously with both slave devices and an external master (scanner) device.

2   HARDWARE AND INSTALLATION

> **NOTE**
> For DeviceNet Safety function that exchanges safety signals on DeviceNet Interface, please read "R-30*i*A/R-30*i*A Mate controller Dual Check Safety Function (ISO 13849-1:2006 compliant) operator's manual (B-83104EN)" or "R-30*i*B/R-30*i*B Mate controller Dual Check Safety Function operator's manual (B-83184EN) in addition to this manual.

2.1   HARDWARE REQUIREMENTS

In order to install the DeviceNet Interface properly, you must have the following components in your system:
- A FANUC DeviceNet Interface motherboard and one to four daughterboards.
    - A full-slot motherboard supports one to four daughterboards.
    - A wide-mini motherboard supports only one daughterboard.
    - A mini-slot DeviceNet DN4 board (composed of one daughterboard and one motherboard).
    - A DeviceNet slave board (needs no motherboard)
- A FANUC robot and a robot controller
- A DeviceNet network and DeviceNet device(s)
- A DeviceNet cable with a five-terminal Phoenix Combicon connector on one end (the other end can have any DeviceNet-compatible connector)
- An R-30*i*A/R-30*i*B wide-mini slot blind plate (A05B-2500-J320) is required when a mini-slot DeviceNet DN4 board is installed to the wide-mini slot.

You must also have knowledge of installing, configuring, and operating the DeviceNet network and devices that will be used in your system.

> **NOTE**
> For details on the DeviceNet Interface, such as DIP switch settings, part numbers, definition of LEDs and connections, refer to Appendix A . The DIP switch settings on the DeviceNet daughterboard must be set correctly and determine whether the Interface is seen as Board #1, 2, 3, or 4 (rack 81, 82, 83, 84).

2.2   DEVICENET NETWORK REQUIREMENTS

The DeviceNet Interface is connected to a DeviceNet network. It consists of the following customer-supplied components:
- Trunk line cable
- T-connectors
- Drop cables
- Termination resistors - one resistor is needed on each end of the trunk line.
- DeviceNet- compatible devices

The following components are optional:
- External master device (such as a PLC) with a separate DeviceNet scanner
- A DeviceNet network configuration device or software for devices that can be configured only through software

2.3 DEVICENET INTERFACE INSTALLATION AND CONFIGURATION

2.3.1 Overview

Installing and configuring the DeviceNet Interface on the controller requires that you perform the following steps:
1.   Install the DeviceNet Interface board in the controller. Refer to Subsection 2.3.2 .
2.   Configure each DeviceNet Interface daughterboard. Refer to Section 3.1 .
3.   Connect each DeviceNet Interface daughterboard to the corresponding DeviceNet network. Refer to Section 3.1 .
4.   Turn on the controller. At Controlled Start, install the DeviceNet software option.
5.   Turn on power to the system, and check for proper installation. Refer to Subsection 2.3.2 .
6.   Define DeviceNet devices connected to each DeviceNet daughterboard. Refer to Section 5.2 .

In addition, you can configure the DeviceNet Interface as follows. Use these configurations only if you want to use the DeviceNet Interface in either of these ways.
•   Configure a DeviceNet Interface daughterboard for slave operation. Refer to Section 4.1 .
•   Configure multiple-module DeviceNet devices. Refer to Section 5.3 .

2.3.2 Installing the DeviceNet Interface Board in the Controller

Use Procedure 2-1 to install the DeviceNet Interface.

Procedure 2-1 Installing the DeviceNet Interface in the Controller

> ⚠ **WARNING**
> Disconnect electrical power from the controller before you remove or replace components, or you could be injured seriously.

Steps
1.   Turn off the controller.
2.   Disconnect electrical power from the controller. Turn the power disconnect circuit breaker handle to the OFF (open) position.
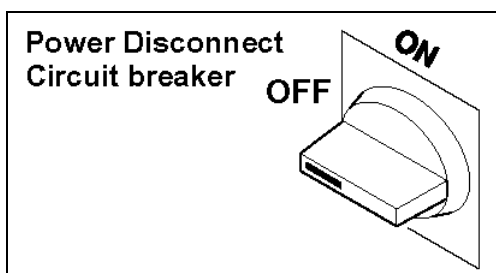
> ⚠ **WARNING**
> When the circuit breaker handle is OFF, power is still present inside the controller. You must unplug the controller from the electrical outlet to remove all power from the controller.

3.   Use a flat-tip screwdriver to turn the latch on the front door of the controller to the UNLOCKED position.

4. **To install the DeviceNet Interface,** plug in the DeviceNet Interface to an appropriate empty slot on the backplane. In R-30*i*B, the DeviceNet Interface can be installed on only slot 2. Be sure the connector seats properly with the backplane connector.

Slot 2

Slot 3

Daughterboards

DeviceNet I/O Interface Board
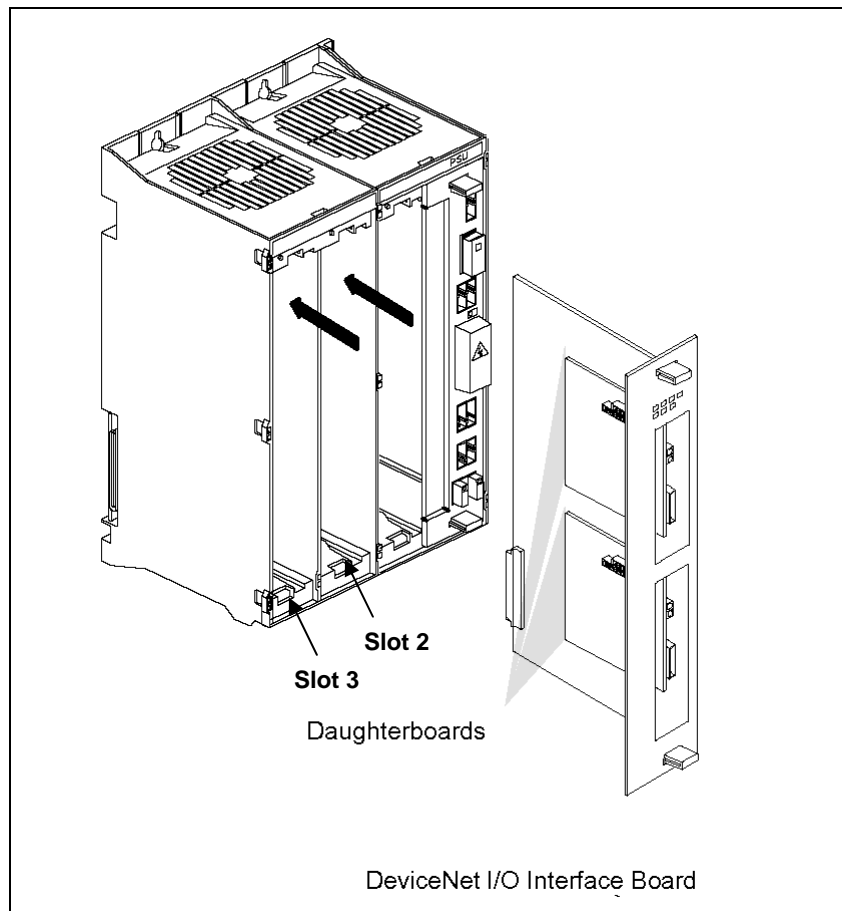
Fig. 2.3.2 (a)   Installing the DeviceNet Interface into Full-width Slot

---

NOTE
For details on the DeviceNet Interface, such as DIP switch settings, part numbers, definition of LEDs and connections, refer to Appendix A . The DIP switch settings on the DeviceNet daughterboard must be set correctly and determine whether the Interface is seen as Board #1, 2, 3, or 4 (rack 81, 82, 83, 84).
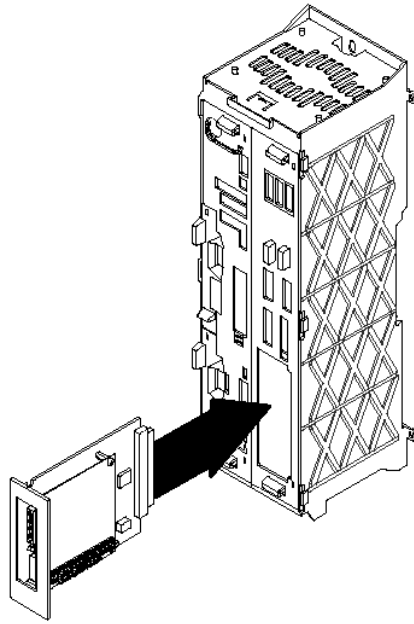
Fig. 2.3.2 (b)   Installing the DeviceNet Interface into Wide-mini Slot
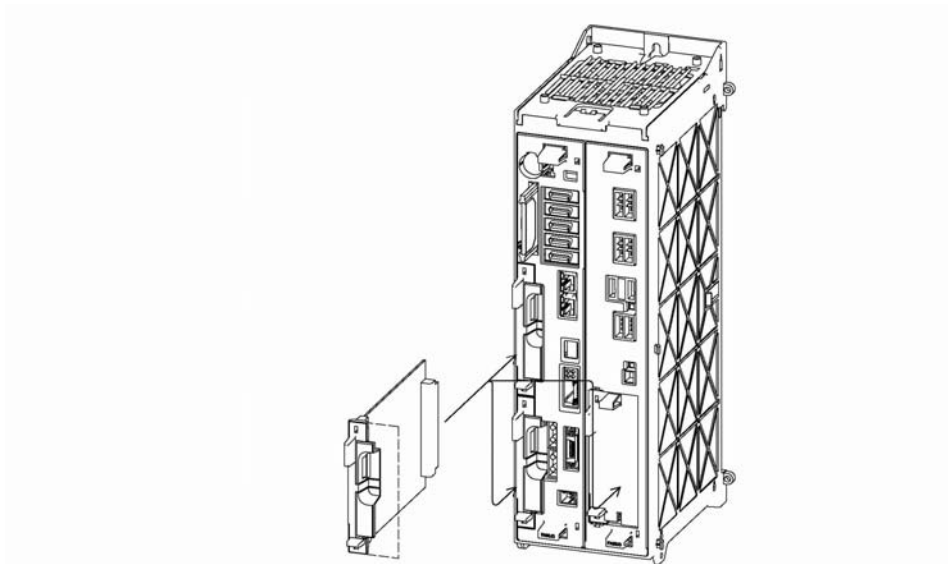
Fig. 2.3.2 (c)   Installing the Mini-Slot DeviceNet DN4 board into Mini Slot/Wide-mini Slot

NOTE
An R-30*i*A/R-30*i*B wide-mini slot blind plate (A05B-2500-J320) is required when a mini-slot DeviceNet DN4 board is installed to the wide-mini slot.
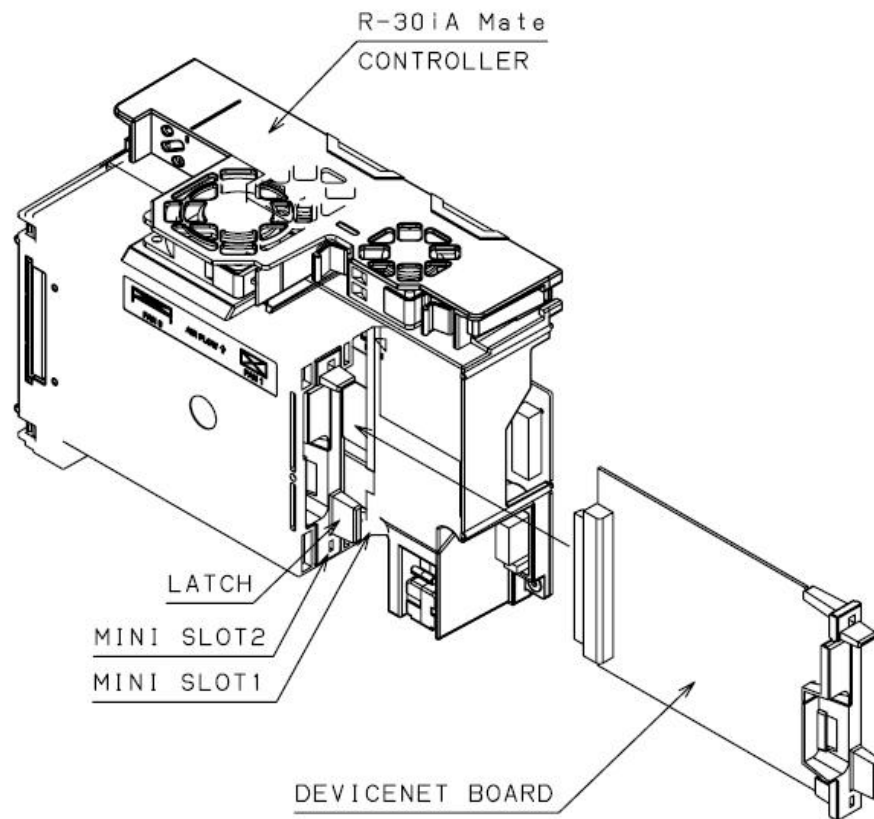
Fig. 2.3.2 (d)   Installing the Mini-Slot DeviceNet DN4 board into R-30*i*A Mate/R-30*i*B Mate controller

5.   Close the controller door and use a flat-tip screwdriver to turn the latch on the front door to the LOCKED position. Set the circuit breaker handle to ON.
6.   **Turn on power to the system** by performing a Cold start:
   •   If you are still at a Controlled start in Step 6 , press FCTN and select START (COLD).
   a.   Turn off the controller.
   b.   Press and continue pressing the SHIFT and RESET keys on the teach pendant.
   c.   Turn the power disconnect circuit breaker to ON.
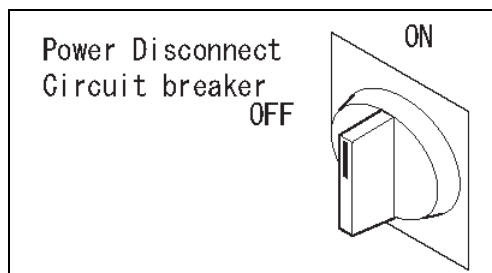
   d.   Release SHIFT and RESET.

NOTE
   Note After the controller has come up in Cold start mode, the BOARD STATUS LED on each DeviceNet Interface daughterboard should be STEADY GREEN.

---

7.   Configure each DeviceNet Interface daughterboard. Refer to Section 3.1 .

3 DEVICENET BOARD SETUP AND CONFIGURATION

3.1 CONFIGURING AND CONNECTING THE DEVICENET INTERFACE DAUGHTERBOARDS

Before you can connect the DeviceNet Interface daughterboards to devices on the DeviceNet network, you must configure them properly. Use Procedure 3-1 to configure the daughterboards.

When you configure DeviceNet Interface daughterboards, you use two screens: the I/O DeviceNet Board List screen and the I/O DeviceNet Board Detail screen. Refer to Table 3.1 (a) and Table 3.2 (b) for a listing and description of each of the items on these screens.

Table 3.1 (a) DeviceNet board list screen items

ITEM	DESCRIPTION
Board	This is the number of the DeviceNet Interface daughterboard, 1–4.
Comment	This is text you enter to describe the daughterboard. A comment is optional.
Rack	This is the I/O rack that will be used to configure the I/O used with the daughterboard on the controller. DeviceNet Interface daughterboards must use racks 81 through 84: • Rack 81 - Daughterboard 1 • Rack 82 - Daughterboard 2 • Rack 83 - Daughterboard 3 • Rack 84 - Daughterboard 4 **You cannot change the rack number of a daughterboard.**
Status	This is the current state of the DeviceNet Interface daughterboard. • **ONLINE** indicates the board is presently active. Information to and from devices configured on this network is being updated. • **OFFLINE** indicates that no data is being transferred to or from devices connected to the board. Scanning of devices connected to this board will not start at power up. • **ERROR** indicates that an error has been detected. The board is effectively off-line, but scanning will be attempted after power up.

Table 3.1 (b) DeviceNet board detail screen items

ITEM	DESCRIPTION
Board	This displays the number of the selected daughterboard.
Status	This displays the status of the selected daughterboard: ONLINE, OFFLINE, ERROR.
Scanner Type	The model of scanner represented by this daughterboard. Currently four kinds are supported: SST 5136-DN, SST 5136-DNP, SST 5136-DN3, SST 5136-DN4, and slave only.
Motherboard	The type of motherboard used with the daughterboard. Currently there are three kinds: "full-slot", "wide-mini" and "mini-slot".
MAC-Id	This is the Media Access Control ID used by the daughterboard. It must have a value of from 0 to 63. The MAC-Id must be different from the MAC-Ids of all other devices on the network.

ITEM	DESCRIPTION
Baud Rate	This specifies the data rate used in transfers between the DeviceNet Interface board and the devices on the network. Specify one of the following baud rates: • 125 KB • 250 KB • 500 KB
Board Auto-restart	When this is set to ON, the board will automatically restart communication with the DeviceNet network after a board or network error has occurred and the error situation has been resolved. Setting this value to OFF turns off board auto-restart. The default value is OFF.
Input resume state	The two valid values for this setting are LAST and ZERO, and this setting affects all input I/O ports (digital, analog, group, and so forth) which have an assigned rack value equal to the board's rack number. When the input resume state is set to LAST, these input ports will retain their last known values if the port goes offline. When the input resume state is set to ZERO, the port values are set to zero. The default value is ZERO.
Slave Status	Slave status indicates the status of the slave connection of this DeviceNet board. If the slave connection is not enabled (if size of output from master and size of input to master are 0), this field displays OFFLINE. If it is enabled and the remote master has not yet connected, this field indicates IDLE and error DNET-125 is posted. If the remote master is connected, this field displays ONLINE. This field is display only.
Slave Error Severity	This sets the error severity level of the error DNET-125 that indicates the slave connection is idle. Select WARN, STOP or PAUSE as required.
Slave Operation: Size of output from master	For slave operation, in which the controller acts as a slave to an external master, this specifies the size of the output **from** the master **to** the daughterboard, in bytes. If the board is not used as slave, set this setting to 0 bytes.
Slave Operation: Size of input to master	For slave operation, in which the controller acts a slave to an external master, this specifies the size of the input **to** the master **from** the daughterboard, in bytes. If the board is not used as slave, set this setting to 0 bytes.
Integrated CIP Safety	This item shows up only if DeviceNet safety function is ordered. For DeviceNet Safety function that exchanges safety signals on DeviceNet Interface, please read "R-30iA/R-30iA Mate controller Dual Check Safety Function (ISO 13849-1:2006 compliant) operator's manual (B-83104EN)" or "R-30iB/R-30iB Mate controller Dual Check Safety Function operator's manual (B-83184EN) in addition to this manual.

Procedure 3-1 Configuring and Connecting DeviceNet Interface Daughterboards

Conditions

- You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
- You have installed the DeviceNet Interface software option. (Procedure 2-1)

Steps

1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet. You will see a screen similar to the following.

```
Board List                            1/4
  Board     Comment          Rack   Status
    1    [              ]      81   OFFLINE
    2    [              ]      82   OFFLINE
    3    [              ]      83   OFFLINE
    4    [              ]      84   OFFLINE
```

> **NOTE**
> To display help information, press F5, HELP. When you are finished, press PREV.

5. **To configure each daughterboard,** move the cursor to the daughterboard you want to configure and press F4, DETAIL. You will see a screen similar to the following.

```
Board Detail
Board: 1                        Status:   OFFLINE
Scanner type:   SST 5136-DN-104
Motherboard:   Full-slot
1   MAC-ID:
2   Baud-rate:                     125 KB
3   Board auto-restart:            OFF
4   Input resume state (rack 81): LAST
Slave Operation:
    Slave Status:                  OFFLINE
5   SLAVE Error Severity:          WARN
6   Size of output from master:   0 bytes
7   Size of input to master:      0 bytes
```

> **NOTE**
> To display help information, press F5, HELP. When you are finished, press PREV.

6. Move the cursor to MAC-Id and type the MAC-Id. This must be a value from 0 to 63 and must be different from the MAC-Id of any other device in the network.

7. Move the cursor to Baud-rate, and press the function key that corresponds to the baud rate you want to use:
   - For 125 KB, press F2.
   - For 250 KB, press F3.
   - For 500 KB, press F4.

8. Move the cursor to Board auto-restart to set the board auto-restart state:
   - To turn it on, press F2.
   - To turn it off, press F3.

9. Move the cursor to input resume state to set the input resume state for the board:
   - If inputs are to retain their last state, press F2.
   - If inputs are to be set to zero, press F3.
     Slave status indicates the status of the slave connection of this DeviceNet board.
   - If the slave connection is not enabled (if size of output from master and size of input to master are 0), this field displays OFFLINE.
   - If it is enabled and the remote master has not yet connected, this field indicates IDLE and error DNET-125 is posted.
   - If the remote master is connected, this field displays ONLINE. This field is display only.

10. **If you are performing slave operations,** move the cursor to SLAVE Error Severity. This sets the error severity level of the error DNET-125 that indicates the slave connection is idle. Select WARN, STOP, or PAUSE as required. Refer to Chapter 4 .

> **NOTE**
> This affects only DNET-125 error posted by the DeviceNet interface.

11. **If you are performing slave operations,** move the cursor to Size of output from master and type the size of the master's output data buffer, in bytes. Refer to Chapter 4 .
12. **If you are performing slave operations,** move the cursor to Size of input to master and type the size of the master's input data buffer, in bytes. Refer to Chapter 4 .

> **NOTE**
> To configure an external master (scanner) to scan the daughterboard, you must specify the following information to the master device:
> - **MAC ID** - This must agree with the value specified for the MAC ID in the Board Detail screen for the slave board.
> - **Baud rate** - This must agree with the value specified for the Baud rate in the Board Detail screen for the slave board.
> - **Input buffer size** - This must agree with the value specified for the size of input to master in the Board Detail screen for the slave board. Note that output for the controller is input to the master device, and vice-versa.
> - **Output buffer size** - This must agree with the value specified for the size of output from master in the Board Detail screen for the slave board.
> - **SST board**: Vendor ID - 8, Device type - 12 (communications adapter), Product code - 14
> - **DeviceNet Slave Board**: Vendor ID - 591, Device type - 12, Product Code - 3

13. Press F4, LIST, or PREV to display the DeviceNet Board List screen.
14. Repeat Step 5 through Step 13 for any remaining daughterboards you want to configure.
15. If you want to add a comment to any daughterboard, move the cursor to the COMMENT and press ENTER. Use the function keys to type the comment you want. When you are finished, press ENTER.

> **NOTE**
> The BOARD STATUS LED on each daughterboard should be STEADY GREEN, and the COMM STATUS LED should be OFF.

16. To connect each daughterboard to the DeviceNet network,
    a. Turn off the controller.

> ⚠ **WARNING**
> Disconnect electrical power from the controller before you remove or replace components; otherwise, you could injure personnel or damage equipment.

   b. Disconnect electrical power from the controller. Turn the circuit breaker handle to the OFF (open) position.

> ⚠ **WARNING**
> When the circuit breaker handle is OFF, power is still present inside the controller. You must unplug the controller from the electrical outlet to remove all power from the controller.

   c. Use a flat-tip screwdriver to turn the latch on the front door of the controller to the UNLOCKED position.
   d. Make sure the baud rate for each DeviceNet device is the same as the baud rate for the DeviceNet daughterboard to which the device will be connected.
   e. Connect a DeviceNet network cable from each daughterboard to the network of devices with which you want to communicate.
   f. Make sure power is connected to the DeviceNet network. If power is supplied from the controller, make sure it is connected in the appropriate location.

g.   Close the controller door and use a flat-tip screwdriver to turn the latch on the front door to the LOCKED position. Set the circuit breaker handle to ON.
h.   Turn on the controller.
i.   Press MENUS.
j.   Select I/O.
k.   Press F1, [TYPE].
l.   Select DeviceNet. See the following screen for an example.

```
Board List                            1/4
Board      Comment           Rack   Status
   1    [New network   ]      81    ONLINE
   2    [              ]      82    OFFLINE
   3    [              ]      83    OFFLINE
   4    [              ]      84    OFFLINE
```

m.   For each daughterboard connected to a DeviceNet network or networks, move the cursor to the board and press NEXT, then F4 (ONLINE). The status of each of the boards should change to ONLINE.
     If the status is not ONLINE, refer to the troubleshooting information in Section 7.2 .

NOTE
   The COMM STATUS LED on each daughterboard should be FLASHING
   GREEN; the BOARD STATUS LED should remain STEADY GREEN.

---

n.   Define each DeviceNet device that will be connected to each DeviceNet Interface daughterboard. Refer to Section 5.2 .

3.2   DELETING AND RESETTING A DEVICENET DAUGHTERBOARD

Use Procedure 3-2 to delete and reset a DeviceNet daughterboard.

Procedure 3-2 Deleting and Resetting a DeviceNet Daughterboard

---
⚠ **CAUTION**
   This procedure will erase all device and board information that currently exists
   for this daughterboard. Be sure you want to do this before you perform this
   procedure; otherwise, information will be set to default settings and current
   information will be lost.

Conditions
   •   You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
   •   You have installed the DeviceNet Interface software option. (Procedure 2-1)
   •   You have configured the DeviceNet Interface daughterboards used in your system. (Procedure 3-1)

Steps
1.   Press MENUS.
2.   Select I/O.
3.   Press F1, [TYPE].
4.   Select DeviceNet. You will see a screen similar to the following.

```
Board List                          1/4
  Board    Comment         Rack   Status
   1    [New network  ]    81    ONLINE
   2    [            ]      82    OFFLINE
   3    [            ]      83    OFFLINE
   4    [            ]      84    OFFLINE
```

5.   Move the cursor to the daughterboard you want to delete.
6.   **If the board is currently ONLINE ,** take it offline:
     a.   Press NEXT, >.
     b.   Press F5, OFFLINE. The status changes to OFFLINE.
7.   Press NEXT, >, and press F1, DELETE.
8.   Press the appropriate function key:
     a.   To delete the board, press F4, YES.
     b.   To cancel the deletion, press F5, NO.

3.3   TURNING BOARD RESTART ON/OFF

Use Procedure 3-3 to turn board auto-restart on or off.

Procedure 3-3 Turning Board Auto-restart ON/OFF

Conditions

   •   You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
   •   You have installed the DeviceNet Interface software option. (Procedure 2-1)

Steps

1.   Press MENUS.
2.   Select I/O.
3.   Press F1, [TYPE].
4.   Select DeviceNet. You will see a screen similar to the following.

```
Board List                          1/4
  Board    Comment         Rack   Status
   1    [New network  ]    81    ONLINE
   2    [            ]      82    OFFLINE
   3    [            ]      83    OFFLINE
   4    [            ]      84    OFFLINE
```

5.   Move the cursor to the board for which you want to turn board auto-restart on or off.
6.   Press F4, DETAIL. You will see a screen similar to the following.

```
Board Detail
Board: 1                    Status:   OFFLINE
Scanner type:   5136-DN-104
Motherboard:   Full-slot
1  MAC-ID:                       0
2  Baud-rate:                   125 KB
3  Board auto-restart:         OFF
4  Input resume state (rack 81): LAST
Slave Operation:
   Slave Status:                OFFLINE
5  SLAVE Error Severity:        WARN
6  Size of output from master:   0 bytes
7  Size of input to master:      0 bytes
```

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7. Move the cursor to the field next to board auto-restart.
    a. If you want to turn auto-restart on, Press F2, ON.
    b. If you want to turn auto-restart off, press F3, OFF.

NOTE
   When auto-restart is turned on, the board status on the board list screen will be enclosed in brackets (<and>). For instance, a board that is online will show the following status: <ONLINE>. Turning auto-restart off removes the brackets.

3.4   CHANGING THE INPUT RESUME STATE

Use Procedure 3-4 to change the input resume state for a board.

Procedure 3-4 Changing the Input Resume State

Conditions

   •   You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
   •   You have installed the DeviceNet Interface software option. (Procedure 2-1)

Steps

1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet. You will see a screen similar to the following.

```
Board List                          1/4
  Board      Comment          Rack   Status
    1    [New network   ]      81    ONLINE
    2    [              ]      82    OFFLINE
    3    [              ]      83    OFFLINE
    4    [              ]      84    OFFLINE
```

5. Move the cursor to the board for which you want to change the input resume state.
6. Press F4, DETAIL. You will see a screen similar to the following.

```
Board Detail
Board: 1                    Status:   OFFLINE
Scanner type:   5136-DN-104
Motherboard:   Full-slot
1  MAC-ID:                        0
2  Baud-rate:                  125 KB
3  Board auto-restart:          OFF
4  Input resume state (rack 81): LAST
Slave Operation:
   Slave Status:                OFFLINE
5  SLAVE Error Severity:        WARN
6  Size of output from master:   0 bytes
7  Size of input to master:      0 bytes
```

7. Move the cursor to the field next to input resume state.
    a. To set the input resume state to be the last known value, press F2, LAST.
    b. To set the input resume state to zero, press F3, ZERO.

3.5   COMPONENTS

The full-slot DeviceNet motherboard can accommodate between one and four DeviceNet scanner daughterboards. The mini-wide motherboard accommodates a single daughterboard. For detailed information about each daughterboard, including DIP switch settings, part numbers, LEDs, and connectors, refer to Appendix A .

3.6   SAVING AND RESTORING DEVICENET CONFIGURATION

DeviceNet configuration is saved in system file SYSDNET.SV. All configuration, including board configuration, device list, and user-defined devices, is saved in this file.

NOTE
   All Robot I/O mapping configuration information is saved in system file
   DIOCFGSV.IO. Prior versions of R-30iA software saved DeviceNet information
   in DIOCFGSV.IO. A part of DeviceNet information is still duplicated in this file
   (newer feature settings are not saved in this file). As a result when
   DIOCFGSV.IO is restored, a part of DeviceNet configuration is also restored. If
   you are restoring SYSDNET.SV and DIOCFGSV.IO files that are from two
   different robots, restore DIOCFGSV.IO first to restore robot I/O mapping
   settings. Then restore SYSDNET.SV to restore DeviceNet settings. If the order
   is reversed, you might configure DeviceNet incorrectly.

This file can be saved at Controlled start or Cold start. However, DeviceNet configuration is restored only at Controlled Start. Restoring diocfgsv.io at Cold start will not be successful and there will be no indication that DeviceNet configuration was not restored.

NOTE
   The file diocfgsv.io is a system file that also contains system DIO configuration.
   Since this file is not used exclusively for DeviceNet, be careful when restoring
   this file on a Controller with different hardware configuration or different I/O
   assignments since all I/O assignments are also saved in this file.

Additionally, if you need to obtain a user defined device definition only and transfer that between robots, this information is obtained by copying DNDEF.DG from MD: file device. Copying DNDEF.DG to MD: file device will result in user device definitions being added. Duplicate entries that have the same name, vendor ID, device type, and product code on the robot will be overwritten, however existing entries on the robot that are in use in a scan-list will be ignored and will not be over-written. This operation can be performed at Cold or Controlled Start operation of the robot.

4   CONFIGURING DEVICENET INTERFACE AS A SLAVE

4.1   OVERVIEW FOR CONFIGURING THE DEVICENET INTERFACE FOR SLAVE OPERATION

This section contains information on configuring the DeviceNet Interface for slave operation, in which the controller acts as a slave to an external master device or scanner.

To use slave operation, you must configure the master scanner to scan the DeviceNet Interface daughterboard , as follows:

- Set the master to the same baud rate as the DeviceNet Interface daughter board.
- Set the master to recognize and scan the DeviceNet Interface daughterboard at the entered MAC-Id from the Board DETAIL screen.

Table 4.1 (a)   Parameters for slave mode configuration of daughterboard – SST board

DeviceNet Interface DAUGHTERBOARD Parameters	
Vendor ID	8
Device type/code	12
Product type/code	14

Table 4.1 (b)   Parameters for slave mode configuration – devicenet slave board

DeviceNet Interface Slave Board Parameters	
Vendor ID	591
Device Type	12
Product Code	3

- Set the I/O size expected by the master scanner for the same value as the DeviceNet Interface daughterboard.

Table 4.1 (c) lists the items on the DeviceNet Board DETAIL Screen that pertain to slave operation. Use Procedure 4-1 to configure the DeviceNet Interface for slave operation.

Table 4.1 (c)   DeviceNet board detail screen items

ITEM	DESCRIPTION
Slave Status	Slave status indicates the status of the slave connection of this DeviceNet board. If the slave connection is not enabled (if size of output from master and size of input to master are 0), this field displays OFFLINE. If it is enabled and the remote master has not yet connected, this field indicates IDLE and error DNET-125 is posted. If the remote master is connected, this field displays ONLINE. This field is display only.
Slave Error Severity	This sets the error severity level of the error DNET-125 that indicates the slave connection is idle. Select WARN, STOP or PAUSE as required.

ITEM	DESCRIPTION
Slave Operation: Size of output from master	For slave operation, in which the controller acts as a slave to an external master, this specifies the size of the output **from** the master **to** the daughterboard, in bytes.
Slave Operation: Size of input to master	For slave operation, in which the controller acts as a slave to an external master, this specifies the size of the input **to** the master **from** the daughterboard, in bytes.
Integrated CIP Safety	This item shows up only if DeviceNet safety function is ordered. For DeviceNet Safety function that exchanges safety signals on DeviceNet Interface, please read "R-30*i*A/R-30*i*A Mate controller Dual Check Safety Function (ISO 13849-1:2006 compliant) operator's manual (B-83104EN)" or "R-30*i*B/R-30*i*B Mate controller Dual Check Safety Function operator's manual (B-83184EN) in addition to this manual.

4.2   PROCEDURE FOR CONFIGURING THE DEVICENET INTERFACE FOR SLAVE OPERATION

Use Procedure 4-1 to configure the DeviceNet interface for slave operation.

Procedure 4-1 Configuring the DeviceNet Interface for Slave Operation

Conditions
- You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
- You have installed the DeviceNet Interface software option. (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system. (Procedure 3-1)
- You have defined DeviceNet devices. (Procedure 5-2)
- You have configured the master device scanner to scan the DeviceNet Interface daughterboard.

Steps
1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet.
5. Move the cursor to the daughterboard you want to configure as a slave device and press F4, DETAIL. See the following screen for an example.

```
Board Detail
Board: 1                        Status:   OFFLINE
Scanner type:   5136-DN-104
Motherboard:   Full-slot
1   MAC-ID:                        0
2   Baud-rate:                    125 KB
3   Board auto-restart:          OFF
4   Input resume state (rack 81): LAST
Slave Operation:
     Slave Status:                  OFFLINE
5   SLAVE Error Severity:          WARN
6   Size of output from master:   0 bytes
7   Size of input to master:      0 bytes
```

> **NOTE**
>   To display help information, press F5, HELP. When you are finished, press
>   PREV.

Slave status indicates the status of the slave connection of this DeviceNet board:
- If the slave connection is not enabled (if size of output from master and size of input to master are 0), this field displays OFFLINE.
- If it is enabled and the remote master has not yet connected, this field indicates IDLE and error DNET-125 is posted.
- If the remote master is connected, this field displays ONLINE. This field is for display only.

6. Move the cursor to SLAVE Error Severity. This sets the error severity level of the error DNET-125 that indicates the slave connection is idle. Select WARN, STOP, or PAUSE as required.
7. Move the cursor to Size of output from master and enter size of the daughterboard's output buffer, in bytes.
8. Move the cursor to Size of input to master and enter size of the daughterboard's input buffer, in bytes.
9. Press F4, LIST, to display the DeviceNet Board List screen.
10. Perform a Cold start:
    a. Turn off the controller.
    b. Press and hold the SHIFT and RESET keys on the teach pendant.
    c. Press the ON button on the operator panel.
    d. When text appears on the teach pendant screen, release the SHIFT and RESET keys.
11. On the DeviceNet Board List screen, move the cursor to the daughterboard you configured, press NEXT, >, and press F5, ONLINE. Repeat this step for each daughterboard you have configured. The Status of each daughterboard should change to ONLINE.

> **NOTE**
>   The BOARD STATUS LED on each daughterboard should be STEADY GREEN.

> ⚠ **WARNING**
>   Disconnect electrical power from the controller before you remove or replace
>   components, or you could be injured seriously.

12. Set the master device to RUN mode.
13. The slave status on the Board DETAIL screen should indicate ONLINE if the remote master has successfully established an I/O connections. If the status indicates IDLE, verify the remote master configuration and refer to Section 7.2 . Contact the manufacturer of the remote master if necessary.

> **NOTE**
>   Configuring I/O for slave operation is the same as configuring I/O for DeviceNet
>   communication with regular devices, except that the slot number used is the
>   Main CPU PCB's MAC ID, not the external master's MAC ID. The rack number
>   used is the rack number shown on the Board List Screen.

5   CONFIGURING THE DEVICENET INTERFACE AS A MASTER

5.1   OVERVIEW

A DeviceNet master (also known as a "Scanner") scans devices and exchanges I/O data with slave devices. Each DeviceNet master has a scan-list that indicates which devices it should scan. Section 5.2 describes how to create a scan-list or a device-list so that the master can exchange I/O with desired devices.

> **NOTE**
> DeviceNet Slave board cannot be configured as a master.

5.2   CREATING A DEVICE LIST FOR EACH DEVICENET DAUGHTERBOARD TO BE CONFIGURED AS MASTER

5.2.1   Overview

You can use two methods to create the device list and add user-created device definitions:
*   Online method with minimal information required from the user
*   Offline method with all information provided by the user

The online method for creating device lists and device definitions queries the device itself for most of the information. You are required to enter information that is not provided by the device (not specified by the DeviceNet protocol). This information typically can be obtained from the device datasheet provided by the manufacturer. This method requires that you have the physical devices connected to the network and your network installed correctly to allow DeviceNet to operate.

The offline method requires you to obtain all information and enter it using the teach pendant.

If you do not know the MAC ID assignment of devices on the network while you create the device list, you can use BROWSE. BROWSE scans the MAC ID from 0 to 63 and list MAC ID, Product Name of the devices on the network. Refer to Subsection 5.2.4 .

5.2.2   Online Method for Creating Device List and User-defined Device Definitions

Verify that you have the physical device connected to the DeviceNet network. If the MAC ID is set using dip switches, set the correct MAC ID and the baud-rate. Make sure that the robot DeviceNet interface card is connected to the DeviceNet network. Also verify that your DeviceNet network is installed correctly (check power, termination, connections, and so forth). If you have any other configuration tools or DeviceNet masters on the network, make sure they are not communicating with the remote device that you are trying to configure. Use Procedure 5-1 to create device lists and user-defined device definitions using the online method.

Refer to Table 5.2.2 (a) for definitions of the items on the DeviceNet Device screen. Refer to Table 5.2.2 (b) for DeviceNet diagnostic board descriptions.

Table 5.2.2 (a)   DeviceNet device info descriptions

ITEM	DESCRIPTION
Board	This item indicates the currently selected board for diagnostic operations.
Mac Id min: 0 max: 63	This item indicates the Mac Id of the remote device that was queried. The Mac Id can be changed here to add it to the scan-list or to change the Mac Id of the remote device. (This applies only to devices that can be set by the software.)
Baud-rate min: 125 kbps max: 500 kbps	This item indicates the baud-rate at which the device is currently communicating. The baud-rate can be changed here to change the setting of the remote device. (This applies only to devices that can be set by the software.)
Device name	This item is the name of the device that will be used if and when this definition is added to the user device definitions. The name can not be more than 16 characters long.
Vendor Id	This item indicates the DeviceNet vendor Id of the device. The vendor Id is assigned by ODVA Inc.
Device Type	This item identifies the DeviceNet classification of this device type.
Product Code	This item is the product code assigned by the manufacturer.
Produced Bytes min: 0 max: 128	This item indicates the size of DeviceNet data that is sent out by the device on the network.
Consumed Bytes min: 0 max: 128	This item indicates the size of DeviceNet data that is accepted by the device from the network.
Dev. Def. Stat	This item indicates if another user definition exists. A match results when the name, vendor Id, device type, and product code match. The status field will indicate if there is an exact match ("EXISTS"), I/O mode mismatch ("I/O mode mismatch"), I/O size mismatch ("I/O size mismatch"), analog mismatch ("Analog mismatch").
Digital Inputs min: 0 max: 1024	This item indicates the number of digital input points.
Digital Outputs min: 0 max: 1024	This item indicates the number of digital output points.
Analog Inputs min: 0 max: 32	This item indicates the number of analog input points.
Analog Outputs min: 0 max: 32	This item indicates the number of analog output points.
COS/CYC Ack default: YES	This item indicates whether the COS/CYCLIC mode of operation is set to acknowledge or not (default is YES, most devices typically acknowledge).
Analog First	This item indicates if the analog points appear before the digital points.
Input Data Offset min: 0 max: (number of digital BYTES – 1)	This item is the number of bytes to be skipped from digital inputs before they are copied into the controller. Allow the start point to be 1 if there is some status data before the input data in the device I/O map.

Table 5.2.2 (b)   I/O DeviceNet diagnostic board setup screen items

ITEM	DESCRIPTION
Mac Id	This item is the Media Access Control ID used by the daughterboard. It must have a value of from 0 to 63. The MAC-Id must be different from the MAC-Ids of all other devices on the network.
Baud-rate	This item is the data rate used in transfers between the DeviceNet Interface board and the devices on the network. Specify one of the following baud rates: • 125 KB • 250 KB • 500 KB
I/O mode	This item indicates the I/O mode in which the remote device will communicate. There are four kinds of I/O modes: • POLL • STROBE • COS • CYCLIC

Procedure 5-1 Creating Device List and User-defined Device Definitions Using the Online Method

Conditions
- You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
- You have installed the DeviceNet Interface software option. (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system. (Procedure 3-1)

Steps
1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet. See the following screen for an example.

```
Board List                    1/4
  Board     Comment      Rack   Status
    1    [New network   ]   81   OFFLINE
    2    [              ]   82   OFFLINE
    3    [              ]   83   OFFLINE
    4    [              ]   84   OFFLINE
```

> **NOTE**
> To display help information, press F5, HELP. When you are finished, press PREV.

5. Move the cursor to the board for which you want to create a device list.

> **NOTE**
> If the board is not ONLINE, put the board ONLINE. To display help information, press F5, HELP. When you are finished, press PREV. If the board is not set to ONLINE, the message, "Please set the board ONLINE," will be displayed.

6. Press NEXT.
7. Press F3, DIAG. You will see a screen similar to the following.

```
DeviceNet Diagnostics Board Setup   4/4
 Board: 1        Diag Status:    ONLINE
  1   Mac Id:             60
  2   Baud-rate:          500 KB
 Remote Device:
  3   I/O Mode:           POLL
  4   Mac Id:             63
```

8. Select a board MAC ID so that it is unique on the network.
9. Select the baud-rate that the board should use when it goes online.
10. Select the I/O mode (POLL, STROBE, COS, CYCLIC) in which the remote device will communicate.
11. Select the MAC ID to which the remote device is set. If the device has a MAC ID that can be set by the software, the MAC ID typically will be 63. You can change this value later in this procedure.
12. Press F4, QUERY. If the message indicates there was no response from the device, check the MAC ID and the connections to the remote device. If the message indicates that the I/O mode is not supported by the remote device, please check the followings:
    - Make sure no other configuration tool or master is communicating with that remote device.
    - Make sure what I/O mode the remote device supports (e.g it is possible that the remote device may not support POLL I/O connection. If so, I/O mode should not be set to POLL).
    If the query is successful, you will see a screen similar to the following:

```
DeviceNet Device Info                1/8
 Board: 1
  Mac Id: 29        Mode:   POLL
  Baud-rate:                500 KB
  Device name:      1794-ADN Flex I
  Vendor Id:                 1
  Device Type:               12
  Product Code:              1
  Produced Bytes:            10
  Consumed Bytes:             4
  Dev. Def. Stat:   Analog mismatch
  Digital Inputs:            80
  Digital Outputs:           32
  Analog Inputs:             0
  Analog Outputs:            0
  COS/CYC Ack:               YES
  Analog First:              NO
  Input Data Offset:         0
```

13. Type the following information:
    - Analog Inputs
    - Analog Outputs
    - Analog First (If analog I/O is sent/received at the beginning of the data packet for the I/O message)
    - COS/CYC Acknowledge (most devices typically acknowledge COS/CYC messages)
    - Input Data Offset (number of data bits used at the beginning of the data packet for DeviceNet status information. If 0 is used, the data status bits can be mapped as Inputs from the device. If non-zero number is used, Input starts after the status bits)
    You must provide the above information since the DeviceNet specification does not specify the Analog Inputs, Analog Outputs, or Analog First . Therefore, this information cannot be obtained online from the network.

NOTE
The following information is obtained automatically from the remote device:
- Device Name
- Vendor ID
- Device Type
- Product Code
- Consumed bytes
- Produced bytes

14. If the remote device has a MAC ID that can be set by the software, change the MAC ID on this screen.
   a. Press NEXT, >.
   b. Press F2, CHG_MAC. This will change the MAC ID of the remote device. This change takes effect immediately.

NOTE
You can change the software configurable baud-rate in the same way, however, this will take affect only when the power is cycled on the remote device. (This is true of DeviceNet specification Version 2.1 devices only.)

15. **To add the device to the user definition list,** press F3, ADD_DEF. The current device definition will be added to the library of user definitions.

NOTE
If there is a match of the name, vendor ID, device type, and product code, the device definition will be overwritten. If the device definition is already in use in a device list, then it cannot be overwritten and a message on the screen will indicate that. You MUST delete that device from the device list. Refer to Procedure 5-5 .

16. **To add this device definition to the board scan list,** press F4, ADD_SCN.
   When you do this, two things happen:
   1. A new device definition is added if one does not already exist.
   2. The device is added to the scan-list for that particular board.

NOTE
When you add the device definition to the device list, the user definition will be added or overwritten if one already exists as described in Step 15 and there is a mismatch. If the user definition cannot be overwritten, an error will be posted. Also, if there is a definition that has a mismatch in name only (vendor ID, device type, product code, I/O mode, I/O size, analog I/O match), the existing device definition will be used and a new one will not be added.
If there is a device in the device-list with the same MAC ID, the current device will not be added.

5.2.3   Offline Method for Creating Device List and User-defined Device Definitions

This section assumes you have configured the DeviceNet interface daughterboard to be used using the procedures described in Chapter 3 .

The Device List screen and the sub-screens are used in this procedure. Refer to Fig. 5.2.3 (a) , Fig. 5.2.3 (b) , Fig. 5.2.3 (c) , and Fig. 5.2.3 (d) , and, Table 5.2.3 (a) , Table 5.2.3 (b) , Table 5.2.3 (c) , and Table 5.2.3 (d) for details on the screens. Use Procedure 5-2 to define the device list using the offline method.

After you have configured the DeviceNet Interface daughterboards used in your system, you must select the DeviceNet devices that are to be scanned by the daughterboards.

When you select DeviceNet devices, you use the DeviceNet Device List screen. Refer to Table 5.2.3 (a) for a listing and description of each of the items on this screen.

```
I/O DeviceNet                JOINT   10%
  Device List   Bd 2   (ONLINE )     1/2
  Device Name        Description    Stat   MAC
  Wago I/O Block   [              ]< ON>    3
  A/B Photo sensor[              ]< ON>   10
```

Fig.   5.2.3 (a)   Device list screen

Table 5.2.3 (a)   Device list screen items

ITEM	DESCRIPTION
Board Number and Status	This item displays the number of the DeviceNet Interface daughterboard to which the device is connected and the current status of the daughterboard (ONLINE, OFFLINE, or ERROR).
Device Name	This item displays the name of the DeviceNet device. You select a device name from a list of pre-defined devices when you press F4, [CHOICE]. If the device you want is not on the list, you must define a new device in order to use it. **************** indicates that no device is configured or present with the associated MAC ID. This value appears by default when a new device-list entry has been added. If the Device List screen is exited before an actual device is selected, the corresponding line is deleted.
Description	This item can be used to indicate the usage or physical location of the device. Use the description to distinguish among several devices of the same type and device name on the same network.
Stat	This item displays the current status of the device. • ON indicates that the device is currently online; input and output ports on this device can be read or set assuming the daughterboard is ONLINE. • ERR indicates that the device is currently in an error state. An error has been detected in communicating with the device. • OFF indicates that the device has been set off line. Newly added devices are set to OFF status. • Brackets ('<' and '>') surrounding the device status indicate that the device is set to autoreconnect. For a description of device autoreconnect, see Table 5.2.3 (b) . ⚠ **CAUTION** A board fault might cause a device to appear to be ON even when there is no communication. The board status (displayed at the top of the screen) will show ERROR if this situation exists. Clearing the board fault or board error and bringing the board on-line will also resume communication with the device. Refer to the troubleshooting chapter of this manual for more information.
MAC	This item specifies the MAC ID for the device. This is also the slot number to be used in specifying ports on this device in the I/O CONFIG screens.

```
I/O DeviceNet                        JOINT   10%
  Device List   Bd 2  (ONLINE )            1/2
  Device Name      Mode   Int   AR   QC   Stat   MAC
Wago I/O Block    COSA    0    Y    N   < ON>   3
A/B Photo sensor  STRB    0    Y    N   < ON>  10
```
Fig. 5.2.3 (b)   Alternative display of the device list screen

Table 5.2.3 (b)   Device list alternative display screen - additional items

ITEM	DESCRIPTION
Mode	This item indicates the current DeviceNet I/O mode of the device. A device can communicate with a DeviceNet network using one of six modes: • POLL: when the device is polled directly by the scanner, the device sends input data to the scanner. The device's output data is sent by the scanner in the original poll request. • STRB: abbreviation for Strobe. The scanner sends a general (strobe) input request to all devices. Any device set to communicate in this mode sends input data to the scanner. • COSA: Change-of-State acknowledged mode. The device sends input data to the scanner only when the input data changes. The scanner sends an acknowledgement of the input data. Output data is sent to the device in a direct message to the device when required. • COSU: Change-of-State unacknowledged mode. Same as COSA, except that the scanner does not send an acknowledgement for input data. • CYCA: Cyclic acknowledged mode. At regular time intervals, the device automatically sends input data to the scanner. The scanner sends an acknowledgement of the input data. Output data is sent to the device in a direct message to the device when required. • COSU: Cyclic unacknowledged mode. Same as CYCA, except that the scanner does not send an acknowledgement for input data.
Int (msec)	This item indicates the interval (multiple of 5 msec) at which the slave is scanned by the master.
AR	This item indicates the autoreconnect status of the device. If the device is set to autoreconnect (indicated by a 'Y' in this column), the board will automatically re-establish communications with the device after a device error is resolved. An 'N' in this column indicates the device is not set to autoreconnect. For Version 7.10, any device errors which occur with this device will result in a WARN-severity error posted (DNET-122) instead of a STOP-severity error (DNET-063) when autoreconnect is enabled. For Version 7.20 or later, no alarm is posted for a device while autoreconnect is enabled, and the STOP-severity DNET-063 is still posted when autoreconnect is disabled.
EM	This field is currently unused.
QC	This item indicates Quick Connect (QC) status of the device. Enable QC if the following conditions are met: • SST-DN3-104 board or SST-DN4-104 board is installed for DeviceNet. • The remote device supports QC and QC is enabled in the remote device.

If the device you want to use has not been pre-defined, you will have to add it using the Defined Device List screen and the Defined Device DETAIL screen. Refer to Table 5.2.3 (c) and Table 5.2.3 (d) for a listing and description of each of the items on both screens.

```
I/O DeviceNet                    JOINT 10%
  Defined Device List             1/3
  Device Name          Comment        INV
[SENSOR_1        ] [                    ]
[SENSOR_2        ] [                    ]
[SENSOR_3        ] [                    ]
```
Fig. 5.2.3 (c)   User defined device list screen

Table 5.2.3 (c)   User defined device list screen items

ITEM	DESCRIPTION
Device Name	This item indicates the name of the device. It appears on the Device List screen when this DeviceNet device is configured on a DeviceNet Interface daughterboard.
Comment	This item indicates an area in which you can provide additional information to describe the DeviceNet device.
INV	An asterisk (*) in this column indicates that the device definition is invalid. If the device definition is valid, this column is blank. If the device definition is invalid, a device with this definition cannot be added to the device list of any of the boards.

```
Defined Device Detail            1/13
   Status:                       IN USE
   1 Device¥name:         BECKHOFF BK5200
   2 Comment:
   3 Vendor ID:                  108
   4 Device type:                12
   5 Product code:               5200
   6 I/O Mode:                   POLL
   7    Digital inputs:          24
   8    Digital outputs:         16
   9    Analog inputs:           0
  10    Analog outputs:          2
  11    COS/CYC Ack:             YES
  12    Analog First:            NO
  13    Input Data Offset (bytes):   0
```
Fig. 5.2.3 (d)   Defined device detail screen

Table 5.2.3 (d)   Defined device detail screen items

ITEM	DESCRIPTION
Device Name	This item is the name of the device. It appears on the Device List screen when this DeviceNet device is configured on a DeviceNet Interface daughterboard.
Comment	This item is an area in which you can provide additional information to describe the DeviceNet device.
Vendor Id default: *** (undefined)	This item is the vendor ID value expected from the device. This value is compared with the corresponding data sent by the devices. If the value is zero, any value received from a device can be accepted. If the value of the received data does not match the value on the screen, the device is put in an ERR state. Any device with an undefined (***) Vendor-Id value is not available for use.
Device Type default: *** (undefined)	This item is the device type value expected from the device. This value is compared with the corresponding data sent by the devices. If the value is zero, any value received from a device can be accepted. If the value of the received data does not match the value on the screen, the device is put in an ERR state. Any device with an undefined (***) Device Type value is not available for use.
Product Code	This item is the product code value expected from the device. This value is

ITEM	DESCRIPTION
line feed default: *** (undefined)	compared with the corresponding data sent by the devices. If the value is zero, any value received from a device can be accepted. If the value of the received data does not match the value on the screen, the device is put in an ERR state. Any device with an undefined (***) Product Code value is not available for use.
I/O Mode	This item indicates which mode to use for the I/O connection that is supported by the slave device.
Digital Inputs default: 0 min: 0 max: 1024	This item is the number of digital input points (rounded up to the nearest multiple of 8).
Digital Outputs default: 0 min: 0 max: 1024	This item is the number of digital output points (rounded up to the nearest multiple of 8).
Analog Inputs default: 0 min: 0 max: 32	This item is the number of analog input points supported by the device, if any.
Analog Outputs default: 0 min: 0 max: 32	This item is the number of analog output points supported by the device, if any.
COS/CYC Ack default: YES	This item indicates whether the COS/CYCLIC mode of operation is set to acknowledge or not (default is YES, most devices typically acknowledge).
Analog First	This item indicates if the analog points appear before the digital points.
Input Data Offset default: 0 min: 0 max: (number of digital input BYTES – 1)	This item specifies how many bytes of digital input to skip before copying the data from the remote device. This can be used to skip status bytes in the beginning of a message so that data starts with a "start point" of 1. This value cannot be greater than the total number of digital inputs and should be selected so that it leaves at least 8 digital input points (1 byte) to be copied. The value will be automatically adjusted if it is greater than the bounds described.

Use Procedure 5-2 to specify DeviceNet devices on the network.

Procedure 5-2 Creating Device List and User-defined Device Definitions Using the Offline Method

Conditions

- You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
- You have installed the DeviceNet Interface software option. (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system. (Procedure 3-1)

Steps
1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet. See the following screen for an example.

```
Board List                          1/4
Board      Comment        Rack    Status
  1    [New network  ]     81    ONLINE
  2    [              ]     82    OFFLINE
  3    [              ]     83    OFFLINE
  4    [              ]     84    OFFLINE
```

> **NOTE**
> To display help information, press F5, HELP. When you are finished, press PREV.

5.   Move the cursor to the board for which you want to create a device list.
6.   Press F2, DEV-LST. See the following screen for an example.

```
Device List   Bd 1 (ONLINE )          0/0
Device Name        Description     Stat MAC
```

> **NOTE**
> To display help information, press F5, HELP. When you are finished, press PREV.

7.   Press NEXT, >, and then press F2, ADD_DEV.
8.   Type the appropriate MAC ID and press ENTER.
     A new line is added in the appropriate location on the Device List screen and the cursor is moved to the Device Name field.
9.   With the cursor on the Device Name, press F4, [CHOICE].
10. Select the device name from the list of pre-defined device names.
11. **If the device name you want is not on the list, refer to Procedure 5-10 to create a new definition.**
12. Repeat Procedure 5-10 until you have defined all of the devices on all of the DeviceNet Interface daughterboards. Go to the board list and start from Step 5 of this procedure again.

> **NOTE**
> You must cycle power before you can communicate with the newly-added devices. You can assign I/O for the device, unless it is a multiple module device. Refer to Section 6.1 for more information about DeviceNet I/O.

13. Turn off the controller then turn it on again.
14. Press MENUS.
15. Select I/O.
16. Press F1, [TYPE].
17. Select DeviceNet. You will see a screen similar to the following.

```
Board List                          1/4
Board      Comment        Rack    Status
  1    [New network  ]     81    ONLINE
  2    [              ]     82    OFFLINE
  3    [              ]     83    OFFLINE
  4    [              ]     84    OFFLINE
```

18. Move the cursor to the first DeviceNet Interface daughterboard you are defining.
19. Press F2, DEV-LST. You will see a screen similar to the following.

```
Device List   Bd 1 (ONLINE )            1/3
 Device Name        Description   Stat   MAC
Proxim switch   [prox switch 1  ]   OFF    1
XYZ Photo sw.   [light detect    ]   OFF    2
Light meter      [light measure  ]   OFF   17
```

20. Move the cursor to a Device name.
21. In the row that contains the Device name, move the cursor right to select the Status of the device.
22. Press F4, ONLINE, to put the device on-line.
     The COMM STATUS LED on the DeviceNet Interface daughterboard turns STEADY GREEN.

NOTE
If the device is communicating properly with the DeviceNet Interface
daughterboard, the status LEDs on the device should also turn STEADY GREEN

---

23. Repeat Step 20 through Step 22 to put all of the devices online.

5.2.4   Identify Devices on the Network Using BROWSE

Verify that you have the physical device connected to the DeviceNet network. If the MAC ID is set using dip switches, set the correct MAC ID and the baud-rate. Make sure that the robot DeviceNet interface card is connected to the DeviceNet network. Also verify that your DeviceNet network is installed correctly (check power, termination, connections, and so forth). Use Procedure 5-3 to list all devices that are ready to make connection with the master.

Procedure 5-3 Identify devices on the network by BROWSE

Conditions
   •   You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
   •   You have installed the DeviceNet Interface software option. (Procedure 2-1)
   •   You have configured the DeviceNet Interface daughterboards used in your system. (Procedure 3-1)

Steps
1.   Press MENUS.
2.   Select I/O.
3.   Press F1, [TYPE].
4.   Select DeviceNet. See the following screen for an example.

```
Board List                        1/4
Board      Comment          Rack   Status
  1    [New network      ]    81   OFFLINE
  2    [                 ]    82   OFFLINE
  3    [                 ]    83   OFFLINE
  4    [                 ]    84   OFFLINE
```

5.   Move the cursor to the board for which you want to create a device list.
     If the board is not ONLINE, put the board ONLINE.

NOTE
To display help information, press F5, HELP. When you are finished, press
PREV. If the board is not set to ONLINE, the message, "Please set the board
ONLINE," will be displayed.

---

6.   Press NEXT.

7.   Press F3, DIAG. You will see a screen similar to the following.

```
DeviceNet Diagnostics Board Setup   4/4
 Board: 1        Diag Status:    ONLINE
        Mac Id:              60
        Baud-rate:       500 KB
 Remote Device:
  1  I/O Mode:         POLL
  2  Mac Id:               63
```

8.   Select Mac ID.
9.   Press F3, BROWSE. BROWSE starts querying devices on the network. It will take 15-20 seconds for browsing network. If you want to cancel, press F2. You will see the screen similar to the following.

```
DeviceNet Browse
 Board: 1        Board Status:   ONLINE
 MAC     Product Name           Stat
```

10.   When Browsing the network is done, you will see a screen similar to the following. MAC, Product Name and Status of the device are listed. Status of the device has three values:
   •   ON: the device is currently exchanging I/O with the board
   •   OFF: the device does not exchange I/O with the board
   •   ERR: the device is in the scanlist of the board and I/O connection is in error state.

```
DeviceNet Browse
 MAC     Product Name           Stat
     2        Wago I/O Block       OFF
    11    A/B Photo sensor      OFF
```

NOTE
   If the user wants to query the device, press F4 [QUERY]. This brings up pull-up menu with I/O mode: Poll, Strobe, COS and CYC. This operation is equivalent to Step 12 in Procedure 5.1 Creating Device List and User-defined Device Definitions Using the Online Method. Refer to Procedure 5-1 to add a device definition and to add a device to the scanlist.

5.3   USING MULTIPLE MODULE DEVICENET DEVICES

NOTE
   This procedure and description applies only if the device you are using and the modules for the device are already defined as standard. If a module or the device is not a standard definition, and you have to create a custom definition, you cannot create definitions for individual modules. In order to create a definition for a non-standard multi-module device, you will have to calculate the total I/O input and output sizes for the device and specify that as the inputs and outputs for the device definition. Use Procedure 5-10 to create a definition and use that in your device list.

This section contains information on using multiple-module DeviceNet devices in conjunction with the DeviceNet Interface. Multiple-module devices allow for the use of multiple I/O modules or blocks at a single DeviceNet node.

For some multiple-module devices, you might need to configure their device adapter internally by specifying to the device adapter which I/O modules are connected to it. Refer to the manual for the multiple-module device you are using to determine whether internal configuration is required and the proper procedure for doing so. **The DeviceNet Interface does NOT internally configure the multiple-module device.**

In order to have multiple-module devices on your DeviceNet network, you must use the Module List screen. Table 5-3 lists and describes the items on this screen.

Use Procedure 5-4 to add a multiple-module device to the network.

> **NOTE**
>   You cannot assign I/O for a multiple module device immediately after adding one to a Device List. You must cycle power before manually assigning I/O to this device.

Table 5.3   DeviceNet module list screen items

ITEM	DESCRIPTION
Slot	This item is the number of the position of an I/O module. In general, slot 1 is directly adjacent to the multiple-module device adapter.
Module Type	This item is the type of I/O module that exists in the specified slot.
Comment	You can use a comment to describe the function of the module or other characteristics.

Procedure 5-4 Adding a Multiple-Module Device to a DeviceNet Network

Conditions
- You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
- You have installed the DeviceNet Interface software option. (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system. (Procedure 3-1)

Steps
1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet.
5. Move the cursor to the daughterboard to which you want to add the multiple-module device.
6. Press F2, DEV-LST.
7. Perform Procedure 5-2 , Step 7 through Step 10 , to add the correct multiple-module device.
8. Move the cursor to the multiple-module device and press NEXT, >. You will see a screen similar to the following.

```
Device List   Bd 1 (ONLINE )          2/6
  Device Name      Description       Stat MAC
A/B Flex I/O     [Multi-module    ]   OFF   11
```

9. Press F3, MOD-LST, to display the Module List screen. You will see a screen similar to the following.

```
Module List              Bd 1   MAC 11 1/16
Slot    Module Type       Comment
  1    [*************] [                      ]
  2    [*************] [                      ]
  3    [*************] [                      ]
  4    [*************] [                      ]
  5    [*************] [                      ]
  6    [*************] [                      ]
  7    [*************] [                      ]
  8    [*************] [                      ]
  9    [*************] [                      ]
```

> **NOTE**
>   Perform Step 10 and Step 11 for each module connected to the multiple-module device .

10. Move the cursor to the Module Type field for the corresponding slot number.
11. Press F4, [CHOICE]. Select the correct module type.
12. Repeat Step 10 and Step 11 for all of the I/O modules connected to the multiple-module device.
13. Perform Procedure 5-2 , Step 12 to Step 22 , to add the rest of the DeviceNet devices to the network and put them online.

5.4   DELETING A DEVICE FROM A DAUGHTERBOARD'S DEVICE LIST

Use Procedure 5-5 to delete a device from a daughterboard's device list.

Procedure 5-5 Deleting a Device from a Daughterboard's Device List

> ⚠ **CAUTION**
>   This procedure will delete the selected device from the scan list for the currently selected daughterboard. I/O configured for this device will be invalid and will no longer be updated. Be sure you want to do this before you perform this procedure; otherwise, information will be lost.

Conditions
- You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
- You have installed the DeviceNet Interface software option. (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system. (Procedure 3-1)
- You have specified the device(s) connected to the daughterboard. (Procedure 5-2)

Steps
1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet. You will see a screen similar to the following.

```
Board List                          1/4
Board     Comment          Rack   Status
  1     [New network   ]    81    ONLINE
  2     [              ]    82    OFFLINE
  3     [              ]    83    OFFLINE
  4     [              ]    84    OFFLINE
```

5. Move the cursor to the daughterboard that contains the device you want to delete.
6. Press F2, DEV-LST, to display the Device List screen. You will see a screen similar to the following.

```
Device List   Bd 1 (ONLINE )              1/3
 Device Name          Description   Stat    MAC
Proxim switch    [prox switch 1 ]    OFF    1
XYZ Photo sw.    [light detect   ]    OFF    2
Light meter      [light measure ]    OFF    17
```

7. Move the cursor to the device you want to delete.
8. **If the Status of the device is ON** (indicating that the device is online), take the device offline:
    a. Move the cursor to the Stat column of the device.
    b. Press F5, OFFLINE. The Status changes to OFF. If the device is in an error state, the Status changes to ERR.

NOTE
> If the board goes into ERROR status while one or more devices are online, the status displayed for these devices remains ON. (The board status display at the top of the screen will show ERROR.) To remove or change one of these devices, move the cursor to the STAT column and press F5, OFFLINE.

---

9. Press NEXT, >, and then press F1, DELETE.
10. Press the appropriate function key:
    *   To delete the device, press F4, YES.
    *   To cancel the deletion, press F5, NO.

NOTE
> Even though the device has been deleted, its I/O assignments are still in the system. You will need to zero out the I/O assignments manually.

5.5   CHANGING THE DEVICE TYPE FOR A CONFIGURED DEVICE

Use Procedure 5-6 to change the device type for a configured device.

Procedure 5-6 Changing the Device Type for a Configured Device

---

NOTE
> This procedure allows you to change the type of device configured at a specific DeviceNet node without change the MAC Id. Use this procedure if you are changing to a new brand or model of device or to a completely new type of device.

Conditions
*   You have installed the DeviceNet Interface in the controller.   (Procedure 2-1)
*   You have installed the DeviceNet Interface software option   .(Procedure 2-1)
*   You have configured the DeviceNet Interface daughterboards used in your system.
                                                                        (Procedure 3-1)
*   You have specified the device(s) connected to the daughterboard. (Procedure 5-2)

Steps
1.   Press MENUS.
2.   Select I/O.
3.   Press F1, [TYPE].
4.   Select DeviceNet. You will see a screen similar to the following.

```
Board List                         1/4
Board       Comment        Rack    Status
  1     [New network   ]    81    ONLINE
  2     [              ]    82    OFFLINE
  3     [              ]    83    OFFLINE
  4     [              ]    84    OFFLINE
```

5.   Move the cursor to the daughterboard that contains the device you want to change.
6.   Press F2, DEV-LST, to display the Device List screen. You will see a screen similar to the following.

```
Device List   Bd 1 (ONLINE )          1/3
 Device Name        Description   Stat   MAC
Proxim switch   [prox switch 1 ]   OFF    1
XYZ Photo sw.   [light detect   ]   OFF    2
Light meter      [light measure ]   OFF    17
```

7.   Move the cursor to the device you want to change.
8.   **If the Status of the device is ON** (indicating that the device is online), take the device offline:
     a.   Move the cursor to the Stat column of the device.
     b.   Press F5, OFFLINE. The Status changes to OFF. If the device is in an error state, the status changes to ERR.

NOTE
If the board goes into ERROR status while one or more devices are online, the status displayed for these devices remains ON. (The board status display at the top of the screen will show ERROR.) To remove or change one of these devices, move the cursor to the STAT column and press F5, OFFLINE.
---

9.   With the cursor on the Device Name, press F4, [CHOICE].

NOTE
If the device type you want is not listed, you will have to define it. Use Procedure 5-10 to add a new device definition for use in the daughterboard's device list.
---

10. Select the device type that corresponds to the new device.
11. Turn off the controller then turn it on again.
12. Remove the old device from the DeviceNet network and attach the new device. Make sure you have configured the new device properly for the correct communications baud rate and MAC Id.
13. Press MENUS.
14. Select I/O.
15. Press F1, [TYPE].
16. Select DeviceNet.
17. Move the cursor to the daughterboard that contains the device you have changed.
18. Press F2, DEV-LST, to display the Device List screen.
19. Move the cursor to the new device.
20. Move the cursor to the Stat column and press F4, ONLINE, to put the new device online.

5.6   TURNING AUTORECONNECT/QUICK CONNECT ON OR OFF

Use Procedure 5-7 to turn autoreconnect on or off for a device so that it automatically reconnects after a device error.

Some applications require DeviceNet nodes to be connected and disconnected periodically. Time takes for the device to power up and exchange I/O with the master (scanner), varies between 3 to 10 seconds. Quick Connect is added to the DeviceNet specification to reduce the connection time. Note that both the master (scanner) and the slave (adapter) should have Quick Connect turned on. Use Procedure 5-7 to turn Autoreconnect On or Off. Use Procedure 5-8 to turn Quick Connect on or off for the master.

Procedure 5-7 Turning Autoreconnect On or Off

Conditions
- You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
- You have installed the DeviceNet Interface software option. (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system. (Procedure 3-1)
- You have specified the device(s) connected to the daughterboard. (Procedure 5-2)

Steps
1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet. You will see a screen similar to the following.

```
Board List                          1/4
Board      Comment          Rack   Status
  1     [New network    ]     81    ONLINE
  2     [               ]     82    OFFLINE
  3     [               ]     83    OFFLINE
  4     [               ]     84    OFFLINE
```

5. Move the cursor to the daughterboard that contains the device you want to modify.
6. Press F2, DEV-LST, to display the Device List screen. You will see a screen similar to the following.

```
Device List   Bd 1 (ONLINE )          1/3
 Device Name        Description    Stat    MAC
Proxim switch   [prox switch 1 ]     OFF      1
XYZ Photo sw.   [light detect   ]    OFF      2
Light meter     [light measure ]     OFF     17
```

7. Press NEXT, then F5, CHGDSP, to display the Device List Alternate Display screen. You will see a screen similar to the following.

```
Device List                          1/1
 Device Name      Mode   Int  AR  QC  Stat  MAC
Std photoeye     POLL    10   N   N   ON    14
```

8. Move the cursor to the device you want to modify.
9. Move the cursor to the AR column of the device. This is the Autoreconnect status of the device.
10. Press the appropriate function key:
    - To turn on autoreconnect, press F2, YES.
    - To turn off autoreconnect, press F3, NO. Changes take effect immediately.

> ⚠ **CAUTION**
> Be aware that when autoreconnect is turned on, device errors involving this
> device will be masked and will no longer halt program execution or robot motion.

> **NOTE**
> If autoreconnect is used for tool change application, be sure all devices to be
> connected or disconnected at a particular MAC ID have exactly the same keying
> parameters (vendor ID, device type, and product code) and the same I/O sizes.
> After disconnect or reconnect, all values are checked even if the initial definition
> used zero for keying.

Procedure 5-8 Turning Quick Connect On or Off

Conditions

- You have installed the DeviceNet Interface in the controller.   (Procedure 2-1)
- You have installed the DeviceNet Interface software option.   (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system.
  .   (Procedure 3-1)
- You have specified the device(s) connected to the daughterboard. (Procedure 5-2)
- You have DeviceNet DN3 or DN4 daughterboard in your system
  (Quick Connect is only supported by DeviceNet DN3 or DN4 daughterboard).

Steps

1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet. You will see a screen similar to the following.

```
Board List                        1/4
  Board     Comment        Rack     Status
    1     [New network  ]    81    ONLINE
    2     [             ]    82    OFFLINE
    3     [             ]    83    OFFLINE
    4     [             ]    84    OFFLINE
```

5. Move the cursor to the daughterboard that contains the device you want to modify.
6. Press F2, DEV-LST, to display the Device List screen. You will see a screen similar to the following.

```
Device List   Bd 1 (ONLINE )          1/3
  Device Name        Description    Stat    MAC
  Proxim switch   [prox switch 1   ]  OFF    1
  XYZ Photo sw.   [light detect    ]  OFF    2
  Light meter     [light measure   ]  OFF    17
```

7. Press NEXT, then F5, CHGDSP, to display the Device List Alternate Display screen. You will see a screen similar to the following.

```
Device List                             1/1
  Device Name      Mode   Int   AR   QC   Stat   MAC
  Std photoeye     POLL    10    N    N    ON     14
```

8. Move the cursor to the device you want to modify.
9. Move the cursor to the QC column of the device. This indicates whether the robot (scanner) will use QC to connect to the remote devices or not. By default, QC is disabled.

10. Press the appropriate function key. Note that Quick Connect cannot be turned ON or OFF if the status of the device is ON. If the device is currently scanned by the robot, please put the device OFFLINE before Turn On/Off Quick Connect.
    a.   To turn on Quick Connect, press F2, YES.
    b.   To turn off Quick Connect, press F3, NO.

⚠ **CAUTION**
Be aware that Quick Connect requires both the master and the slave devices have Quick Connect turned on. You can turn Quick Connect on for slave device(s) by either using DeviceNet configuration tool (e.g RSNetworks for DeviceNet) or using Predefined Explicit Message detailed in Section 5.10.

5.7   CHANGING OR DELETING A MODULE ON A MULTIPLE-MODULE DEVICE

Use Procedure 5-9 to change or delete a module on a multiple-module device.

Procedure 5-9 Changing or Deleting a Module on a Multiple-Module Device

Conditions
- You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
- You have installed the DeviceNet Interface software option. (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system.
                                        (Procedure 3-1)
- You have specified a multiple-module device connected to one of the daughterboards.
                                        (Procedure 5-4)

Steps
1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet. You will see a screen similar to the following.

Board List			1/4
Board	Comment	Rack	Status
1	[New network]	81	ONLINE
2	[ ]	82	OFFLINE
3	[ ]	83	OFFLINE
4	[ ]	84	OFFLINE

5. Move the cursor to the daughterboard that contains the multiple-module device you want to change.
6. Press F2, DEV-LST, to display the Device List screen. You will see a screen similar to the following.

Device List Bd 1 (ONLINE)		1/3	
Device Name	Description	Stat	MAC
Proxim switch	[prox switch 1]	OFF	1
XYZ Photo sw.	[light detect]	OFF	2
Light meter	[light measure]	OFF	17
A/B Flex I/O	[digital IO blk]	OFF	20

7. Move the cursor to the multiple-module device.
8. **If the Status of the device is ON** (indicating that the device is online), take the device offline:
    a.   Move the cursor to the Stat column of the device.
    b.   Press F5, OFFLINE. The Status changes to OFF. If the device is in an error state, the Status changes to ERR.

> **NOTE**
> If the board goes into an ERROR status while one or more devices are online,
> the status displayed for these devices remains ON. (The board status display at
> the top of the screen will show ERROR.) To remove or change one of these
> devices, move the cursor to the STAT column and press F5, OFFLINE.

9. Press NEXT, >, and then press F3, MOD-LST, to display the Module List screen. You will see a screen similar to the following.

```
Module List                  Bd 1   MAC 20 1/16
Slot    Module Type        Comment
  1    [Dig 16-In A/B   ] [                    ]
  2    [Dig 16-Out A/B ] [                    ]
  3    [***************] [                    ]
  4    [***************] [                    ]
  5    [***************] [                    ]
  6    [***************] [                    ]
  7    [***************] [                    ]
  8    [***************] [                    ]
  9    [***************] [                    ]
```

10. Move the cursor to the module you want to change or delete.
11. **To change a module** :
    a. Move the cursor to the Module Type.
    b. Press F4, [CHOICE], and select the new module type.
    c. Reconfigure the multiple-module device adapter as necessary.
    d. Turn the controller off and back on in order for the changes to take effect.
    e. Press MENUS.
    f. Select I/O.
    g. Press F1, [TYPE].
    h. Select DeviceNet.
    i. Move the cursor to the daughterboard that contains the multiple-module device.
    j. Press F2, DEV-LST, to display the Device List screen.
    k. Move the cursor to the multiple-module device.
    l. Move the cursor to the Stat column and press F4, ONLINE, to put the multiple-module device online.
12. **To delete a module ,** do the following:
    a. Press F2, DELETE.
    b. Press the appropriate function key:
    c. To delete the device, press F4, YES.
    d. To cancel the request deletion, press F5, NO.
    e. Turn the controller off and back on in order for the changes to take effect.

5.8   ADDING A USER-DEFINED DEVICE

Procedure 5-10 describes how to add a user-defined device.

Procedure 5-10 Adding a User-Defined Device

Conditions
- You have installed the DeviceNet Interface in the controller.   (Procedure 2-1)
- You have installed the DeviceNet Interface software option.   (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system.
                                                              (Procedure 3-1)

Steps
1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet. You will see a screen similar to the following.

```
Board List                        1/4
  Board     Comment       Rack   Status
    1    [New network  ]   81    ONLINE
    2    [             ]   82    OFFLINE
    3    [             ]   83    OFFLINE
    4    [             ]   84    OFFLINE
```

5. Press F3, DEF-DEV. See the following screen for an example.

```
Defined Device List                 1/4
  Device Name         Comment        INV
[XYZ Photo sw.      ][Photocell sensor]
[Brand-x prox #1    ][Hvy proxim snsr.]
[Brand-y FRC-SNS    ][Analog force sns]   *
[Brand-x Valve      ][Flow control vlv]
```

6. Read the list of devices to make sure that the required device definition is not already listed but marked as invalid, indicated by an asterisk (*) in the INV column.
   If the device is listed and has an asterisk (*) , verify the definition. Move the cursor to the device and press F4, DETAIL. Then go to Step 11 .
7. If the required definition is not listed, you must add it. Press NEXT, >, and then press F2, ADD_DEF. The Defined Device DETAIL screen is displayed. See the following screen for an example.

```
Defined Device Detail              1/13
   Status:                    IN USE
   1 Device name:        BECKHOFF BK5200
   2 Comment:
   3 Vendor ID:               108
   4 Device type:              12
   5 Product code:            5200
   6 I/O Mode:                POLL
   7    Digital inputs:        24
   8    Digital outputs:       16
   9    Analog inputs:          0
  10    Analog outputs:         2
  11    COS/CYC Ack:          YES
  12    Analog First:          NO
  13    Input Data Offset (bytes):   0
```

NOTE
  To display help information, press F5, HELP. When you are finished, press
  PREV.

---

8. Make sure you have all of the device information required in this screen. Refer to Table 5.2.3 (d) .
9. Move the cursor to Device name, press ENTER, and use the function keys to type the name. When you are finished, press ENTER.
10. Move the cursor to each of the items on the screen and enter the appropriate value.
11. **When you have finished entering device information,** move the cursor to any line except I/O type or Access mode and press F2, VERIFY.
   You should see the message

Device definition is valid

If you do not see this message, check whether the Device name, Device type, Vendor-Id, and Product code were entered correctly and try again.

12. Press F4, LIST, to display the Defined Device List screen.
The device you just defined should be listed.

```
Defined Device List                    1/4
 Device Name          Comment          INV
[XYZ Photo sw.      ][Photocell sensor]
[Brand-x prox #1    ][Hvy proxim snsr.]
[Brand-y FRC-SNS    ][Analog force sns]   *
[Brand-x Valve      ][Flow control vlv]
```

NOTE
If you do not have access to the device's Vendor ID, Device Type, or Product Code, you can use the value 0 for the unknown parameter. However, you should enter the correct value for the parameter as soon as possible to avoid bypassing the diagnostic capability of DeviceNet.

5.9   DELETING A USER-DEFINED DEVICE DEFINITION

Use Procedure 5-11 to delete a user-defined device definition.

Procedure 5-11 Deleting a User-Defined Device Definition

NOTE
If the device type you want to delete is currently used in a Device List for a daughterboard, you must first delete the device from that board's Device List. Refer to Procedure 5-5 to delete the device from the Device List.

Conditions
   •   You have installed the DeviceNet Interface in the controller. (Procedure 2-1)
   •   You have installed the DeviceNet Interface software option. (Procedure 2-1)
   •   You have defined one or more user-defined device definitions. (Procedure 5-10)

Steps
1.   Press MENUS.
2.   Select I/O.
3.   Press F1, [TYPE].
4.   Select DeviceNet. You will see a screen similar to the following.

```
Board List                         1/4
 Board    Comment        Rack    Status
   1    [New network   ]   81    ONLINE
   2    [              ]   82    OFFLINE
   3    [              ]   83    OFFLINE
   4    [              ]   84    OFFLINE
```

5.   Press F3, DEF-DEV, to display the Defined Device List screen. You will see a screen similar to the following.

```
Defined Device List                    1/4
 Device Name          Comment          INV
[XYZ Photo sw.      ][Photocell sensor]
[Brand-x prox #1    ][Hvy proxim snsr.]
[Brand-y FRC-SNS    ][Analog force sns]   *
[Brand-x Valve      ][Flow control vlv]
```

> **NOTE**
> If the device type you want to delete is currently used in a Device List for a daughterboard, you must first delete the device from that board's Device List. Refer to Procedure 5-5 to delete the device from the Device List.

6. Move the cursor to the device type you want to delete.
7. Press NEXT, >, and then press F1, DELETE.
8. Press the appropriate function key:
   - To delete the device definition, press F4, YES.
   - To cancel the deletion, press F5, NO.

5.10 EXPLICIT MESSAGING

Some third party DeviceNet devices support features which must be configured using explicit messaging. An example is the Rockwell Armor block (1792D-8BVT8CD) where a parameter, Input Filter Off To On Delay, could be tuned to a non-default value for a particular application. This is generally done with a PC configuration tool such as RS-Networx for DeviceNet. In some instances, a PC configuration tool is not available. Explicit Message Configuration offers an alternative method for configuring these parameters directly from the robot DeviceNet scanner. You can access this option from the main DeviceNet screen and execute queries from the teach pendant.

The explicit messaging feature implements the Get Attribute Single, and Set Atribute Single services. It requires you to submit the following information:
- Destination Mac Address
- Class
- Instance
- Attribute
- Value and Value Size (if setting the attribute)

Aside from the MAC Address, these values come from a parameter definition within the device EDS file. The class, instance, and attribute values are held in the Link Path within a particular parameter definition and must be interpreted based on C-1.4.2 in Appendix C of Volume 1 of CIP common specification. The Value Size can be found in the Data Size field. The values themselves are an enumerated list for each parameter shown as min, max, and default values. This feature is not intended as a replacement for a PC configuration tool (like RS-Networx for DeviceNet) to configure complex third party devices.

This feature can be used when specifically identified attributes need to be set to known values. An explicit message configuration file can be created that performs a batch of commands. (Refer to Procedure 5-14). Most devices do not require this kind of configuration. Use Procedure 5-12 to get parameters manually. Some explicit message parameters (e.g Vendor ID, Product Name, Revision Number, etc) are pre-programmed for users. Use Procedure 5-15 .

> **NOTE**
> In some cases, the following procedures reference Appendix H in Volume 1 of the DeviceNet Specification Release 2.0 Errata 5.

Procedure 5-12 Getting Parameters Manually

Conditions
- You have installed the DeviceNet interface in the controller.   (Procedure 2-1)
- You have installed the DeviceNet Interface software option.   (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system.
  (Procedure 3-1)
- You have obtained the Electronic Data Sheet (EDS) file of the device you want to configure.

1. Press MENUS.

2.   Select I/O.
3.   Press F1, [TYPE].
4.   Select DeviceNet. See the following screen for an example.

```
I/O DeviceNet        JOINT 10 %
  Board List                      1/4
 Board   Comment         Rack   Status
   1    [              ] 81  ONLINE
   2    [              ] 82  OFFLINE
   3    [              ] 83  OFFLINE
   4    [              ] 84  OFFLINE
```

NOTE
    The board should be ONLINE to use EXP-MSG. If not, the error message,
    "Please set the board ONLINE," will be displayed.

5.   Move the cursor to the board for which you want to query the device.
6.   Press NEXT >.
7.   Press F2, EXP-MSG. You will see a screen similar to the following.

```
I/O DeviceNet        JOINT 10 %
Explicit Message Query     2/8

  Board:1
  1  Input Mode:     Manual
  2  Mac ID:          0
  3  Class:           0
  4  Instance:        0
  5  Attribute:       0
  6  Service:        Get Att
  7  Value Size:     Byte(1)
  8  Value:           0
```

8.   Select Input Mode, and choose Manual.
9.   Select the MAC ID to which the remote device is set.
10. Get Class, Instance, Attribute and Value Size from the EDS file. In the following example, Class is
     0Fh, instance is 02h and Attribute is 01h. Value Size can be obtained from Data Size in EDS file and
     it is 1 (byte) in this example.

NOTE
    You need to decode Link Path to obtain Class, Instance, and Attribute. Refer to
    Section C-1.4.2 in the Appendix C of Volume 1 of CIP common specification for
    more information.

11. Select Class and type the value in decimal. In this example, type 15.

NOTE
    0F in hexadecimal is equivalent to 15 in decimal

12. Select Instance and type the value in decimal. In this example, type 2.
13. Select Attribute and type the value in decimal. In this example, type 1.
14. Select Service field and choose Get Att.
15. Select Value Size and Choose Byte(1). Returned data is always in Byte form for Get Att service.
16. Select Value. You do not need to type any values when Get Att is selected for Service.
17. Press F4, EXEC. The software will attempt to make Explicit Message connection to the device. The
     response will be:

- "No response from device" - check the MAC ID of the device. Also, check if the remote device is attached to the same DeviceNet where the current DeviceNet board is attached (In this example, board 1 should be in the same DeviceNet with the remote device).
- "Error from device [error code]" - refer to Appendix H in Volume 1 of the DeviceNet Specification Release 2.0 Errata 5 for more information.
- "Response:…" - the query is successful and the returned data (up to 7 bytes) is shown.

Procedure 5-13 Setting Parameters Manually

Conditions
- You have installed the DeviceNet interface in the controller   (Procedure 2-1)
- You have installed the DeviceNet Interface software option.   (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system.
                                                                        (Procedure 3-1)
- You have obtained the Electronic Data Sheet (EDS) file of the device you want to configure.

1.   Press MENUS.
2.   Select I/O.
3.   Press F1, [TYPE].
4.   Select DeviceNet. See the following screen for an example.

```
I/O DeviceNet        JOINT 10 %
  Board List                         1/4
 Board   Comment            Rack   Status
   1    [                 ]  81   ONLINE
   2    [                 ]  82   OFFLINE
   3    [                 ]  83   OFFLINE
   4    [                 ]  84   OFFLINE
```

NOTE
   The board should be ONLINE to use EXP-MSG. If not, the error message,
   "Please set the board ONLINE," will be displayed.

5.   Move the cursor to the board for which you want to query the device.
6.   Press NEXT.
7.   Press F2, EXP-MSG. You will see a screen similar to the following.

```
I/O DeviceNet        JOINT 10 %
Explicit Message Query      2/8

  Board:1
  1  Input Mode:       Manual
  2  Mac ID:           0
  3  Class:            0
  4  Instance:         0
  5  Attribute:        0
  6  Service:          Get Att
  7  Value Size:       Byte(1)
  8  Value:            0
```

8.   Select Input Mode and choose Manual.
9.   Select the MAC ID to which the remote device is set.
10. Get Class, Instance, Attribute and Value Size from the EDS file. In the following example, Class is 0Fh, instance is 02h and Attribute is 01h. Value Size can be obtained from Data Size in EDS file and it is 1 (byte) in this example.

> **NOTE**
> You need to decode Link Path to obtain Class, Instance and Attribute. Refer to Section C-1.4.2 in the Appendix C of Volume 1 of CIP common specification for more information.

11. Select Class and type the value in decimal. In this example, type 15.

> **NOTE**
> 0F in hexadecimal is equivalent to 15 in decimal.

12. Select Instance and type the value in decimal. In this example, type 2.
13. Select Attribute and type the value in decimal. In this example, type 1.
14. Select Service field and choose Set Att.
15. Select Value Size and Choose Byte(1).
16. Select Value and type in the value. In this example, change the value to 4.
17. Press F4, EXEC. The software will attempt to make Explicit Message connection to the device. The response will be:
     •   "No response from device" - check the MAC ID of the device. Also, check if the remote device is attached to the same DeviceNet where the current DeviceNet board is attached.
     •   "Error from device [error code]" - refer to Appendix H in Volume 1 of the DeviceNet Specification Release 2.0 Errata 5 for a more specific cause of the errors.
     •   "Successfully executed" - the query has been successfully executed.
18. [Optional Step] You can verify whether this parameter has been set by performing Procedure 5-12 . Make sure returned data is 4 based on this example.

Procedure 5-14 Setting Parameters Using the File Method

Conditions
     •   You have installed the DeviceNet interface in the controller   (Procedure 2-1)
     •   You have installed the DeviceNet Interface software option.   (Procedure 2-1)
     •   You have configured the DeviceNet Interface daughterboards used in your system.
                                                                (Procedure 3-1)
     •   You have obtained or created an EM configuration file under either MC: or FR: devices.
                                                                (Refer to Section 5.10 .)
1.   Press MENUS.
2.   Select I/O.
3.   Press F1, [TYPE].
4.   Select DeviceNet. See the following screen for an example.

```
I/O DeviceNet          JOINT 10 %
  Board List                      1/4
 Board   Comment          Rack   Status
   1     [            ]    81   ONLINE
   2     [            ]    82   OFFLINE
   3     [            ]    83   OFFLINE
   4     [            ]    84   OFFLINE
```

> **NOTE**
> The board should be ONLINE to use EXP-MSG. If not an error message, "Please set the board ONLINE," displayed.

5.   Move the cursor to the board for which you want to query the device.
6.   Press NEXT.
7.   Press F2, EXP-MSG. You will see a screen similar to the following.

```
I/O DeviceNet          JOINT 10 %
Explicit Message Query      2/8

  Board:1
  1  Input Mode:        Manual
  2  Mac ID:              0
  3  Class:               0
  4  Instance:            0
  5  Attribute:       0
  6  Service:             Get Att
  7  Value Size:          Byte(1)
  8  Value:               0
```

8.   Select Input Mode and choose File. You will see a screen similar to the following.

```
I/O DeviceNet          JOINT 10 %
Explicit Message Query      1/3

  Board:1
  1  Input Mode:        File
  2  Device:            FR:
  3  Config File No.:   1
```

9.   Select Device and choose either FR: or MC:.

NOTE
   If a config file is stored in FR:, choose FR: If a config file is stored in MC:, choose
   MC:

---

10.   Select Config File No., and type in the file Number.
11.   Press F4, EXEC. The software will attempt to make Explicit Message connection to the device. The
      response will be :
      •   "Cannot open Config File", check if a config file exists in MC: or FR:. Also, make sure the file
           extension is *.EM not *.txt or anything else.
      •   "Error from device [Query: 2] 0x14", an error, 0x14, was returned while Query 2 was
           processed. Look up the error code in the Appendix H in Volume 1 of the DeviceNet
           Specification Release 2.0 Errata 5, and go back to Query 2 to fix it.
      •   "No response from device [Query 2]", check the MAC ID of the device in Query 2. Also, check
           if the remote device is attached to the same DeviceNet where the current DeviceNet board is
           attached.
      •   If you see the message "Parsing Error [Query 2, line 4]", check if all fields are entered
           appropriately. You should start from line 4 in Query 2. If you do not see any problems,
           investigate previous line and next line in Query 2. If you still do not see any problems, check
           the previous query. (In this example, Query 1).

Creating a Configuration File for the File Method—Example

NOTE
   For example, EMCFG_01.EM config file might consist of some comments that
   start with * and Queries as shown below.

```
*    File Name: EMCFG_01.EM
*    Author: Joe User
*    Date: 03/15/2004
*    File name must be EMCFG_XX.EM where XX is the number.
*    (i.e. EMCFG_1.EM, EMCFG_15.EM)
```

```
* Lines beginning with '*' are comments.
* Comments and blank lines are ignored.
* Following 7 lines MUST exist for each query.
* There can be multiple queries within a file.
* The "SET ATT" service is assumed in all cases.
* Each Query begins with a query number which is unique and generally * *
sequential.
* Size field refers to the Data Size of the parameter.   This can be
* obtained from Electronic Data Sheet(EDS) of the device.   We support
* the following three:
* 1 (BYTE or 1 byte), 2(WORD or 2 bytes), 4 (LONG or 4 bytes)
QUERY: 1
MACID: 5
CLASS: 15
INSTANCE: 2
ATTRIBUTE: 1
SIZE: 1
VALUE: 4
QUERY: 2
MACID: 5
CLASS: 15
INSTANCE: 3
ATTRIBUTE: 1
SIZE: 2
VALUE: 300
```

NOTE
> For information on DeviceNet error codes, refer to Appendix H in Volume 1 of
> the DeviceNet Specification Release 2.0 Errata 5.

Procedure 5-15 Getting and Setting Parameters by using Predefined Method

Conditions

- You have installed the DeviceNet interface in the controller   (Procedure 2-1)
- You have installed the DeviceNet Interface software option.   (Procedure 2-1)
- You have configured the DeviceNet Interface daughterboards used in your system.
                                                                  (Procedure 3-1)
- You have obtained or created an EM configuration file under either MC: or FR: devices.
                                                                  (Refer to Section 5.10 .)

1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select DeviceNet. See the following screen for an example.

```
I/O DeviceNet        JOINT 10 %
  Board List                    1/4
 Board   Comment            Rack   Status
   1     [              ]    81    ONLINE
   2     [              ]    82    OFFLINE
   3     [              ]    83    OFFLINE
   4     [              ]    84    OFFLINE
```

> **NOTE**
>   The board should be ONLINE to use EXP-MSG. If not, the error message,
>   "Please set the board ONLINE," will be displayed.

5.   Move the cursor to the board for which you want to query the device.
6.   Press NEXT, >.
7.   Press F2, EXP-MSG. You will see a screen similar to the following.

```
I/O DeviceNet          JOINT 10 %
Explicit Message Query      2/8

  Board:1
  1  Input Mode:      Manual
  2  Mac ID:          0
  3  Class:           0
  4  Instance:        0
  5  Attribute:       0
  6  Service:         Get Att
  7  Value Size:      Byte(1)
  8  Value:           0
```

8.   Select Input Mode, and choose Predef. You will see a screen similar to the following.

```
I/O DeviceNet          JOINT 10 %
Explicit Message Query      1/4

  Board:1
  1  Input Mode:      Predef
  2  Query:            Vendor ID
  3  Service:          Get Att
  4  MAC ID:           0
```

9.   Select Query and choose the query from the menu. Refer to Table 5-10.

Table 5.10   Queries supported by Predef

Query (Attribute)	Access	Data Type	Description
Vendor ID	Get	Integer	Managed by ODVA
Device Type	Get	Integer	Managed by ODVA
Product Code	Get	Integer	Assigned by vendors
Revision	Get	Structure	Displayed by Major.Minor format. (e.g 2.4 where Major Rev. is 2 and Minor Rev. is 4)
Status	Get	Integer	Current status of the device. Refer to Table 6.B Bit Definitions for Status Instance Attribute of Identity Object in Volume 2 of the DeviceNet Specification Release 2.0 Errata 5.
Serial Number	Get	Integer	Unique number assigned by vendors
Product Name	Get	String	Short description of device

Query (Attribute)	Access	Data Type	Description
Quick Connect	Get Set (QC_ON) Set (QC_OFF)	Boolean None None	Get: returns if Quick Connect is enabled (return 1) or disabled (return 0) on the remote device QC_ON: enable Quick Connect on the remote device. It returns "Successfully executed" for success or the error code for failure. QC_OFF: disable Quick Connect on the remote device. It returns "Successfully executed" for success or the error code for failure.

NOTE
  Refer to Section 6-2.2 Instance Attributes in Volume 2 of the DeviceNet
  Specification Release 2.0 Errata 5 for complete description of each attribute.

10. Select the MAC ID of the remote device.
11. Press F3, EXEC and the response will show up in Prompt Window of Teach Pendant. The example below illustrates Product Name query performed on the remote device (MAC 19).

```
I/O DeviceNet        JOINT 10 %
Explicit Message Query     1/4

  Board:1
  1  Input Mode:        Predef
  2  Query:              Product Name
  3  Service:           Get Att
  4  MAC ID:            19
Response: MaXum 8 in, 8 out, Pt Diagnost
```

6   DEVICENET I/O AND ASSIGNMENTS

6.1   DEVICENET I/O ASSIGNMENT

The DeviceNet slave card supports a maximum of 512 input/output points. The DeviceNet master card supports a maximum of 1024 input/output points.

To assign I/O to DeviceNet devices, you can do the following:

- Determine the number of I/O ports used - Procedure 6-1
- Have the system configure the I/O ports for all DeviceNet devices automatically by setting the system variable $IO_AUTO_CFG to TRUE.

Procedure 6-1 Assigning I/O Ports for a DeviceNet Device

Steps

1. On the Board List screen, make note of the rack number of the board to which the device is connected.
2. Press F2, DEV-LST.
3. On the Device List screen, make note of the device's MAC Id. (For slave operation, use the board's MAC Id.)
4. Press NEXT, then F5, CHGDSP, to display the Device List Alternate Display screen. You will see a screen similar to the following

```
Device List                          1/1
 Device Name    Mode   Int  AR  EM  Stat  MAC
Std photoeye    POLL   10   N   N   ON    14
```

5. Note the I/O mode setting under the Mode column.
6. Press F3, DEF-DEV, to display the Defined Device List screen. You will see a screen similar to the following.

```
Defined Device List                  1/4
 Device Name         Comment        INV
[XYZ Photo sw.   ]   [Photocell sensor]
[Brand-x prox #1 ]   [Hvy proxim snsr.]
[Brand-y FRC-SNS ]   [Analog force sns]    *
[Brand-x Valve   ]   [Flow control vlv]
```

7. If the desired device is a standard device type, press NEXT, >, and then press F3, STD-DEV, to display the Standard Device Definition List screen. You will see a screen similar to the following.

```
Standard Device Def'n List           1/4
 Device Name         Comment        INV
[ Std photoeye   ]   [                ]
[ Std prox switch]   [                ]
[ Std digital dev]   [                ]
[ Std analog dev ]   [                ]
```

8. Move the cursor to the standard or user-defined device for which you want I/O information and press F4, DETAIL. You will see a screen similar to the following.

```
Defined Device Detail            1/13
   Status:                     IN USE
   1 Device¥name:         BECKHOFF BK5200
   2 Comment:
   3 Vendor ID:                   108
   4 Device type:                  12
   5 Product code:               5200
   6 I/O Mode:                   POLL
   7    Digital inputs:            24
   8    Digital outputs:           16
   9    Analog inputs:              0
  10    Analog outputs:             2
  11    COS/CYC Ack:            YES
  12    Analog First:             NO
  13    Input Data Offset (bytes):   0
```

9.   Look at the input and output sizes for the selected I/O mode to determine the number of I/O ports required.
10. Using the rack number for the board noted in Step 1 , and using the MAC Id (Step 3) as the slot number, go to the appropriate I/O configuration screen to assign I/O for the device.
11. Turn off the controller and then turn it on for the I/O assignments to take effect.

NOTE
   Assigning I/O for multiple-module devices will also require determining the amount of I/O used by modules actually connected to the device. Refer to the manufacturer's documentation for each module connected to the device to determine the amount of I/O used by them.

NOTE
   To remove the I/O assignments of a specific device, you need to remove the device from the device list, then delete its I/O assignments manually, and turn off and on the controller.

6.2   MONITORING I/O

You can monitor I/O on teach pendant screens. This section describes how to monitor I/O. Table 6-2 lists and describes the information displayed on an I/O CONFIG screen, as it applies to the DeviceNet Interface.

Table 6.2   I/O CONFIG screen items

ITEM	DESCRIPTION
Rack	This item is the rack number displayed on the Board List screen. The DeviceNet Interface daughterboards are assigned racks as follows: • Daughterboard 1 - Rack 81 • Daughterboard 2 - Rack 82 • Daughterboard 3 - Rack 83 • Daughterboard 4 - Rack 84
Slot	This item is the MAC-Id for the DeviceNet device you want to configure, displayed on the Device List screen for the daughterboard to which the device is connected. (Board MAC Id for slave operation.)
Starting Point	This item is the physical position on the DeviceNet device of the first port in a range of input or output signals.

Use Procedure 6-2 to monitor I/O.

Procedure 6-2 Monitoring I/O

Steps
1. Press MENUS.
2. Select I/O.
3. Press F1, [TYPE].
4. Select the kind of I/O you want to monitor: Digital, Group, or UOP. See the following screen for an example of the digital input screen.

```
# SIM   STATUS              1/512
DI [    1]   *    OFF  [                ]
DI [    2]   *    OFF  [                ]
DI [    3]   *    OFF  [                ]
DI [    4]   *    OFF  [                ]
DI [    5]   *    OFF  [                ]
DI [    6]   *    OFF  [                ]
DI [    7]   *    OFF  [                ]
DI [    8]   *    OFF  [                ]
DI [    9]   *    OFF  [                ]
DI [   10]   *    OFF  [                ]
```

> **NOTE**
> Ports assigned to DeviceNet devices that are offline are shown with OFFLN status.

- **To change the display between the Input and Output screen** press F3, IN/OUT.
- **To move quickly through the information**, press and hold the SHIFT key and press the down or up arrow keys.
5. Press F2, CONFIG. See the following screen for an example of the digital input CONFIG screen.

```
1/32
 #    RANGE      RACK  SLOT  START PT
STAT
1 DI [ 1 -  16]   1     1      1      ACTIV
2 DI [17 -  24]   1     2      1      ACTIV
3 DI [25 -  32]   0     2     25      INVAL
4 DI [33 -  40]  81     3      1      ACTIV
5 DI [41 - 512]   0     0      0      UNASG
```

7   DIAGNOSTICS AND TROUBLESHOOTING

7.1   DIAGNOSTICS

The controller provides two diagnostic tools. They are
*   Monitoring I/O
*   Forcing outputs

The DeviceNet Interface system provides two additional diagnostic tools:
*   LED indicators
*   System error messages

Use these diagnostic tools to help you determine the problems in your system. After you know what the problems are, refer to the troubleshooting section of this chapter for information about how to solve them.

Refer to the R-30*i*A/R-30*i*A Mate controller ALARM CODE LIST operator's manual (B-83124EN-6) or R-30*i*B/R-30iB Mate controller ALARM CODE LIST operator's manual (B-83284EN-1) for more information about error codes.

7.2   TROUBLESHOOTING

Now that you have an idea of what your problem is from using diagnostics, you are ready to solve it. Use the troubleshooting table, Table 7-2 , to help solve the problems in your system.

⚠ **WARNING**
Disconnect electrical power from the controller before you remove or replace components, or you could be injured seriously.

⚠ **WARNING**
When the circuit breaker handle is OFF, power is still present inside the controller. You must unplug the controller from the electrical outlet to remove all power from the controller. Otherwise, you could injure personnel or damage equipment.

NOTE
For DeviceNet Safety function that exchanges safety signals on DeviceNet Interface, please read "R-30*i*A/R-30*i*A Mate controller Dual Check Safety Function (ISO 13849-1:2006 compliant) operator's manual (B-83104EN)" or "R-30*i*B/R-30*i*B Mate controller Dual Check Safety Function operator's manual (B-83184EN) in addition to this manual.

Table 7.2   Troubleshooting

Problem	Possible Cause	Solution
A board cannot be brought online	The board is not initialized as it could not be detected.	Make sure the DIP switches are set correctly. Refer to Appendix A for information on setting the DIP switches.
	Network power is not supplied	Make sure there is a connection to a 24VDC power supply somewhere on the network. If there is no connection, connect a 24VDC power supply to a DeviceNet cable (make sure you have power connected to the correct wires) and connect the cable to the network.
	There are baud rate conflicts with devices	Check the baud rate on the Board Detail screen for the board that cannot be brought online. Make sure the devices are set for the same baud rate.
	There are MAC Id conflicts with another device or board	• If multiple boards are connected to the same network, check the MAC Ids on their respective Board Detail screens and change one of the MAC Ids if necessary.
	There is a bad network connection	• Check the cable that connects the board to the network for a loose wire or other problem. Make sure all connectors are completely plugged in and screwed on. • If you are using open connectors (such as Phoenix 5-terminal), check that the connector is wired properly.
	There is an improper network hookup/termination	Make sure the trunk line is terminated at both ends. If you have long drop lines, make sure the length is within DeviceNet specifications for the baud rate being used.
	Board DIP switches are set improperly	Determine the board number of the board that cannot be brought online. Refer to Appendix A for the correct DIP switch configuration. Compare the correct configuration with the board's current DIP switch configuration and make adjustments if necessary.
	There is a bad daughterboard	• Make sure that you are not experiencing one of the problems listed above. • Contact your FANUC Customer Service Representative for replacement.
	Network power is not supplied	Make sure there is a connection to a 24VDC power supply somewhere on the network. If there is no power supply, connect a 24VDC power supply to a DeviceNet cable (make sure you have power connected to the correct wires) and connect the cable to the network.

Problem	Possible Cause	Solution
A device cannot be brought online	The device has an incorrect baud rate configuration	• If the devices is DIP-switch configured, make sure the DIP switches are set to the same baud rate on the board. • If the device is software-configured, check the device's baud rate with the DeviceNet configuration management software (not available from FANUC).
	There are MAC Id conflicts with another device	Make sure that no two devices on the same network are configured for the same MAC Id.
	The device has an incorrect MAC Id configuration	• If the device is DIP-switch configured, make sure the DIP switches are set to the same MAC Id as shown in the Device List. • If the device is software-configured, check the device's MAC Id with the DeviceNet configuration management software (not available from FANUC).
	An incorrect device definition has been selected	Check that the proper device definition has been selected on the Device List screen. If the correct definition has not been selected, move the cursor to the Device Name column, press F4, [CHOICE], and select the correct one. If the required definition is not listed, create a new one, and correct the device definition.
	The I/O size of the device is incorrect	Check that the device definition specifies the number of inputs and outputs required by the device. If the definition is incorrect, change the device definition or create a new one.
	The device must be reset	Unplug the DeviceNet cable from the device and either turn it off or unplug power. Turn on the device and reconnect the device to the network.
	The device has an incorrect I/O type	Check that the device definition specifies the same I/O type (analog or digital) as given in the device documentation.
	The device is set to an incorrect access mode	Check that the device definition specifies the same access mode (polled or strobed) as given in the device documentation.
	The device has an incorrect module list	• Check that the Module List screen lists the same modules that are found connected to the device. • If the multiple-module device adapter must be software configured, re-configure the device using DeviceNet configuration management software (not available from FANUC).
	The device has incorrect DeviceNet parameters	Check that the device definition contains the correct Vendor Id, Device Type, and Product or Device Code. These are found in the device documentation or EDS file.

Problem	Possible Cause	Solution
A device cannot be brought online	Devices are not connected to the proper board	Check the network connections to make sure the device is connected to the proper board.
	The network was hooked up improperly	• Make sure the trunk line is terminated at both ends. • If you have long drop lines, make sure the length is within DeviceNet specifications for the baud rate being used. • If you are using open connectors (such as Phoenix 5-terminal), check that the connector is wired properly. Refer to Section A.1 .
	A device is malfunctioning.	• Make sure that you are not experiencing one of the problems listed above. • Contact the device vendor for repair or replacement.
DeviceNet I/O with slave devices not working	I/O has not been assigned or has been assigned incorrectly	Check the I/O configuration screens to see if DeviceNet device I/O have been assigned. DeviceNet I/O assignments are made for rack numbers 81-84 (corresponding to boards 1-4) and slot numbers equal to device MAC Ids.
	The board is not online	Attempt to bring the board online.
	The device is not online	Attempt to bring the device online.
	The device has an incorrect I/O size	Check that the device definition specifies the number of inputs and outputs required by the device. If not, change the device definition or create a new one.
	Devices are not connected to the correct board	Check cabling to ensure that the devices are corrected to the correct board.
	The device was not set up properly	Some devices might require additional power supplies or other setup. Consult the device's documentation to make sure the device is set up properly.
	The network was hooked up improperly	• Make sure the trunk line is terminated at both ends. • If you have long drop lines, make sure the length is within DeviceNet specifications for the baud rate being used.
DeviceNet I/O with external master is not working	I/O size was not specified on the DeviceNet Interface board	On the Board Detail screen, specify the size (in bytes) of the input and output data to be shared between the controller and the external master device.
	There is an I/O size mismatch	Make sure the data size specified on the board Detail screen matches the data size specified on the external master device.
	The master is not scanning the DeviceNet Interface board	Set up the external master to scan the DeviceNet Interface daughterboard (usually requires DeviceNet configuration management software, which is not supplied by FANUC).

Problem	Possible Cause	Solution
DeviceNet I/O with external master is not working (continued)	There is a baud rate mismatch	Make sure the baud rate configuration of the external master matches the baud rate of the board as specified on the Board DETAIL screen.
	There is a MAC Id mismatch	Make sure the external master is set up to scan the board at the MAC Id specified on the Board Detail screen.
	The network was hooked up improperly	• Make sure the trunk line is terminated at both ends. • If you have long drop lines, make sure the length is within DeviceNet specifications for the baud rate being used.

APPENDIX

A   DEVICENET HARDWARE DETAILS

A.1   DEVICENET INTERFACE OVERVIEW

> **NOTE**
> The DeviceNet motherboards used in R-30*i*A/R-30*i*B are NOT the same as those used in R-J3/R-J3*i*B. **DO NOT** use an R-J3/R-J3 *i*B DeviceNet (PC-104) motherboard in R-30*i*A/R-30*i*B (or vice-versa).

> **NOTE**
> The mini-slot boards and the wide-mini motherboard are the same hardware in R-30*i*A/R-30*i*B. On the other hand, the full-slot motherboard is different hardware in R-30*i*A/R-30*i*B. Be sure to use the proper hardware for the controller type.

> **NOTE**
> For DeviceNet Safety function that exchanges safety signals on DeviceNet Interface, please read "R-30*i*A/R-30*i*A Mate controller Dual Check Safety Function (ISO 13849-1:2006 compliant) operator's manual (B-83104EN)" or "R-30*i*B/R-30*i*B Mate controller Dual Check Safety Function operator's manual (B-83184EN) in addition to this manual.

Table A.1(a)   DeviceNet hardware part numbers (R-30*i*A/R-30*i*A Mate)

Part Number	Description	Refer to...
A05B-2500-J042	DN3 daughterboard single channel (R-30*i*A)	Section A.2
A05B-2500-J043	DN3 daughterboard dual channel (R-30*i*A)	Section A.3
A05B-2500-J045	DN4 daughterboard single channel (R-30*i*A)	Section A.2
A05B-2500-J046	DN4 daughterboard dual channel (R-30*i*A)	Section A.3
A05B-2500-J040	Mini-slot Slave only Devicenet (R-30*i*A)	Section A.4
A05B-2500-J048	Mini-slot DeviceNet DN4 board (R-30*i*A)	Section A.5
A05B-2500-J010	Mini-slot Slave only Devicenet (For R-30*i*A Mate controller)	Section A.4
A05B-2500-J012	Mini-slot DeviceNet DN3 board (For R-30*i*A Mate controller)	Section A.5
A05B-2500-J014	Mini-slot DeviceNet DN4 board (For R-30*i*A Mate controller)	Section A.5
A05B-2500-J320	R-30*i*A/R-30*i*B wide-mini slot blind plate	It is required when a mini-slot board is installed to the wide-mini slot.
A05B-2500-J095	PC104 Wide mini slot Motherboard	N/A
A05B-2500-J090	PC104 Full size Motherboard	N/A

Table A.1(b)   DeviceNet hardware part numbers (R-30*i*B/R-30*i*B Mate)

Part Number	Description	Refer to...
A05B-2600-J080	DN4 daughterboard single channel (R-30*i*B)	Section A.2
A05B-2600-J081	DN4 daughterboard dual channel (R-30*i*B)	Section A.3
A05B-2600-J040	Mini-slot Slave only Devicenet	Section A.4
A05B-2600-J042	Mini-slot DeviceNet DN4 board	Section A.5
A05B-2500-J320	R-30*i*A/R-30*i*B wide-mini slot blind plate	It is required when a mini-slot board is installed to the wide-mini slot.
A05B-2600-J095	PC104 Wide mini slot Motherboard	N/A
A05B-2600-J090	PC104 Full size Motherboard	N/A

A.2   SST-DN3-104, SST-DN4-104 HARDWARE INFORMATION

Fig. A.2 shows the DIP switches for the SST-DN3-104, SST-DN4-104 daughterboard, while Table A.2(a) shows the DIP switch settings for each board number. Table A.2(b) shows the LED status descriptions.
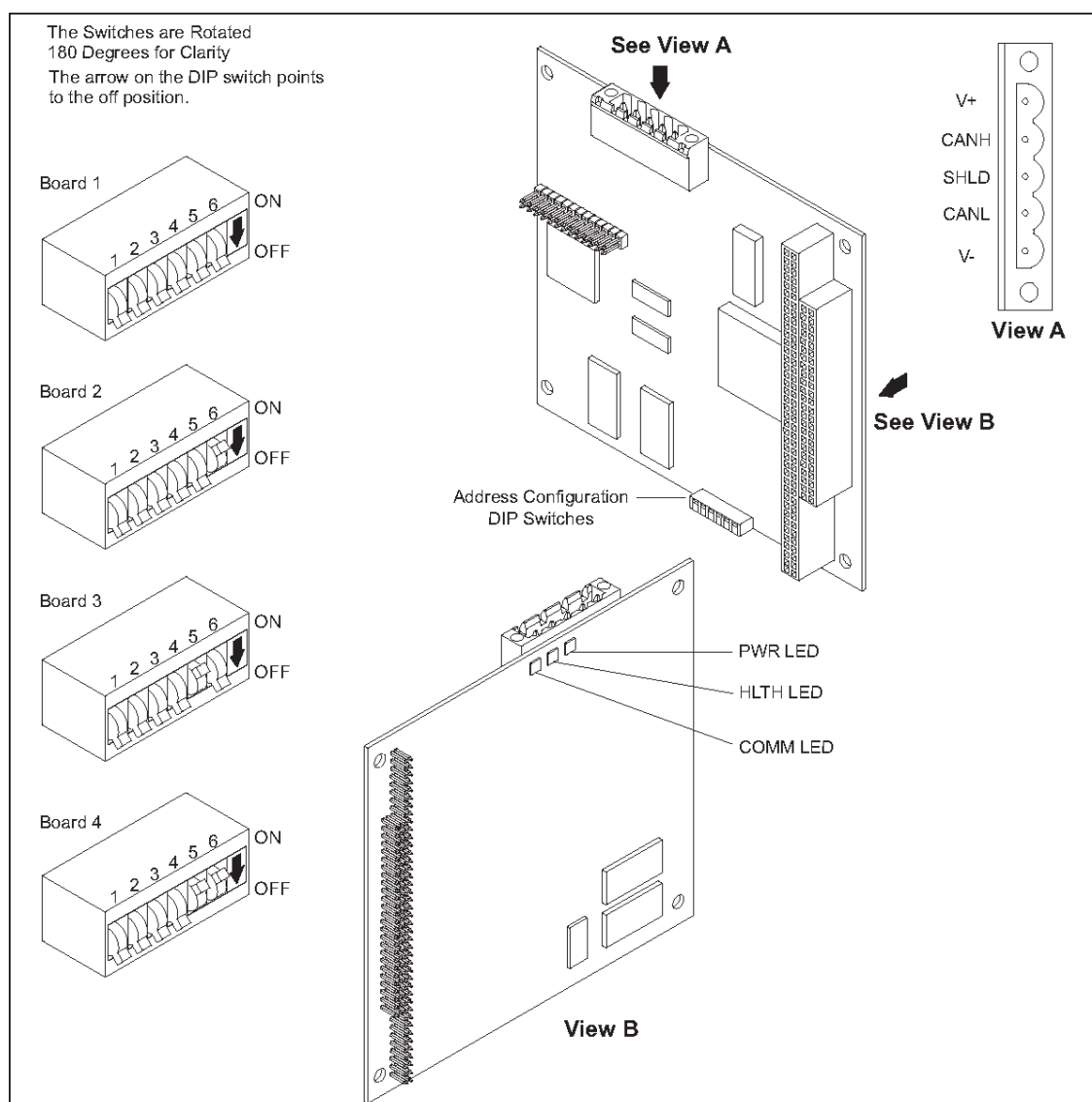
Fig. A.2   SST-DN3–104, SST-DN4-104

Table A.2(a) DIP switch settings

Board	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6
1	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	OFF	OFF	OFF	OFF	ON
3	OFF	OFF	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	OFF	ON	ON

Table A.2 (b)   LED status description

LED	Green	Flashing Green	Red	Off
Comm Status	The DeviceNet Interface board is online and scanning and the DeviceNet network is functioning properly.	The DeviceNet Interface board is online on the DeviceNet network, but it is not scanning. No devices are online to the DeviceNet Interface.	The DeviceNet network is not turned on.	The DeviceNet Interface board is offline from the DeviceNet network.
Health Status	The DeviceNet Interface board is functioning properly.	Not a valid state	The board has not been initialized. No DeviceNet communication can occur.	No power is being applied to the DeviceNet Interface.
Network Power Status	Network power is present.	Not applicable.	Network power is not present. Apply 24V before communications can occur.	Not applicable.

A.3 SST-DN3-104-2, SST-DN4-104-2 HARDWARE INFORMATION

Table A.3 shows the DIP switches for the SST-DN3-104-2, SST-DN4-104-2 daughterboard, while Figure A.3 (a) shows the DIP switch settings for each board/channel number. Table A.3 (b) shows the LED status descriptions.
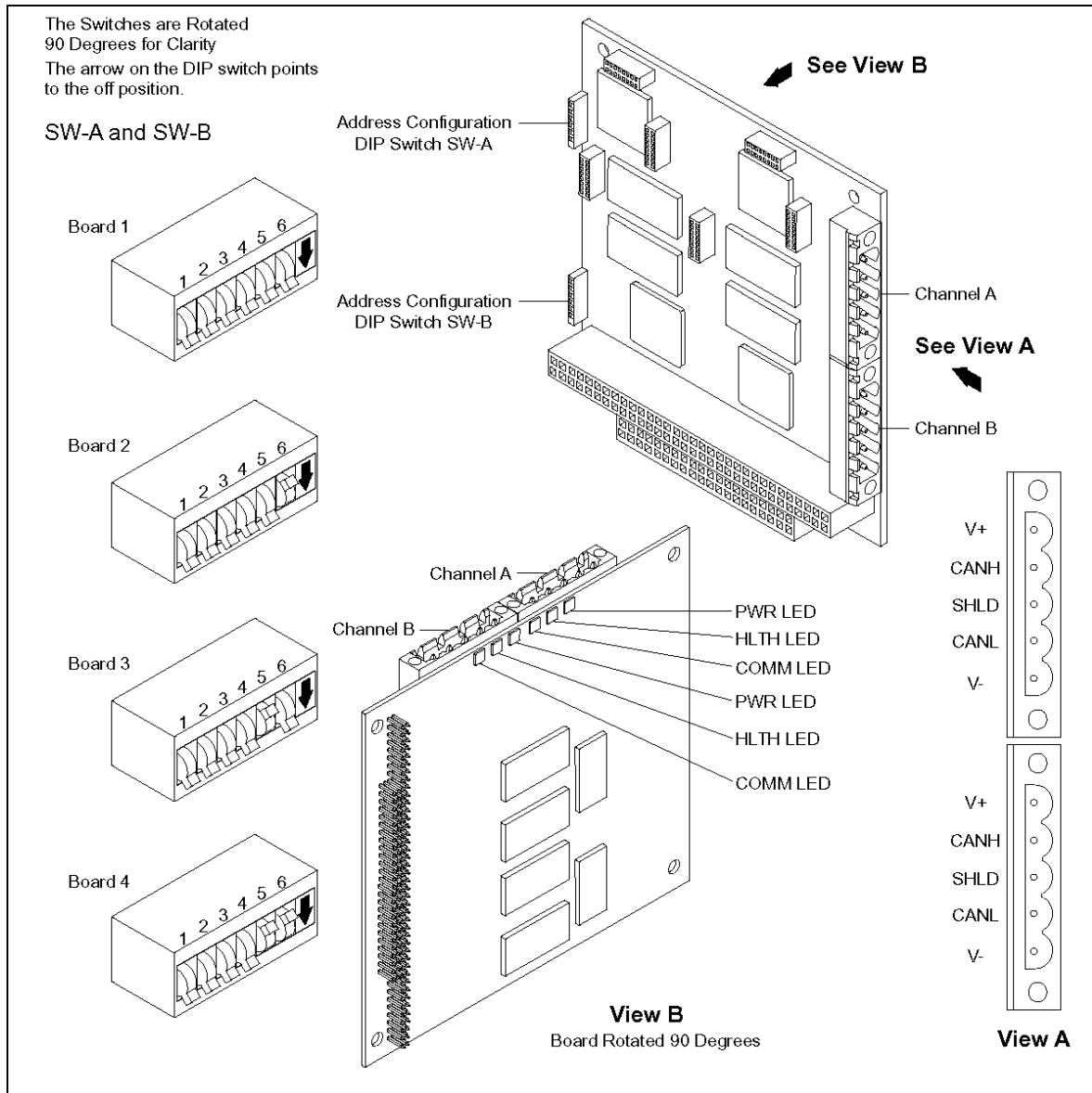
Fig. A.3   DN3–104–2, DN4-104-2

Table A.3 (a)   DIP switch settings

Board	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6
1	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	OFF	OFF	OFF	OFF	ON
3	OFF	OFF	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	OFF	ON	ON

NOTE
   DIP switch A and DIP switch B need to be set to one of these four switch
   configurations. They cannot be the same.

Table A.3 (b)   LED status descriptions

LED	Green	Flashing Green	Red	Off
Comm Status	The DeviceNet Interface board is online and scanning and the DeviceNet network is functioning properly.	The DeviceNet Interface board is online on the DeviceNet network, but it is not scanning. No devices are online to the DeviceNet Interface.	The DeviceNet network is not turned on.	The DeviceNet Interface board is offline from the DeviceNet network.
Health Status	The DeviceNet Interface board is functioning properly.	Not a valid state	The board has not been initialized. No DeviceNet communication can occur.	No power is being applied to the DeviceNet Interface.
Network Power Status	Network power is present.	Not applicable.	Network power is not present. Apply 24V before communications can occur.	Not applicable.

A.4   DEVICENET SLAVE BOARD HARDWARE INFORMATION
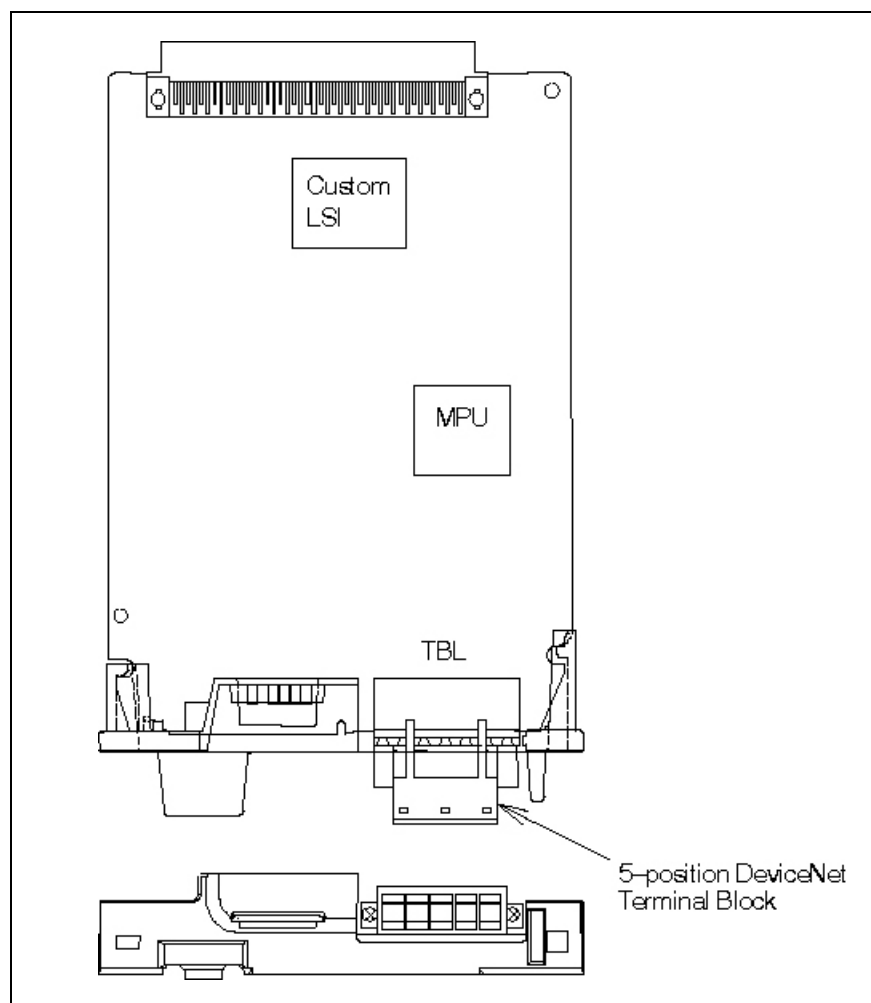
Fig. A.4 (a)   DeviceNet slave board
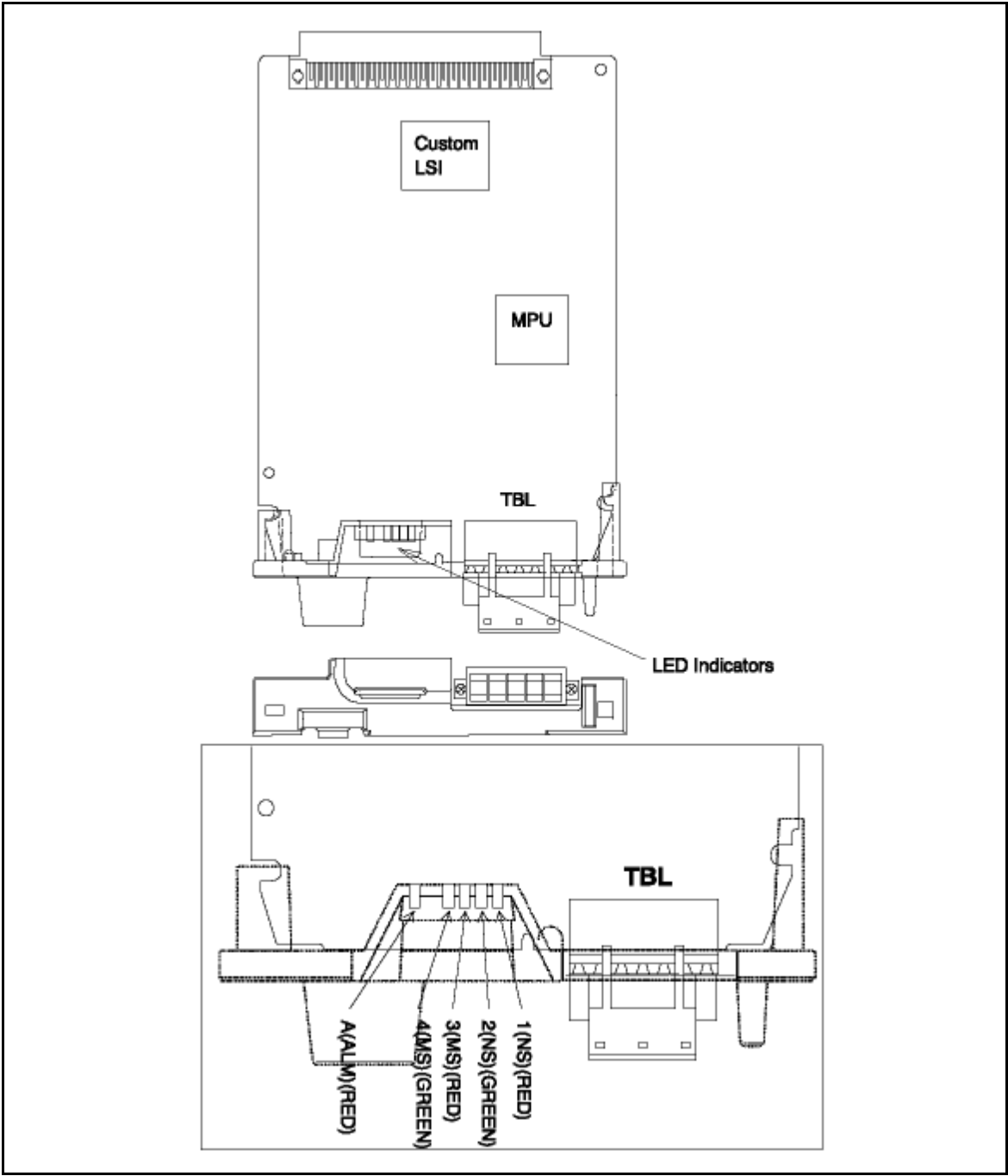
Fig. A.4 (b)   DeviceNet slave board

Table A.4 (a) , Table A.4 (b) , and Table A.4 (c) , show the board status when various LEDs are on or off on the DeviceNet slave Board.

Table A.4 (a)   ALM (DeviceNet slave board)

No.	LED Status ALM (Red)	Board Status
1	ON	The reset state or an error was detected.

TableA.4 (b)   MS (DeviceNet Module Status LEDs – DeviceNet slave board)

No.	LED Status MS (Green), (Red)	Board Status
1	ON, OFF	The board is operating normally.
2	Blinking, OFF	Adjustment is required because there is a missing, insufficient, or incorrect setting.
3	OFF, Blinking	A recoverable error occurred.
4	Blinking, ON	An unrecoverable error occurred.
5	Blinking, Blinking	Self–diagnosis is in progress.

Table A.4 (c)   NS (DeviceNet Network Status LEDs – DeviceNet slave board

No.	LED Status NS (Green), (Red)	Board Status
1	OFF, OFF	The communication link is not online.
2	Blinking, OFF	The communication link is online, but no connection has been established.
3	ON, OFF	The communication link is online, and a connection has been established.
4	OFF, Blinking	The connection is in the time-out status.
5	OFF, ON	An error which disabled communication on the network was detected.
6	Blinking, Blinking	A network access error was detected. The board is in the communication faulted state and receives an Identify Communication Faulted request.

A.5   MINI-SLOT DEVICENET DN3/DN4 BOARD HARDWARE INFORMATION
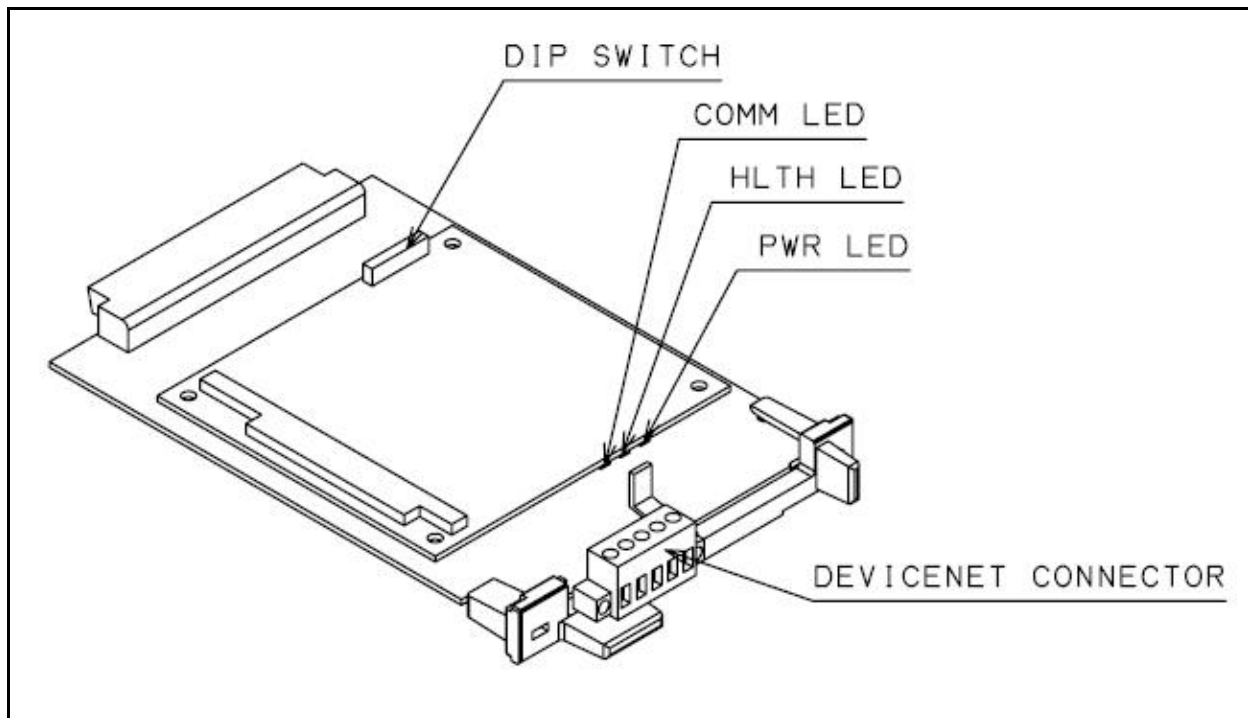
Fig. A.5 (a) Mini-slot DeviceNet DN3/DN4 board
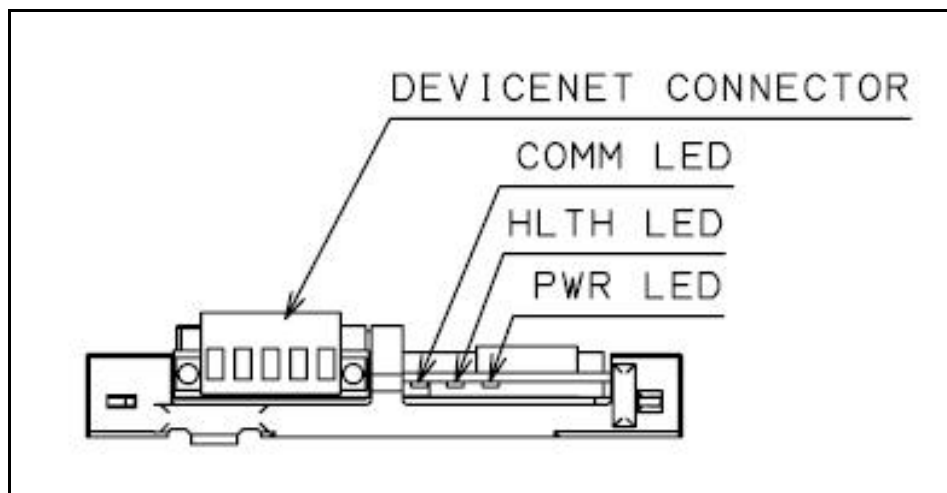
Fig. A.5 (b) Mini-slot DeviceNet DN3/DN4 board

Refer to the Table A.2(a) and the Table A.2(b) in the section A.2 for the LED and the DIP switch of the mini-slot DeviceNet DN3/DN4 board since they are the same as those of SST-DN3-104/ SST-DN4-104.

B RESPONSE TIME

The *response time* of the system is the amount of time it takes an I/O signal to propagate through the system to its destination. The response time of a DeviceNet network depends most significantly on three factors:
- The number of devices on the network
- The amount of data being transmitted across the network
- The communications or baud rate

Response Time Calculation

To calculate the response time, the following information must be taken into account (all expressed in milliseconds):
- **Transmission time per bit (Tb)** - the time required to transmit a bit across the network.
  Tb = 1 / baud rate (baud rate = 125, 250, or 500 Kbaud) = 0.008 ms for 125 Kbaud= 0.004 ms for 250 Kbaud= 0.002 ms for 500 Kbaud
- **Transmission time per byte (TB)** - the time required to transmit a byte (8 bits) across the network.
  TB = 8 x Tb
- **Inter-message interval (Ti)** - the time required between DeviceNet messages.
  Ti = 0.250 ms
- **CAN message interval (Tc)** - CAN (Controller Area Network) based messages such as those transmitted on DeviceNet networks contain 44 bits of status and identification information.
  Tc = 44 *Tb
- **Scanner refresh and memory access interval (Tsc)**
  Tsc = 1.5 ms
- **The number of strobed devices (Ns)**
- **The number of polled devices (Np)**
- **The number of input bytes from strobed devices (Bs)**
- **The total number of input and output bytes for polled devices (Bp)**

The response time is calculated as shown in Fig. B.

$$RESPONSE\ TIME = Tsc + (Ns + Np)(Tc + Ti) + (Bs + Bp)(TB)$$

Fig. B Response time

Response time is **not** deterministic; this means that communication between the controller and the DeviceNet network occurs asynchronously, not at set intervals. In addition, noise on the network might cause retransmissions, and other traffic on the network might cause the interval to be longer than at other times.

C DEVICENET EDS INFORMATION

C.1 DEVICENET ELECTRONIC DATA SHEET INFORMATION

C.1.1 SST Daughterboard EDS Files

This Electronic Data Sheet information applies to the SYSTEM DeviceNet interface Master and Slave mode. For slave mode, enter input and output size in the Configuration tool for the Remote Master for polled I/O connection.

DeviceNet EDS Information for DN3

```
$ SST DeviceNet Electronic Data Sheet
$ Copyright (C) 2003 Woodhead Canada Limited.
[File]
  DescText    = "DeviceNet G3 Scanner Module 3.14";
  CreateDate = 05-08-2007;
  CreateTime = 12:59:12;
  ModDate     = 05-08-2007;
  ModTime     = 12:59:12;
  Revision    = 1.4;
[Device]
  VendCode      = 8;
  VendName      = "SST";
  ProdType     = 0x0c;
  ProdTypeStr = "Communication Adapter";
  ProdCode      = 0x0e;
  MajRev        = 3;
  MinRev        = 14;
  ProdName      = "DeviceNet G3 Scanner Module";
[IO_Info]
  Default      = 0X0001;
  PollInfo     = 0X0001, 1, 1;
  Input1=
        0x8,                    $ 8 bytes
        0,                      $ All bit are significant
        0x0001,                 $ polled
        "Status",               $ Name
        0x2,                    $ path size
        "61 50",                $ path
        "";                     $ help
  Output1=
        0x8,                    $ 8 bytes
        0,                      $ All bit are significant
        0x0001,                 $ polled
        "Status",               $ Name
        0x2,                    $ path size
        "61 43",                $ path
        "";                     $ help
[Params]
[EnumPar]
[Groups]
```

> **NOTE**
> Version 7.10 uses a minor revision (MinRev) of 6, Version 7.20 – V7.30 uses a minor rev (MinRev) of 9, Version V7.40 or later uses a minor rev (MinRev) of 14.

DeviceNet EDS Information for DN4

```
$ SST DeviceNet Electronic Data Sheet
$ Copyright (C) 2003 Woodhead Canada Limited.
[File]
  DescText    = "DeviceNet G4 Scanner Module 4.01";
  CreateDate = 2-29-2008;
  CreateTime = 12:59:12;
  ModDate     = 2-29-2008;
  ModTime     = 12:59:12;
  Revision    = 1.0;
[Device]
  VendCode      = 8;
  VendName      = "SST";
  ProdType      = 0x0c;
  ProdTypeStr = "Communication Adapter";
  ProdCode      = 0x0e;
  MajRev        = 4;
  MinRev        = 1;
  ProdName      = "DeviceNet G4 Scanner Module";
[IO_Info]
  Default       = 0X0001;
  PollInfo      = 0X0001, 1, 1;
  Input1=
        0x8,                    $ 8 bytes
        0,                      $ All bit are significant
        0x0001,                 $ polled
        "Status",               $ Name
        0x2,                    $ path size
        "61 50",                $ path
        "";                     $ help
  Output1=
        0x8,                    $ 8 bytes
        0,                      $ All bit are significant
        0x0001,                 $ polled
        "Status",               $ Name
        0x2,                    $ path size
        "61 43",                $ path
        "";                     $ help
[Params]
[EnumPar]
[Groups]
```

C.1.2   DeviceNet Slave EDS File

DeviceNet Slave EDS File

```
$ DeviceNet Configurator Generated Electronic Data Sheet
$
[File]
   DescText = "";
   CreateDate = 04-08-2005;
   CreateTime = 15:01:29;
   ModDate = 04-08-2005;
   ModTime = 15:01:29;
   Revision = 1.1;
   HomeURL = "";
[Device]
   VendCode = 591;
   VendName = "FANUC Ltd.";
   ProdType = 12;
   ProdTypeStr = "";
   ProdCode = 3;
   MajRev = 1;
   MinRev = 1;
   ProdName = "A20B-8101-0330";
   Catalog = "";
   Icon = "";
[IO_Info]
   Default      = 0x0001;
   PollInfo = 0x0001, 1, 1;
   Input1 =
   64,   0,   0x0001,
   "",
   6, "20 04 24 64 30 03",
   "";
   Output1 =
   64,   0,   0x0001,
   "",
   6, "20 04 24 65 30 03",
   "";
```

D   TRANSFERRING USER DEVICE DEFINITIONS

User device definitions can be transferred between robots using ASCII files. User device definitions are accessible through MD: dndef.dg. A user can copy from or to this file through the MD: device.
The following program is a typical MD:dndef.dg file.

```
*****************************************************
*           DeviceNet User Device Definitions           *
*****************************************************
* Protocol example is given below (* indicates comment)
* A new device definition begins with DEVICE line
* Each line should be less than 60 characters long
* A line that does not begin with a keyword will be
* ignored.
*****************************************************
* DEVICE "device name "
*       Displayed on device list screen, must be less than
*       17 characters.
*****************************************************
* DEVTYPE 12
*       Device type for the device
*****************************************************
* PRODCODE 32
*       Product code for the device
*****************************************************
* POLL 32 32 0 0
*       Specified as <mode> <dins> <douts> <ains> <aouts>
*       I/O modes are POLL, COS, CYCLIC, STROBE
*       For Strobe device, format is: STROBE <din> <ain>
*       din, dout - Digital inputs and outputs
*       ain, aout - Analog inputs and outputs
*****************************************************
* UNACK
*       Specifies unacknowledged COS/ACK, Optional
*       (not typically supported/used by devices)
*****************************************************
* ANLGFST
*       for analog first, optional
*****************************************************
* DATAOFFSET 1
*       specifies data offset for digital inputs in bytes
*       Optional, should be less or equal (din bytes - 1).
*****************************************************
DEVICE "SOME SENSOR"
VENDORID 108
DEVTYPE 12
PRODCODE 5200
POLL 24 16 0 2
```

```
ANLGFST
DATAOFFSET 1
DEVICE "1794-ADN Flex I"
VENDORID 1
DEVTYPE 12
PRODCODE 1
POLL 16 0 4 2
DEVICE "PHOTOSENSOR"
VENDORID 1
DEVTYPE 6
PRODCODE 7
STROBE 8 0
```

Each device definition will have the following items specified:
1. Device name specifying the name of the device (DEVICE "Device Name")
2. DeviceNet Vendor Id: (VENDORID xxx)
3. Device Type: (DEVTYPE xx)
4. Product Code: (PRODCODE xx)
5. I/O mode: Polled (POLL), strobed (STROBE), change-of-state (COS), cyclic (CYC), following by I/O points (DINS, DOUTS, AINS, AOUTS). All of them are specified as points. E.g. POLL 24 16 0 2 (24 digital inputs, 16 digital outputs, 0 analog inputs, 2 analog outputs).
6. Analog first - optional: (ANLGFST) specifies if analog data is sent/received by device before digital data in the DeviceNet I/O message.
7. Unacknowledged COS/Cyclic messaging - optional: (UNACK) specifies that COS/Cyclic messaging should be unacknowledged. Most devices use acknowledged messaging and so this option is not typically used.
8. Digital Input Data Offset - optional: (DATAOFFSET xx), specifies number of digital input BYTES to be skipped before the data is available for mapping in the Controller I/O subsystem.

Rules for Writing Definitions:
1. Each line cannot be more than 60 characters per line. A line is terminated using a new-line character.
2. Every definition has to begin with a DEVICE line.
3. A complete definition contains at least all the required specifiers (DEVICE, VENDORID, DEVTYPE, PRODCODE, POLL/STROBE/COS/CYC). The optional specifiers are not required to create a complete definition.
4. Any line not beginning with one of the above specifiers will be ignored.
5. A definition that has the same name, vendor id, device type and product code as an existing definition on the controller will be considered a MATCH.
6. Any definition that is in use by a scan-list on the controller will not be overwritten.
7. Any definition that matches an existing defintion on the controller according to the rule described in 6, but has a different I/O mode or different I/O size, will be overwritten with the new definition if that definition is not in use.

E   KAREL PROGRAMS FOR DEVICENET

E.1   OVERVIEW

The DeviceNet option installs the following KAREL programs:
- BD_OFFLN – Allows a teach pendant program to turn DNET board off
- BD_ONLN – Allows a teach pendant program to turn DNET board on
- BD_RSOFF - Allows a teach pendant program to turn off board auto-restart for a DNET board.
- BD_RSON - Allows a teach pendant program to turn on board auto-restart for a DNET board.
- BD_STCHK - Allows a teach pendant program to check if a DNET board is online.
- DV_OFFLN – Allows a teach pendant program to turn DNET device off
- DV_ONLN – Allows a teach pendant program to turn DNET device on
- DV_AROFF - Allows a teach pendant program to turn off auto-reconnect for a DNET device.
- DV_ARON - Allows a teach pendant program to turn on auto-reconnect for a DNET device.
- DV_STCHK - Allows a teach pendant program to check if a DNET device is online.

E.2   KAREL PROGRAM DESCRIPTIONS AND PARAMETERS

The following are the KAREL program descriptions and parameters.

BD_OFFLN (INTEGER bd_number, INTEGER <wait_flag>)
This program allows a teach pendant to turn DNET board offline. This program takes the board number as an argument and the wait flag as an optional argument. The valid values of the board number are 1 through 4. For example, 1 corresponds to DeviceNet board 1, rack 81.
The optional argument, wait_flag, is used as follows:
- If wait_flag is not used or set as non-zero, then do the operation (BD_OFFLN) and wait up to 10 seconds to ensure that the board is offline. If the board becomes offline in less than 10 seconds, it returns as soon as the board becomes offline. If the board does not become offline, an alarm is posted.
- If wait_flag is used and set it to 0, then do the operation (BD_OFFLN) and does not wait for the board to become offline. The application or user programs can use BD_STCHK() to check the status of the board if it needs to confirm the status of the board.

BD_ONLN (INTERGER bd_number, INTEGER<wait_flag>)
This program allows a teach pendant to turn DNET board online. This program takes the board number as an argument and the wait flag as an optional argument. The valid values of the board number are 1 through 4. For example, 1 corresponds to DeviceNet board 1, rack 81.
The optional arugument, wait_flag, is used as follows:
- - If wait_flag is not used or set as non-zero, then do the operation (BD_ONLN) and wait up to 10 seconds to ensure that the board is online. IF the board becomes online in less than 10 seconds, it returns as soon as the board becomes online. If the board does not become online, an alarm is posted.
- - If wait_flag is used and set it to 0, then do the operation (BD_ONLN) and do not wait for the board to become online. The application or user programs can use BD_STCHK() to check the status of the board if it needs to confirm the status of the board.

BD_RSOFF (INTEGER bd_number)
This program allows a teach pendant program to turn off board auto-restart for a DNET board. This program takes the board number as an argument. The valid values of the argument are 1 through 4. For example, 1 corresponds to DeviceNet board 1, rack 81.

BD_RSON (INTEGER bd_number)
This program allows a teach pendant program to turn on board auto-restart for a DNET board. This program takes the board number as an argument. The valid values of the argument are 1 through 4. For example, 1 corresponds to DeviceNet board 1, rack 81.

BD_STCHK (INTEGER bd_number, INTEGER register_number)
This program allows a teach pendant program to check the status of a board. This program takes the board number and a register number as arguments. The valid values for a board number are 1 through 4. For example, 1 corresponds to DeviceNet board 1, rack 81. The status of the board is returned in the register. The following values are returned in the register:

- 0 - Offline, not initialized
- 1 - Offline, cannot be initialized
- 2 - Offline, initialized
- 3 - Error, not initialized
- 4 - Error, cannot be initialized
- 5 - Error, initialized
- 6 - Online
- 7 - Being initialized
- 99 - DeviceNet system variables have not yet been initialized

DV_OFFLN (INTEGER bd_number, INTEGER mac_id, INTEGER <wait_flag>)
This program allows a teach pendant program to turn a DeviceNet device offline. This program takes the board number and device MAC ID as an argument. It also takes wait_flag as an optional argument. The valid values for a board number are 1 through 4. For example, 1 corresponds to DeviceNet Board 1, rack 81. The valid values for MAC ID are 0 through 63. The optional flag, wait_flag, is used as follows:
- If wait_flag is not used or set as non-zero, then do the operation (DV_OFFLN) and wait up to 10 seconds to ensure that the device is offline. IF the device becomes offline in less than 10 seconds, it returns as soon as the device becomes offline. If the device does not become offline, an alarm is posted.
- If wait_flag is used and set it to 0, then do the operation (DV_OFFLN) and do not wait for the device to become offline. The application or user programs can use DV_STCHK() to check the status of the device if it needs to confirm the status of the device.

DV_ONLN (INTEGER bd_number, INTEGER mac_id, INTEGER <wait_flag>)
This program allows a teach pendant program to turn a DeviceNet device online. This program takes the board number and device MAC ID as an argument. It also takes wait_flag as an optional argument. The valid values for a board number are 1 through 4. For example, 1 corresponds to DeviceNet Board 1, rack 81. The valid values for MAC ID are 0 through 63. The optional flag, wait_flag, is used as follow:
- If wait_flag is not used or set as non-zero, then do the operation (DV_ONLN) and wait up to 10 seconds to ensure that the device is online. IF the device becomes online in less than 10 seconds, it returns as soon as the device becomes online. If the device does not become online, an alarm is posted.
- If wait_flag is used and set it to 0, then do the operation (DV_ONLN) and do not wait for the device to become online. The application or user programs can use DV_STCHK() to check the status of the device if it needs to confirm the status of the device.

DV_AROFF (INTEGER bd_number, INTEGER mac_id)
This program allows a teach pendant program to turn off auto-reconnect for a DeviceNet device. This program takes the board number and device MAC ID as arguments. The valid values for a board number are 1 through 4. For example, 1 corresponds to DeviceNet board 1, rack 81. The valid values for MAC ID are 0 through 63, corresponding to the MAC ID setting for the DeviceNet device.

DV_ARON (INTEGER bd_number, INTEGER mac_id)
This program allows a teach pendant program to turn on auto-reconnect for a DeviceNet device. This program takes the board number and device MAC ID as arguments. The valid values for a board number are 1 through 4. For example, 1 corresponds to DeviceNet board 1, rack 81. The valid values for MAC ID are 0 through 63, corresponding to the MAC ID setting for the DeviceNet device.

DV_STCHK (INTEGER bd_number, INTEGER mac_id, INTEGER register_number)
This program allows a teach pendant program to check the status of a DeviceNet device. This program takes the board number, device MAC ID, and register number as arguments. The valid values for a board number are 1 through 4. For example, 1 corresponds to DeviceNet board 1, rack 81. The valid values for MAC ID are 0 through 63, corresponding to the MAC ID setting for the DeviceNet device. The possible values returned in the register are:
- 0 - Offline
- 1 - Error
- 2 – Online

> **NOTE**
> If board status is Offline, DV_STCHK does not reflect the true state of the device. Use BD_STCHK to verify the DeviceNet Board Status is online before using DV_STCHK.

E.3   USING KAREL PROGRAMS IN TEACH PENDANT PROGRAMS

To place the call to the KAREL program in the teach pendant program, follow the steps in Procedure E-1. Procedure E-1 shows how to use the DV_STCHK KAREL program. The other programs listed in this section can be used in the same way.

Procedure E-1 Placing the Call to the KAREL Program in the Teach Pendant Program

Steps
1. Press SELECT.
2. Display the appropriate list of programs:
   If F1, [TYPE], is not displayed on the screen, press >, NEXT, until it is displayed.
   a. Press F1, [TYPE].
   b. Select the list you want:
      - TP Programs displays all teach pendant programs.

> **NOTE**
> You cannot modify details if the program is set up as a system level macro. These macros are identified with the letter "s" at the far right side of the macro setup screen.

3. Move the cursor to the name of the program you want to modify and press ENTER.
4. Turn the teach pendant ON/OFF switch to ON.
5. Select F4, [INST].
6. Select Call from the list of options that appear at the top of the screen.
7. Select Call Program and press ENTER.
8. Press F3, [KAREL] to display the available KAREL programs at the top of the screen.
9. Select DV_STCHK and press ENTER.
10. Place the cursor to the right of the word DV_STCHK.
11. Press F4, [CHOICE].

12. Select Constant from the list at the top of the screen and press ENTER.
13. Type the Board Number and press ENTER.
14. Press F4, [CHOICE].
15. Select Constant from the list at the top of the screen and press ENTER.
16. Type the MAC ID for the device and press ENTER.
17. Press F4, [CHOICE].
18. Select Constant from the list at the top of the screen and press ENTER.
19. Type the Register Number for the result of the device status check and press ENTER.
    The finished line in the teach pendant program should look like the following:
    CALL DV_STCHK (2,55,10)

> **NOTE**
>   10 is the register number for result.

E.4   EXAMPLES USING DEVICENET MACROS

Generally, DeviceNet macros are used to support tool change applications. The following examples demonstrate using Auto-Reconnect and Device Offline/Online macros in tool changing applications. This information supplements the information that is in Section 5.6 .

Device offline/online macros are necessary if different types of I/O blocks (different electronic keying) are used on the various tools (note that I/O size must always be the same for the same MAC ID). Setting electronic keying parameters to zero allows the scanner to connect to any device addressed with a particular MacID. However, this does not apply to reconnections. When reconnecting a device with the same MacID, the scanner expects the SAME keying parameters from the slave as the initial connection. If the various devices have different electronic keying parameters, then the device must be taken offline and put back online to establish a new connection. The device offline/online macros are similar to manually taking the device offline or online in the teach pendant screens but are called programmatically through a teach pendant program.

> **NOTE**
>   When using the DeviceNet Quick Connect feature, Quick Connect should be
>   enabled in both the scanner and adapter for the fastest connection times. The
>   slave device must support the Quick Connect feature and be explicitly enabled
>   along with enabling the Quick Connect feature in the robot scanner to take
>   advantage of Quick Connect.

Turning on Auto-Reconnect means that the robot will automatically try to reconnect the node if the connection is lost. Without Auto-Reconnect enabled, the robot will fault if a DeviceNet connection is lost and reset must be pressed to retry the connection With auto-reconnect enabled, the robot will not fault and will continuously try to reconnect to the device. Auto-reconnect should be turned off if a tool change is not underway (when you do not expect the connection to be lost) so that unexpected connection problems are not masked.

The example below turns on Auto-Reconnect for board #2, MacID 55 and should be called just before the tool is to be physically disconnected.

1:   CALL DV_ARON(2,55) ;

The next example turns off Auto-Reconnect for board #2, MacID 55 and should be called after the tool is physically reconnected.

NOTE
It can take roughly 2-6 seconds for the DeviceNet connection to be re-established based on ODVA specifications (including slave powerup time, duplicate Mac acknowledgement checks, and the asynchronous nature of the scanner connection requests). The following example can be done after moving away from the tool changer nest to help cycle time by allowing the 2-6 seconds connection time to be done in parallel with the robot motion. If Quick Connect is enabled in the scanner and the device, the reconnection time can be reduced to under 500ms depending on the powerup time of the device. The following logic will check for the device to go online for up to 10 seconds. If the device status becomes online in less than 10 seconds, the robot will resume immediately after the online status is obtained. If the device is still not online after 10 seconds a User Alarm is posted and the robot will fault.

```
 1:   TIMER[1]=RESET ;
 2:   TIMER[1]=START ;
 3:   LBL[1] ;
 4:   CALL DV_STCHK(2,55,50) ;
 5:   IF R[50]=2,JMP LBL[3] ;
 6:   WAIT      .10(sec) ;
 7:   IF (TIMER[1]<10),JMP LBL[1] ;
 8:   UALM[1] ;
 9:   JMP LBL[1] ;
10:   LBL[3] ;
11:   TIMER[1]=STOP ;
12:   CALL DV_AROFF(2,55) ;
```

Using the Device Offline/Online macros is very similar to setting the device offline/online manually on the teach pendant. For example, setting board #2, MacID 55 offline is done as follows :

```
 1:   CALL DV_OFFLN(2,55) ;
```

Care must be used when setting a device online just after it is reconnected. If it is not fully powered up and available for reconnection by the scanner, an alarm might be generated. To avoid this problem auto-reconnect is generally enabled while setting the device online.

NOTE
The example below includes the optional wait flag (3rd parameter) set to 1. Setting this parameter to 1 (or not including the 3rd parameter) will cause the DV_ONLN routine to wait for the device to return an online status before continuing to the next line. If the device does not return an online status within 10 seconds, an alarm will be posted and the robot will fault.

```
 1:   CALL DV_ARON(2,55) ;
 2:   CALL DV_ONLN(2,55,1) ;
 3:   CALL DV_AROFF(2,55) ;
```

In some instances it might be beneficial to set the device online and check for the device to achieve the online state later in the process (i.e. after moving to the 'away from nest' position). This might provide some cycle time savings by allowing the device to power up while moving away from the nest. In this case, setting the device online is done with the optional wait_flag (3rd parameter) set to 0.

```
1:   CALL DV_ARON(2,55) ;
2:   CALL DV_ONLN(2,55,0) ;
```

The following check can be used later to verify that the node is available (same logic as above example when turning off auto-reconnect).

```
 1:   TIMER[1]=RESET ;
 2:   TIMER[1]=START ;
 3:   LBL[1] ;
 4:   CALL DV_STCHK(2,55,50) ;
 5:   IF R[50]=2,JMP LBL[3] ;
 6:   WAIT     .10(sec) ;
 7:   IF (TIMER[1]<10),JMP LBL[1] ;
 8:   UALM[1] ;
 9:   JMP LBL[1] ;
10:   LBL[3] ;
11:   TIMER[1]=STOP ;
12:   CALL DV_AROFF(2,55) ;
```

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REVISION RECORD

Edition	Date	Contents
04	Apr., 2014	• Revised as the manual for R-30*i*B Mate controller.
03	Sep., 2012	• Revised as the manual for R-30*i*A/R-30*i*A Mate/R-30*i*B controller.
02	Nov., 2009	• Add Mini-slot DeviceNet DN3 board, and SST-DN4-104 board • Add reference to Dual Check Safety function manual for DeviceNet Safety.
01	Mar., 2007	

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