Installation Instructions

1747-SDN
DeviceNet Scanner Module

Cat. No. 1747-SDN/B

Contents

Use this document as a guide to install the 1747-SDN/B scanner module.

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of these products must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

In no event will Allen-Bradley be responsible or liable for indirect or consequential damage resulting from the use or application of these products.

Any illustrations, charts, sample programs, and layout examples shown in this publication are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Throughout this publication, notes may be used to make you aware of safety considerations. The following annotations and their accompanying statements help you to identify a potential hazard, avoid a potential hazard, and recognize the consequences of a potential hazard:

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

ATTENTION

Environment and Enclosure

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 meters without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

This equipment is supplied as "open type" equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

See NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure. Also, see the appropriate sections in this publication, as well as the Allen-Bradley publication 1770-4.1 ("Industrial Automation Wiring and Grounding Guidelines"), for additional installation requirements pertaining to this equipment.

Prevent Electrostatic Discharge

ATTENTION

This equipment is sensitive to electrostatic discharge which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- touch a grounded object to discharge potential static
- wear an approved grounding wrist strap
- do not touch connectors or pins on component boards
- do not touch circuit components inside the equipment
- if available, use a static-safe workstation
- when not in use, store the equipment in appropriate static-safe packaging

Where to Find More Information

The following table describes related documentation. To order a copy or to view or download an online version, visit The Automation Bookstore at:

www.theautomationbookstore.com

For information about:	See this document:	Publication number:
Configuring the scanner module and associated hardware in an example application	SLC 500™ DeviceNet Scanner Module User Manual	1747-6.5.5
Performing the ControlFlash Update	ControlFlash Firmware Upgrade Kit User Manual	1756-6.5.6
RSLogix 500™ software	Getting Results with RSLogix 500	9399-RL50GR
RSLinx™ software	Getting Results with RSLinx	9399-WAB32GR
Connecting the DeviceNet network	DeviceNet Cable Planning and Installation Manual	DN-6.7.2

Module Features

Slave Mode

Slave mode allows processor-to-processor communication and enables the scanner to perform as a slave device to another master on the network.

When the scanner module is in slave mode, it exchanges data with only one master. You control what information is exchanged through scan list configuration and associated mapping functions of RSNetWorx for DeviceNet software.

This feature has the following variations:

When the scanner module is in:	the scanner:
Null mode	Contains an empty or disabled scan list (default)
Master mode	Serves as a master to one or more slaves but is not simultaneously serving as a slave to another master
Slave mode	Serves as a slave to another master
Dual mode	Serves as both a master to one or more slaves and as a slave to another master simultaneously

Poll

A poll message is a point-to-point transfer of data (0-255 bytes) sent by the scanner module that solicits a response from a single device. The device responds with its input data (0-255 bytes).

Strobe

A strobe message is a multicast transfer of data (64 bits in length) sent by the scanner module that solicits a response from each strobed slave device. There is one bit for each of the possible 64 node addresses. The devices respond with their data, which can be as much as 8 bytes.

Change of State

Change of state enables the scanner module to perform a scan:

- whenever a network data change occurs, or
- at a user-configurable heartbeat rate

Because data is only sent on an as-needed basis, this feature increases system performance by reducing network traffic.

Cyclic I/O

Cyclic I/O allows you to instruct the scanner module to perform a scan at a specific send rate.

Because data is only sent at a periodic rate, this feature increases system performance by reducing network traffic.

Pass-Through

The SLC 500™ "pass-through" feature allows communication with the DeviceNet network from another network. This feature can be used to adjust and fine tune the nodes on your network.

The pass-through feature is not intended to replace a 1770-KFD, PCD, PCID, or PCIDS connection to the network.

System Requirements for Pass-Through

To use the pass-through feature you must meet the following hardware, software and firmware requirements:

Component	Requirement	Requirement
SLC 500 processor	SLC 5/03 or higher	SLC 5/03 or higher
1747-SDN firmware	4.015 - 5.001	6.001 or higher
RSLinx software	2.10 or higher	2.31 or higher
M0 and M1 files	Configured for 361 words	Configured for 395 words

External Module Features

Use this illustration to identify the external features of the scanner module.

Module Status Indicator indicates module status

Network Status Indicator indicates status of DeviceNet channel communication link

Node address and status displays numeric codes and indicates scanner node address or error

Access door

Wiring color codes

10-pin linear plug inserted into DeviceNet port

*Device**Net***

STATUS
MODULE   NET

ADDRESS/ERROR

Front of module

Hardware and Software Requirements

Before you install your module you need the following items:

- personal computer with Microsoft Windows™ 95 or later operating system
- RSNetWorx for DeviceNet software, version 2.22 or later
- RSLogix 500 software
- SLC 1746 chassis with SLC 5/02, 5/03, 5/04 or 5/05 processor

For network communication, you have two options:

- use the pass-through feature to communicate with the DeviceNet network from another network. This method is intended for fine tuning and adjustment of network devices.
- use a 1770-KFD RS-232 DeviceNet adapter or 1784-PCD, -PCID or -PCIDS DeviceNet PC Card. This method is necessary for a complete network configuration and real time monitoring of your network devices.

Before you install your module you must know how to:

- program and operate an Allen-Bradley SLC 500 programmable controller
- install and configure the devices on your DeviceNet network

Electronic Data Sheet Requirement

This release of the scanner module requires the latest EDS file for RSNetWorx for DeviceNet software. If the software displays the device as an "unknown device", the EDS file must be downloaded.

You can get the latest EDS file online at:

http://www.ab.com/networks/eds

Once you are at this location:

1. Select `DeviceNet`

2. Enter the catalog number: `1747-SDN`

3. Enter major revision number

4. Enter minor revision number

5. Select `Search`

For more information, contact Rockwell Automation Technical Support at 440.646.5800.

Perform the ControlFLASH Update

If you have the previous release of firmware and you want to upgrade it to this release, you must perform the ControlFLASH update. To get the kit, contact Rockwell Automation Technical Support at 440.646.5800. To install the kit, refer to the ControlFLASH Firmware Upgrade Kit User Manual, publication 1756-6.5.6.

Make Sure That Your Processor and Adapter are Compatible

You can use the 1747-SDN Scanner Module in an I/O chassis any slot except for the left-most which is reserved for the SLC 500 processor.

| IMPORTANT	You cannot use the scanner module in a remote I/O chassis with a 1747-ASB adapter module. The adapter module does not support M file transfer.

Install the Module Into the Chassis

To install your module into the chassis:

1. Turn off the chassis power supply.

WARNING	If you insert or remove the scanner module with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

2. Select a slot for the module in the chassis. You may use any slot except the leftmost slot, which is reserved for the SLC 500 processor.
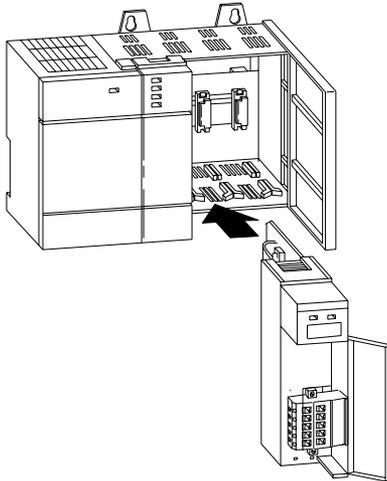
3. Insert the module into the slot you have selected.

4. Apply firm, even pressure to seat the module in the I/O chassis backplane connectors.

Connect the Module to the DeviceNet Network

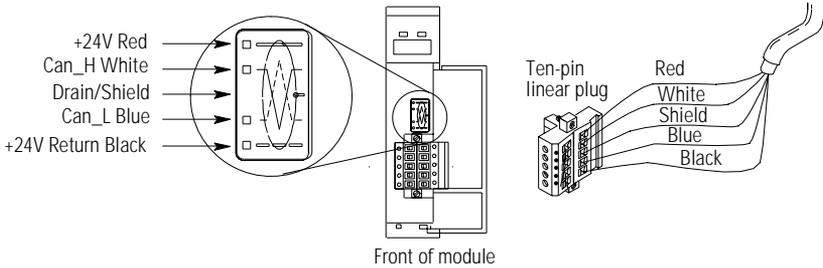To connect your module to the DeviceNet network:

**1.** Turn off the network power supply.

WARNING	If you connect the scanner module with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

2. Connect the DeviceNet drop line to the ten-pin linear plug by matching the wire insulation colors to the colors shown on the label:

+24V Red
Can_H White
Drain/Shield
Can_L Blue
+24V Return Black

Ten-pin linear plug

Red
White
Shield
Blue
Black

Front of module

3. Locate the DeviceNet port connector on the front of the module.

4. Insert the ten-pin linear plug into the DeviceNet port connector.

Ten-pin linear plug

DeviceNet port connector

DeviceNet drop line
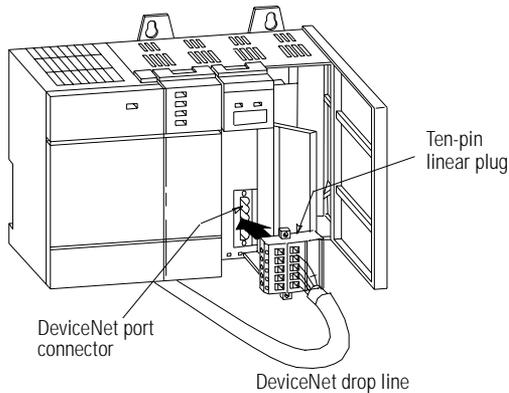
You have installed and wired your module. To operate the module you must apply power and then configure and program the SLC processor to communicate with it. We describe how to do this in the next three sections.

Apply Chassis Power

When you apply chassis power, the module numeric indicators cycle through the following displays:
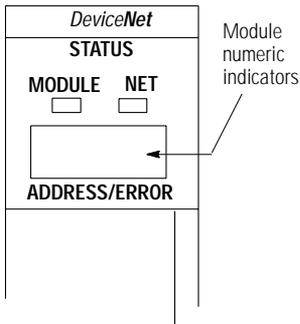
1. Seven-segment lamp test (**88**)

2. Firmware major revision (**01** through **7F** hexadecimal)

3. Firmware minor revision (**01** through **FF** hexadecimal)

4. Baud rate (indicates **00** for the default of 125, **01** for 250 or **02** for 500 Kbits/s)

5. Node address (**00** to **63** with **63** as the default)

Use the RSNetWorx for DeviceNet software to change the baud rate and node address.

Refer to the Numeric Code Display Summary table on page 36 for a complete listing of numeric displays.

Understand the Data Organization of the Module

The module has four data areas to transfer data, status and command information between the module and the processor:

- SLC input image table
- SLC output image table
- SLC M1 file
- SLC M0 file

Input and Output Image Tables

The following table describes the mapping of the 1747-SDN input and output image tables and the M1 and M0 files.

Words	SLC Input Image	Words	SLC Output Image
0	Status	0	Command
1-31	DeviceNet Input Data (31 words)	1-31	DeviceNet Output Data (31 words)

Words	SLC M1 File	Words	SLC M0 File
0-149	DeviceNet Input Data (150 words)	0–149	DeviceNet Output Data (150 words)
150-205	Reserved (56 words)	150–223	Reserved (74 words)
206-209	Device Active Table (4 words)		
210	Node Address/Status Indicator (1 word)		
211	Scan Counter (1 word)		
212-215	Device Idle Table (4 words)		
216-219	Device Failure Table (4 words)		
220-223	Auto Verify Failure Table (4 words)		
224-255	Explicit Message Program Control (32 words)	224–255	Explicit Message Program Control (32 words)
256-394	Pass-Through (139 words)	256-394	Pass-Through (139 words)

Use RSLogix 500 Software to Configure M0-M1 Files

To enable pass-through capability of the scanner module, you must configure the M0 and M1 files associated with the 1747-SDN module to 395 words. If you do not want to use pass-through, configure the files to the default length of 256 words.

ATTENTION

The pass-through feature is not intended to replace a 1770-KFD, PCD, PCID, or PCIDS connection to the network:

- Pass-through is intended only for fine tuning and adjustment of your network devices. Do not attempt to configure your entire network using a pass-through driver or a time-out may occur.

- The pass-through method is not suitable for real time monitoring of your network devices.

Use the following procedure to configure the 1747-SDN's M0 and M1 files using RSLogix 500 software.

1. Run **RSLogix 500** and go offline to the SLC 500 processor.
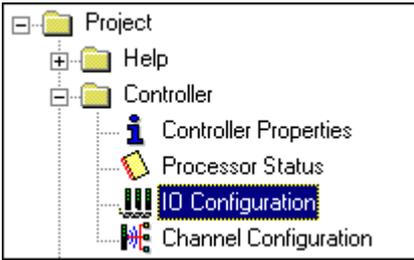
2. Under the **Controller** folder in the Project window, double-click on **IO Configuration**.

The **I/O Configuration** window will open.
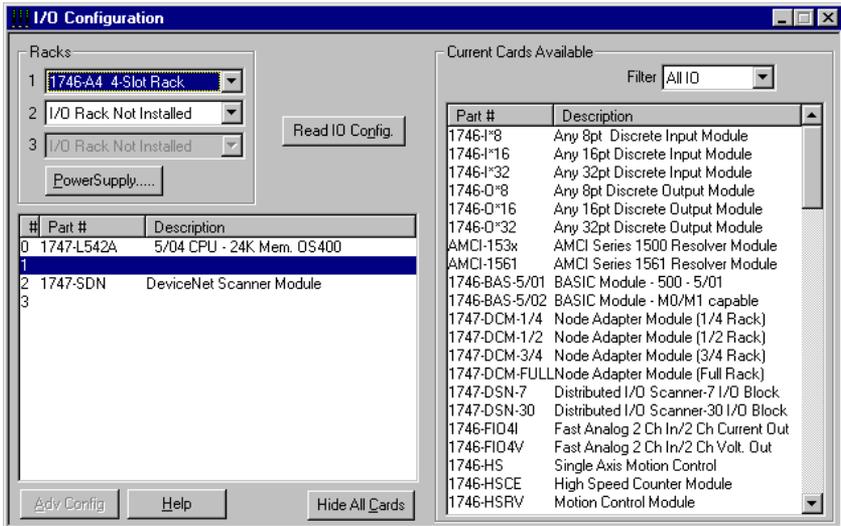
3. Click on the **Read I/O Config**. button to upload the I/O configuration from the processor.

4. Double-click on the **1747-SDN** module.

The **Advanced I/O Configuration** window will open.

5. Set the **MO Length** and the **M1 Length** to one of the following:
   a. 256 for 1747-SDN firmware prior to 4.015 for **no pass-through** support
   b. 361 for 1747-SDN firmware 4.015-5.001 **for pass-through** support
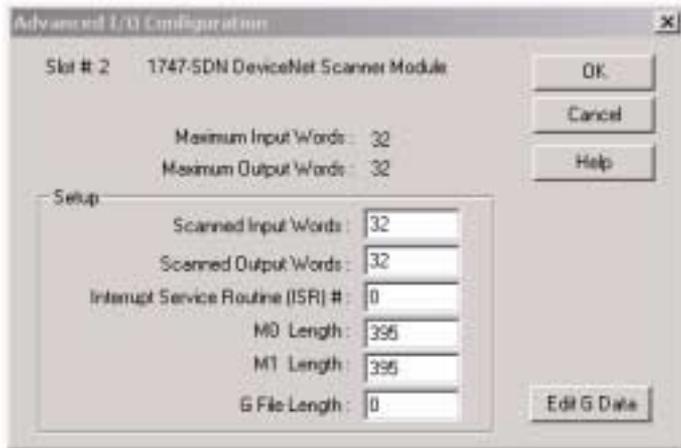   c. 395 for 1747-SDN firmware 6.001 or higher **for improved pass-through support**

6. Click on the **OK** button.

7. **Download** the changes to the processor.

IMPORTANT   The SLC 500 must be placed in **Run** mode at least one time after downloading the M0/M1configuration to enable 1747-SDN pass-through transactions.

For more information on how to:

- configure your module for DeviceNet operation
- map data from DeviceNet nodes to M1, M0, input and output image files,

  refer to the Getting Results with RSLogix 500 (publication number 9939-RL50GR) and the 1747-SDN Scanner User Manual (publication number 1747-6.5.5).

Program the Module Using the SLC M0 and M1 Files

The M0 and M1 files are data files that reside in the module. There is no image for these files in the processor memory. The M0 file is a module output file and the M1 file is a module input file. Both M0 and M1 files are read/write files.

M0 and M1 files can be addressed in your ladder program and they can also be acted upon by the module, independent of the processor scan.

IMPORTANT	During the processor scan, M0 and M1 data can be changed by the processor according to ladder diagram instructions addressing the M0 and M1 files. During the same scan, the module can change M0 and M1 data, *independent* of the rung logic applied during the scan.

Address the M0-M1 Files

The addressing format for M0 and M1 files is as follows:

```
Mf:S.w/b
```

Where M = module
f = file (0 or 1)
S = slot (1-30)
w = word (0-maximum supplied by the module)
b = bit (0-15)

When You Cannot Use M0-M1 Data File Addresses

You can use M0 and M1 data file addresses in all instructions except the OSR instruction and the instruction parameters below.

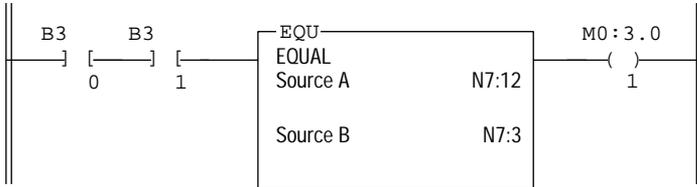| Instruction	Parameter (characterized by file indicator #)
BSL BSR	File (bit array)
SQO SQC SQL	File (sequencer file)
LFL LFU	LIFO (stack)
FFL FFU	FIFO (stack)

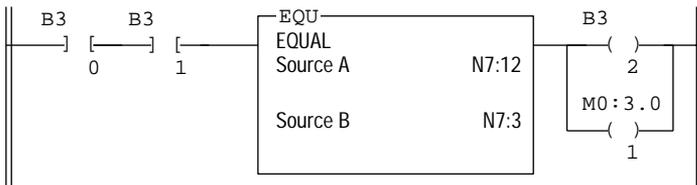## Monitor Bit Instructions with M0 or M1 Addresses

When you monitor a ladder program in the Run or Test mode, the following bit instructions, addressed to an M0 or M1 file, are indicated as false regardless of their actual true/false logical state.

```
    Mf:S.w        Mf:S.w        Mf:S.w        Mf:S.w        Mf:S.w
───┤ ├──    ───┤/├──    ──( )────    ──(L)────    ──(U)────
      b             b             b             b             b
    XIC           XIO           OTE           OTL           OTU
```
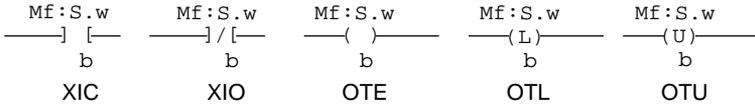
To show the state of the M0 or M1 addressed bit, transfer the state to an internal processor bit. This is illustrated below, where an internal processor bit is used to indicate the true/false state of a rung.

```
 B3      B3        ┌EQU──────────────────┐              M0:3.0
─┤ ├────┤ ├─       │EQUAL                │             ──( )──
  0       1        │Source A      N7:12  │                1
                   │                     │
                   │Source B       N7:3  │
                   └─────────────────────┘
```

This rung does not show its true rung state because the EQU instruction is always shown as true and the M0 instruction is always shown as false.
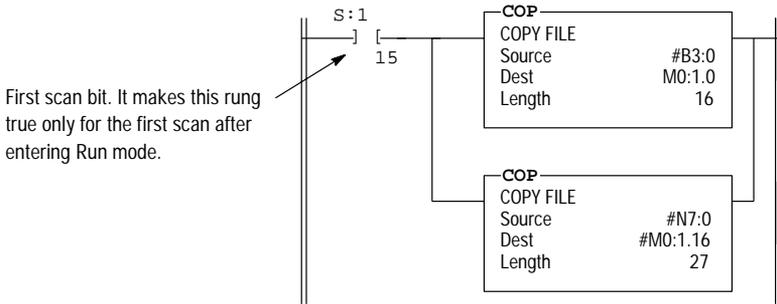
```
 B3      B3        ┌EQU──────────────────┐               B3
─┤ ├────┤ ├─       │EQUAL                │             ──( )──
  0       1        │Source A      N7:12  │                2
                   │                     │             M0:3.0
                   │Source B       N7:3  │             ──( )──
                   └─────────────────────┘                1
```

OTE instruction B3/2 has been added to the rung. This instruction shows the true or false state of the rung.
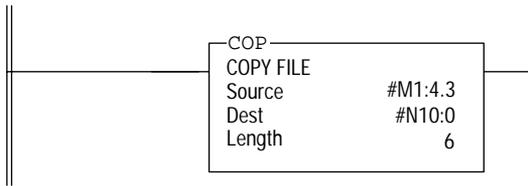
Transfer Data Between Processor Files and M0 or M1 Files

The processor does not contain an image of the M0 or M1 file so you must edit and monitor M0 and M1 file data via instructions in your ladder program. For example, you can copy a block of data from a processor data file to an M0 or M1 data file or vice versa using the COP (copy) instruction in your ladder program.

The COP instructions below copy data from a processor bit file and integer file to an M0 file.

```
         S:1
       ] [                 ┌COP─────────────────────┐
         15                │ COPY FILE              │
                           │ Source           #B3:0 │
                           │ Dest            M0:1.0  │
                           │ Length             16   │
                           └────────────────────────┘

                           ┌COP─────────────────────┐
                           │ COPY FILE              │
                           │ Source           #N7:0 │
                           │ Dest          #M0:1.16  │
                           │ Length             27   │
                           └────────────────────────┘
```

First scan bit. It makes this rung true only for the first scan after entering Run mode.

The COP instruction below copies six words of data from an M1 data file in a module positioned in slot four to an integer file (N1:0). This technique is used to monitor the contents of an M0 or M1 data file indirectly, in a processor data file. An update of these six words is made for each SLC program scan.

```
                    ┌COP─────────────────┐
                    │ COPY FILE          │
                    │ Source      #M1:4.3│
                    │ Dest        #N10:0 │
                    │ Length          6  │
                    └────────────────────┘
```
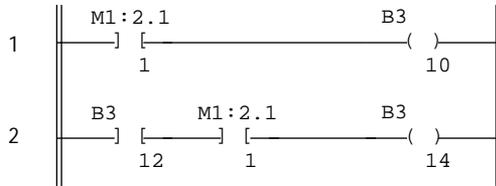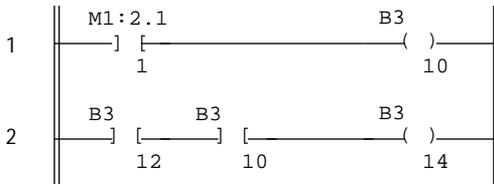
Reduce Scan Time

TIP

To reduce processor scan time, use discretion when you use instructions addressing the M0 or M1 files. For example, XIC instruction M1:2.1/1 is used in rungs 1 and 2 below, adding approximately 2 ms to the scan time if you are using a 5/02, Series B processor.

```
        M1:2.1                      B3
1      ──┤ ├──────────────────────( )──
          1                        10

        B3      M1:2.1            B3
2      ──┤ ├────┤ ├──────────────( )──
         12       1               14
```

XIC instructions in rungs 1 and 2 are addressed to the M1 data file. Each of these instructions adds approximately 1ms to the scan time (5/02, Series B processor)

In the equivalent rungs below, XIC instruction M1:2.1/1 is used only in rung 1, reducing the scan time by approximately 1 ms.

```
        M1:2.1                      B3
1      ──┤ ├──────────────────────( )──
          1                        10

        B3      B3                B3
2      ──┤ ├────┤ ├──────────────( )──
         12      10               14
```
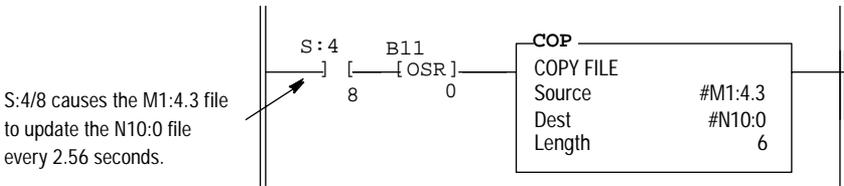
These rungs provide equivalent operation to those of the previous diagram by substituting XIC instruction B3/10 for XIC instruction M1:2.1/1 in rung 2. Scan time is reduced by approximately 1ms (5/02 Series B processor).

The first two ladder diagrams in the last section illustrate a technique you use to capture and use M0 or M1 data as it exists at a specific time. In the first diagram, bit M1:2.1/1 could change state between rungs 1 and 2. This could interfere with the logic applied in rung 2. The second diagram avoids the problem. If rung 1 is true, bit B3/10 captures this information and places it in rung 2.

The following diagram illustrates another economizing technique. The COP instruction addresses an M1 file, adding approximately 4.29 ms to the scan time if you are using a 5/02, Series B processor. You can save scan time by making this rung true only periodically. For example, you can use a clock bit S:4/8 (clock bits are discussed in the programming manual).

A rung such as this might be used when you want to monitor the contents of the M1 file, but monitoring need not be continuous.

S:4/8 causes the M1:4.3 file to update the N10:0 file every 2.56 seconds.

```
        S:4       B11        ┌─COP─────────────────────┐
        ┘ ├──── ─┘ [─[OSR]── │ COPY FILE               │
         8          0        │ Source          #M1:4.3 │
                             │ Dest            #N10:0  │
                             │ Length              6   │
                             └─────────────────────────┘
```

In this example, a COP instruction can be used to monitor the contents of an M1 file. When the instruction goes true, the six words of data in file #M1:4.3 is captured as it exists at that time and placed in file #N10:0. All subsequent logic should address the data in #N10:0. The data will be consistent and it shortens scan time by eliminating reads to the module each time an M0 or M1 address is encountered in the program.

Upload Input Data from the Module to the SLC Processor

The SLC 500 processor reads input data from the module using two methods:

- input image table
- M1 file transfer

Input Image Table

The input image table is a 32-word table for the module slot that is updated by the processor with each program scan. The first word (word 0) is reserved for the module status register. The remaining 31 words can be used to transfer DeviceNet input data to the SLC input image table. The addressing format is:

```
I:S.w/b
```

Where S = slot
w = word (0-31)
b = bit (0-15)

Module Status Register

The module status register is located at word 0 in the input image area for the slot. Bits 0–5 echo back to the processor, the current state of bits 0–5 of the module command register. The echoes verify that the commands were executed. The module sets the remaining bits when it detects a problem. The bits latch in the ON state until the problem clears. Bits 6 and 8 indicate that you should read the device failure table for more specific information about which devices failed.

You can use bit 6 to keep the communication port in the Idle mode until the bit clears. When the bit clears, this indicates that all devices in the scanner's scan list are up and available. When the devices are available, you can put the port in Run mode. If a device failure is detected, you can put the communication into the Idle mode, so that all output devices go to a safe state.

The SLC program can monitor the bits in the module status register and set the appropriate bits of the module command register to automatically control the operating mode of the module should a device failure occur.

Status Word I:s.0		Operating Mode Description
Bit	**Operating Mode**	
0	1 = Run mode, 0 = Idle mode (echoed from the module command register)	**Run** The scanner module maps output data from its scanner output table (M0) and discrete outputs to each device on the network. Inputs are received and mapped into the scanner input table (M1) and discrete inputs. Outputs on the network are under SLC program control. **Idle** The scanner does not map output data to the devices, but keeps network connections to devices open so device failures can be detected. Input data is returned from devices, and mapped into the scanner input table (M1) and the discrete inputs. Outputs on the network are not under program control and will be in their configured 'Idle state.' The scanner must be put into this mode to perform offline configuration of the scanner database tables.
1	1 = fault network (echoed from the module command register)	**Fault Network** The scanner has stopped communicating with devices on the network. No outputs or inputs are mapped. Outputs on the network are not under program control. If scanner was in Run mode, devices will go to their fault state.
2	Reserved	
3	Reserved	
4	1 = disable network (echoed from the module command register)	**Disable Network** The DeviceNet channel is disabled for communication. No communication may occur over this channel. Outputs on the network are not under program control. If scanner was in Run mode, devices will go to their fault state.
5	Reserved	
6	1 = device failure (at least one device failed)	**Device Failure** One or more of the devices in the scanner's scan list has failed to communicate with the scanner.
7	Reserved	
8	1 = autoverify failure (at least one device has failed auto verify)	**Autoverify Failure** One or more of the devices in the scanner's scan list is returning an incorrect number of bytes of data in response to a connection establishment, according to the information stored in the scanner's scan list.
9	Reserved	
10	1 = communication failure	**Communications Failure** There is no communication on the port.

Status Word I:s.0		Operating Mode Description
Bit	**Operating Mode**	
11	Reserved	
12	1 = duplicate node address failure	**Duplicate Node Address Failure** There is another node with the same address as the scanner on the network.
13	Reserved	
14	Reserved	
15	1 = Explicit Message Program Control Response available in M1 file. 0 = Empty	**Explicit Message Program Control** A response to a previously sent Explicit Message is now available to be read/interpreted by the ladder program.

SLC M1 File

The SLC M1 file is a 256 word file that can be used to transfer a large quantity of information to the module with a single SLC instruction.

IMPORTANT	Transferring data using this file takes more time than using the input image table.

The first 150 words are used for data transfer from the module. The remaining 106 words are reserved for:

- device active table
- node status
- scan counter
- device idle table
- device failure table
- auto verify table
- explicit message program control

For a details on the mapping of input and output image tables, refer to page 13.

Device Active Table

Words 206 through 209 in the M1 file are used for the Device Active Table. The scanner assigns one bit in consecutive order to consecutive device addresses starting at node 0 at M1.S.206/0. If a bit is set, it indicates that the node is in the scanner's scan list and has successfully communicated with the scanner module. The bit is reset if the scanner tries to communicate to the node but the node has gone offline.

Node Address/Status Indicator

Word 210 is used for node address and scanner diagnostic information displayed in numeric codes. The high byte is the node address and the low byte is the status for that node. These codes and their descriptions are listed on page 36.

Scan Counter

Word 211 is used for the module scan counter. The module increments this counter whenever a scan of the DeviceNet devices is completed. The counter rolls over when it reaches a maximum value of 65535. It is located at M1:S.211.

Device Idle Table

Words 212 through 215 in the M1 file are used for the device idle table. This table indicates that there are devices on the network in Idle mode. The module tracks devices in Idle mode by assigning one of the 64 bits in the table to each device on the network. The bits are assigned in consecutive order to consecutive device addresses starting at mode 0 at M1.S.212/0.

Device Failure Table

Words 216 through 219 in the M1 file are used for the device failure table. This table indicates communication failures of devices on the network. The module tracks device failures by assigning one of the 64 bits in the table to each device on the network. The bits are assigned in consecutive order to consecutive device addresses starting at mode 0 at M1.S.216/0.

Auto Verify Failure Table

Words 220 through 223 in the M1 file are used for the auto verify failure table. The auto verify failure table is used to verify that data size received from the device matches the setting in the scanner's scanlist entry for that node. This check occurs at connection establishment time. The module tracks auto verify failures by assigning one of the 64 bits in the table to each device on the network. The bits are assigned in consecutive order to consecutive device addresses starting with node 0 at M1:S.220/0. If the bit is set, the corresponding node has failed to verify.

Explicit Message Program Control

Words 224 through 255 are used for Explicit Message Program Control. Use this feature to configure device parameters on your DeviceNet network via the M0 and M1 files in the SLC processor that is controlling these devices. This feature is described in detail on page 27.

Download Output Data to the Module

The SLC 500 processor writes output data to the module using two methods:

- output image table
- M0 file transfer

Output Image Table

The output image table is a 32-word table for the module slot that is updated from the processor with each program scan. The first word (word 0) of this table is reserved for the module command register. The remaining 31 words can be used to transfer data from the SLC output table to the DeviceNet nodes.

Module Command Register

The module command register is located at word 0 in the output image area for the slot. To execute a command, set the appropriate bits in the module command word using SLC ladder instructions.

The following table describes the functionality of the command register bits.

Command Word 0:S.0		Operating Mode Description
Bit	**Operating Mode**	
0	1 = Run mode, 0 = Idle mode	**Run** The scanner module maps output data from its scanner output table (M0) and discrete outputs to each device on the network. Inputs are received and mapped into the scanner input table (M1) and discrete inputs. Outputs on the network are under SLC program control. **Idle** The scanner does not map output data to the devices, but keeps network connections to devices open so device failures can be detected. Input data is returned from devices, and mapped into the scanner input table (M1) and the discrete inputs. Outputs on the network are not under program control and will be in their configured 'idle state.' The scanner is put into this mode to perform online configuration of the scanner database tables.
1	1 = fault network	**Fault Network** The scanner stops communicating with devices on the network. No outputs or inputs are mapped. Outputs on the network are not under program control. If scanner was in Run mode, devices will go to their fault state.
2	1 = restore to factory defaults/flush memory	**Restore to Factory Defaults/Flush Memory** The scanner may receive a scan list or configuration that causes inappropriate scanner behavior. It may be necessary to restore to the scanner module's factory defaults to recover from this state. This procedure is described below.
3	Reserved[1]	
4	1 = disable network	**Disable Network** The DeviceNet channel is disabled for communication. No communication may occur over this channel. Outputs on the network are not under program control. If scanner was in Run mode, devices will go to their fault state.
5	Reserved[1]	
6	1 = halt scanner	**Halt Scanner** All scanner operations stop when this command is issued. No communications occur over either DeviceNet port. No M-file or discrete I/O mapping occurs. Outputs on the network are not under program control. If scanner was in Run mode, devices will go to their fault state.
7	1 = reboot	**Reboot** This command causes the scanner to reset as though power had been cycled. When this command is issued, all scanner communication stops for the duration of the scanner's initialization sequence. Outputs on the network are no longer under program control. If scanner was in Run mode, devices will go to their fault state.
8-15	Reserved[1]	

[1] All reserve bits must be set to zero or improper operation may result.

Restore Factory Default Settings/Flush Memory

To restore the scanner module's factory default settings, follow these procedures:

1. While the SLC processor in Program mode, clear the module command word 0 and set bit 2 of word 0 for the scanner module to "ON" or 1 (starting with bit 0 going from right to left, this is the third bit).

IMPORTANT   If other bits in the module command word are set, then the scanner module will generate an error.

---

2. Set bit 0 of word 0 for the scanner module to "OFF" or 0.

3. On the SLC processor, cycle the keyswitch from Program mode to Run mode then back to Program mode.

IMPORTANT   The ladder logic may set bit 0 of word 0 for the scanner module. If this happens, then you must disable or delete this rung from the ladder program.

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4. When the code E9 is displayed on the Address/Error LED display the default settings have been restored.

5. Set bit 2 of word 0 for the scanner module to "OFF" or 0.

6. Cycle power to the 1746 chassis to restore normal operation to the scanner module.

   The scanner module will now have its factory default settings:
   - node 63
   - 125 K baud
   - no scanlist

SLC M0 File

The SLC M0 file is a 256 word file that can be used to transfer a large quantity of information to the module with a single SLC instruction. Transferring data using this file can take several scans and more time than using the output image table. The first 150 words are used for sending data to DeviceNet nodes. The next 74 words are reserved for future use, the next 32 words are used for explicit message program control and the final 139 words are used for pass-through.

For a detailed description of the mapping of input and output image tables, refer to page 13.

Using Explicit Message Program Control

Use the Explicit Message Program Control feature to configure device parameters on your DeviceNet network via the M0 and M1 files.

Use the Explicit Message Program Control feature to:

- transmit configuration data from your scanner module to its slave devices on your DeviceNet network
- receive status and diagnostics from these devices on your DeviceNet network
- make runtime adjustments to device parameters according to changing conditions detected by your processor

How the Explicit Message Program Control Feature Works

Explicit Message - A message used to transmit commands, data, requests for data or responses. The message is sent from a client on the DeviceNet network to a server on that network.

Request - An explicit message sent by a client to a server requesting the server to perform a function.

Response - An explicit message sent by a server to a client in response to the client's request. For every request issued, there is a response.

1. **Format an M0 file transfer in the processor to send an Explicit Message Request to the scanner module (download).**

2. The scanner module transmits the Explicit Message Request to the slave device over the DeviceNet network.

3. The slave device transmits the Explicit Message Response back to the scanner and is queued into a file transfer buffer.

4. The processor uses an M1 file transfer to retrieve the Explicit Message Response from the scanner's buffer (**upload**).

5. Format an M0 file transfer with a Delete Response Command and the current transaction ID read in step 4. The transaction IDs are deleted and can be reused.

The scanner module requires a precisely-formatted M0 and M1 file transfer size of 32 words including words 224–255. The scanner module uses the file memory content as a client/server request.

How to Format the Explicit Message Transaction Block

Up to ten 32-word transaction blocks may be queued within the scanner module for Explicit Message Program Control. The transaction blocks accommodate both the download of Explicit Message Requests and the upload of Explicit Message Responses.

The scanner module can accommodate one request or response for each transaction block. You must format each transaction block as shown in the following figure:

One word = two bytes = 16 bits
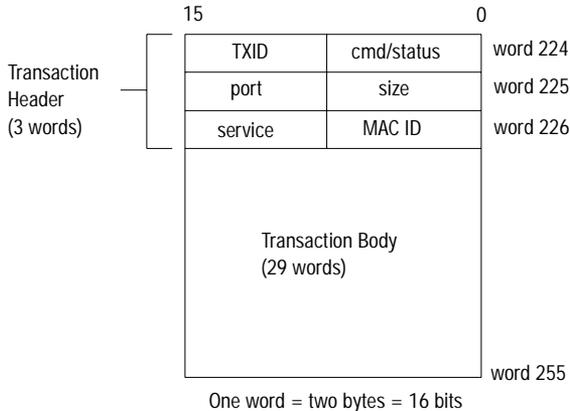
The transaction block is divided into two parts:

- **transaction header** – contains information that identifies the transaction to the scanner and processor
- **transaction body** – in a request, this contains the DeviceNet Class, Instance, Attribute and Service Data portion of the transaction. In a response, this contains only the response message.

Each of the data attributes in the transaction header are one byte in length:

- **command/status** – for each download, you assign a command code to instruct the scanner how to administer the request:

Command Code	Description
0	Ignore transaction block (block empty)
1	Execute this transaction block
2	Get status of transaction TXID
3	Reset all client/server transactions
4	Delete transaction from response queue
5–255	Reserved

For each upload, the status code provides the processor with status on the device and its response:

Status Code	Description
0	Ignore transaction block (block empty)
1	Transaction completed successfully
2	Transaction in progress (not ready)
3	Error – slave not in scan list
4	Error – slave offline
5	Error – DeviceNet port disabled/offline
6	Error – transaction TXID unknown
7	Error – slave not responding to explicit request
8	Error – Invalid command code
9	Error – Scanner out of buffers
10	Error – Other Client/server transaction in progress
11	Error – could not connect to slave device
12	Error – response data too large for block
13	Error – invalid port
14	Error – invalid size specified
15	Error – connection busy
16–255	Reserved

- **TXID (transaction ID)** – when you create and download a request to the scanner, the processor's ladder logic program assigns a TXID to the transaction. This is a one-byte integer in the range of 1 to 255. The scanner uses this value to track the transaction to completion, and returns the value with the response that matches the request downloaded by the processor. The ladder logic program monitors rollover and usage of TXID values.
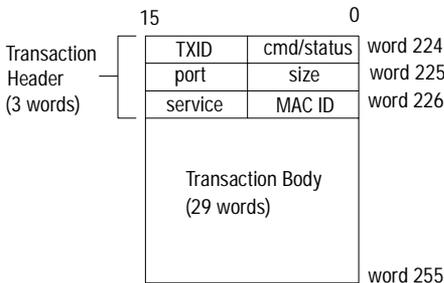

One word = two bytes = 16 bits

- **size** – the size of the transaction body in bytes. The transaction body can be as many as 29 words (58 bytes) in length. If the size exceeds 29 words, an error code will be returned.
- **port** – the DeviceNet port (zero) where the transaction is routed.

- **MAC ID (node address)** – the DeviceNet network address of the slave device where the transaction is sent. This value can range from 0 to 63. The port and MAC ID attributes coupled together identify the target slave device. The slave device must be listed in the scanner module's scan list and be online for the Explicit Message transaction to be completed successfully.
- **service** – for each Explicit Message Request and Response, the service attribute contains the service request and response codes that match the corresponding request for the TXID.

The following figure describes the format and mapping of transaction blocks for request and response messages in the scanner module:

Format of 32-word M0 Transfer File for Explicit Message Request

Format of 32-word M1 Transfer File for Explicit Message Response
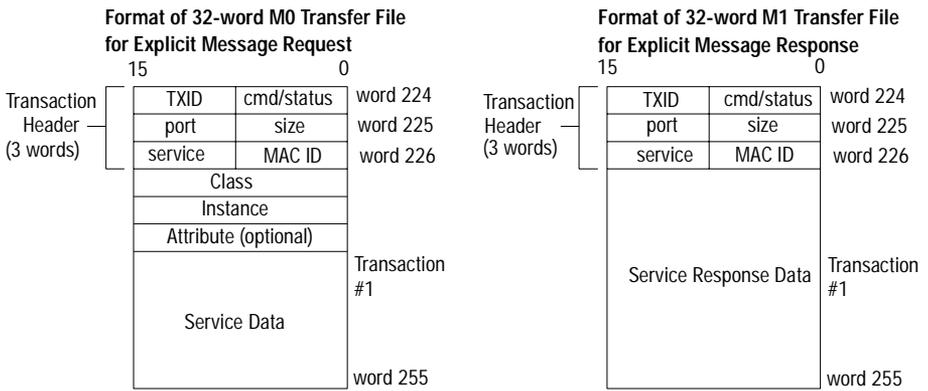
How the Processor and Scanner Module Manage Messages

File transfer operations between the processor and the scanner always originate in the processor. The scanner module can only wait for the processor to download a transaction block to the module or request an upload of a transaction block from the module.

Once an Explicit Message Request transaction block is downloaded to the scanner module, a ladder logic program in the processor polls the scanner module for the transaction block containing the Explicit Message Response for that request. This is done by the processor with an M1 file transfer on the scanner module.

Depending on the network load, the scanner could take a few seconds to complete the request. When a response is loaded, bit 15 of the module status register is set to 1. The program may have to poll the scanner module a number of times before the scanner returns a Response Transaction Block.

The scanner module recognizes I/O data and control as higher priorities over explicit messaging on DeviceNet.

Message lengths and slave device types impact transaction message completion times. If the processor has queued multiple Explicit Message Transactions to the scanner module for multiple slave devices, the transactions with the slaves may not complete in the order in which the requests were received. The slave responses are queued to the 32 word M1 file transfer in the order in which they are received. As response transaction blocks are uploaded, the processor's program matches the responses to the requests using the TXID field.
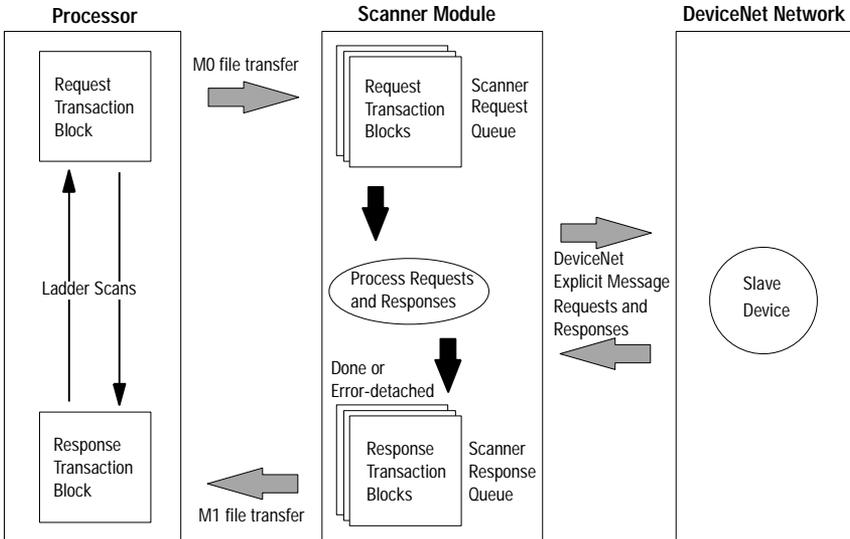
Explicit Message Program Control Limitations

- The processor is always the DeviceNet client and the slave is always the DeviceNet server.

- A maximum of **ten** Explicit Message Request Transaction Blocks with the execute command can be queued to the scanner module at any time. For example, **ten** M0 file transfers containing one transactions each, can be queued at any time. The scanner module receives and deletes any additional client/server requests with the execute command over the maximum of **ten**.

As transactions are removed from the queue and response transaction blocks are returned to the processor, additional transaction blocks can be issued in their place, as long as the total does not exceed ten.

- The scanner module supports **one** transaction block per upload and download.

- Request Transaction Blocks can only be queued for slave devices of the scanner module and must appear in the scanner module's scan list.

- If a slave device is not communicating at the time the scanner module processes its Request Transaction Block, the scanner module will return an error status for that transaction.
- Check documentation of destination device for specifics concerning services supported and Class Instance Attribute information. At a minimum, the scanner module supports the following DeviceNet services in Request Transaction Blocks:

Service Name:	Service Code:	Example:
Get_Attribute_Single	0E $_{hex}$	Upload a single parameter value from a device
Set_Attribute_Single	10 $_{hex}$	Download a single parameter value to a device
Get_Attribute_All	01 $_{hex}$	Upload all parameter values from a device
Set_Attribute_All	02 $_{hex}$	Download all parameter values to a device

- All transaction blocks are processed, therefore, an unused transaction block must be left blank.
- Client/Server commands and requests with transaction IDs that are in use are ignored by the scanner module.
- If a slave device returns a DeviceNet error in response to the request downloaded from the processor, the scanner recognizes the error as a successful transaction (status code =1).

A failure to respond to the request within the number of retries or timeout period specified for the Explicit Message Connection is recognized by the scanner module as an error. The error code is returned in the status attribute of the transaction header.

Explicit Messaging Error Codes

Error codes have two bytes of data. The first byte is a General Error Code and the second is an optional Additional Code Field that may contain additional information about the error. If this field is unused, the value 0FFH is shown. The following table describes explicit messaging error codes.

Numeric Code:	Name:	Description:
02H	Resource unavailable	A needed resource was not available
08H	Service unsupported	Service is not defined or implemented for this class/instance
09H	Invalid attribute value	Data is invalid for the specified attribute
0BH	Already in requested state	Object is in the requested state - redundant request
0CH	Object state conflict	Not allowed with object in present state
0EH	Attribute cannot be set	Read-only attribute
0FH	Privilege violation	A permission/privilege check failed
10H	Device state conflict	Not allowed with device in present state
11H	Reply too big	Reply larger than buffer allocated when connection was established
13H	Too little data	Request included insufficient data
14H	Attribute not supported	Attribute number is incorrect
15H	Too much data	Request included extra data
16H	Object does not exist	Class/instance numbers are incorrect
18H	No stored attribute data	Attribute data was not saved prior to this request
19H	Store operation failure	Attribute data was not successfully saved
1FH	Vendor-specific error	Second byte may offer details - refer to vendor documentation
20H	Invalid parameter	Parameter associated with request is invalid
D0H FFH	Reserved and service-specific errors	Used only when none of the standard error codes supplemented by the second byte accurately describes the problem.

Troubleshoot the Module and Network

The bicolor (green/red) module status indicator (MODULE) located on the front of your module displays module status. It indicates whether the module has power and is functioning properly.

Module Status Troubleshooting

If the MODULE indicator is:	Then:	Take this action:
Off	There is no power applied to the module.	Verify power connections and apply power.
Green	The module is operating normally.	No action required.
Flashing Green	The module is not configured.	Configure the module.
Flashing Red	There is an invalid configuration.	Check configuration setup.
Red	The module has an unrecoverable fault.	Replace the module.

The DeviceNet channel has a bicolor (green/red) network status indicator (NET). The following table provides troubleshooting information about the DeviceNet channel communication link.

DeviceNet Channel Communications Troubleshooting

If the NET indicator is:	Then	Which indicates	Take this action
Off	The device has no power or the channel is disabled for communication due to bus off condition, loss of network power, or has been intentionally disabled.	The channel is disabled for DeviceNet communication.	Power-up the module, provide network power to the channel, and be sure the channel is enabled in both the module configuration table and the module command word.
Green	Normal operation.	All slave devices in the scan list table are communicating normally with the module.	None.
Flashing Green	The two-digit numeric display for the channel indicates an error code that provides more information about the condition of the channel.	The channel is enabled but no communication is occurring.	Configure the scan list table for the channel to add devices.
Flashing Red	The two-digit numeric display for the channel displays an error code that provides more information about the condition of the channel.	At least one of the slave devices in the module's scan list table has failed to communicate with the module.	Examine the failed device and the scan list table for accuracy.
Red	The communications channel has failed. The two digit numeric display for the channel displays an error code that provides more information about the condition of the channel.	The module may be defective.	Reset module. If failures continue, replace module.

Numeric Codes and Descriptions

Your module uses numeric displays to indicate diagnostic information about the status of your module. The display flashes at 1 second intervals. The following table summarizes the meanings of the numeric codes.

Numeric Code Display Summary

Numeric Code	Description	Take this action
0 - 63	Normal operation. The numeric display indicates the 1747-SDN's node address on the DeviceNet network.	None.
70	Module failed Duplicate Node Address check.	Change the module channel address to another available one. The node address you selected is already in use on that channel.
71	Illegal data in scan list table (node number alternately flashes).	Reconfigure the scan list table and remove any illegal data.
72	Slave device stopped communicating (node number alternately flashes).	Inspect the field devices and verify connections.
73	Device's identity information does not match electronic key in scan list table entry.	Verify that the correct device is at this node number. Make sure that the device at the scrolling node address matches the desired electronic key (vendor, product code, product type, etc.).
74	Data overrun on port detected.	Modify your configuration and check for invalid data. Check network communication traffic.
75	No traffic from other modules detected on the network.	Check the network configuration. (Scanlist may be empty.)
76	No direct network traffic for module detected.	None. The module hears other network communication.
77	Data size expected by the device does not match scan list entry.	Reconfigure your module for the correct transmit and receive data sizes.
78	Slave device in scan list table does not exist.	Add the device to the network, or delete the scan list entry for that device.
79	Module has failed to transmit a message.	Make sure that your module is connected to a valid network. Check for disconnected cables.
80	Module is in Idle mode.	Put controller in Run mode. Enable Run bit in module command register.
81	Module is in FAULT mode.	Check Module Command Register for fault bit set.
82	Error detected in sequence of fragmented I/O messages from device.	Check scan list table entry for slave device to make sure that input and output data lengths are correct. Check slave device configuration.
83	Slave device is returning error responses when module attempts to communicate with it.	Check accuracy of scan list table entry. Check slave device configuration. Slave device may be in another master's scan list. Reboot slave device.
84	Module is initializing the DeviceNet network.	None. This code clears itself once module attempts to initialize all slave devices on the network.

Numeric Code	Description	Take this action
85	Data size was incorrect for this device at runtime.	• Slave device is transmitting incorrect length data. • Verify device is not configured for variable poll connection size. • Try replacing the device.
86	Device is producing zero length data (idle state) while module is in Run Mode.	Check device configuration and slave node status.
87	The primary owner has not allocated the slave.	Put the primary owner on line.
88	The connection choices (polled, strobed, etc.) between the primary connection and the shared input only connection do not match.	Reconfigure the shared input only connection's choice(s) to be the same as, or a subset of, the primary connection's choice(s).
89	Slave device initialization using Auto Device Replacement parameters failed.	• Put the slave device into configurable mode. • Check the slave's EDS file, if the slave is configured offline. • Check to see if the slave device has been replaced with an incompatible device.
90	User has disabled communication port.	Check Module Command Register for DISABLE bit set.
91	Bus-off condition detected on comm port. Module is detecting communication errors.	Check DeviceNet connections and physical media integrity. Check system for failed slave devices or other possible sources of network interference.
92	No network power detected on communication port.	Provide network power. Make sure that module drop cable is providing network power to module comm port.
95	Application FLASH update in progress.	None. Do not disconnect the module while application FLASH is in progress. You will lose any existing data in the module's memory.
97	Module operation halted by user command.	Check Module Command Register for HALT bit set.
98	Unrecoverable firmware failure.	Service or replace your module.
99	Unrecoverable hardware failure.	Service or replace your module.
E2	RAM Test Failure	Service or replace your module.
E4	Lost power during FLASH upgrade	Service or replace your module.
E5	No boot or main code	Service or replace your module.
E9	Module memory has been flushed for factory default settings.	Cycle module power to recover.

The following information applies when operating this equipment in hazardous locations:	Informations sur l'utilisation de cet équipement en environnements dangereux :
Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.	Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.

WARNING

EXPLOSION HAZARD

- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.
- Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Substitution of components may impair suitability for Class I, Division 2.
- If this product contains batteries, they must only be changed in an area known to be nonhazardous.

AVERTISSEMENT

RISQUE D'EXPLOSION

- Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.
- Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit.
- La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2.
- S'assurer que l'environnement est classé non dangereux avant de changer les piles.

Specifications

Module Location	SLC 5/02 or later chassis
Module Defaults	Node Address – 63 Baud Rate – 125 Kbits/s

Power Consumption
  - Backplane Current
  - DeviceNet[1]
	5Vdc, 500 mA
	24Vdc, 90mA Class 2

Isolation Voltage	Optical Isolation between backplane and DeviceNet channel, tested to withstand 500Vac for 60 seconds 1 Megohm resistor from DeviceNet channel to chassis
Operating Temperature	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): 0-60°C (32–140°F)
Storage Temperature	IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold), IEC 60068-2-2 (Test Bc, Un-packaged Non-operating Dry Heat), IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock): –40 to 85°C (–40 to 185°F)
Relative Humidity	IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat): 5–95% non condensing
Vibration	IEC60068-2-6 (Test Fc, Operating): 2g @10–500Hz
Shock	IEC60068-2-27:1987, Test Ea (Unpackaged shock, ES#002) Operating - 30g Non-operating - 50g
Emissions	CISPR 11: Group 1, Class A (with appropriate enclosure)
ESD Immunity	IEC 61000-4-2: 4kV contact discharges
Radiated RF Immunity	IEC 61000-4-3: 10V/m with 1kHz sine-wave 80% AM from 30MHz to 1000Mhz
EFT/B Immunity	IEC 61000-4-4: ±2kV at 5kHz on communications ports
Surge Transient Immunity	IEC 61000-4-5: ±2kV line-earth(CM) on signal ports
Conducted RF Immunity	IEC 61000-4-6: 10Vrms with 1kHz sine-wave 80%AM from 150kHz to 30MHz
Enclosure Type Rating	None (open style)

Wiring
  - Type
  - Category[2]
	1771-CD
	2

10-pin Linear Plug
  - Torque
  - Catalog Number
	5-7 pound-inches
	1787-PLUG10R

Specifications - Continued

Certifications (when product is marked)	UL	UL Listed Industrial Control Equipment
	CSA	CSA Certified Process Control Equipment
	CSA	CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations
	CE[1]	European Union 89/336/EEC EMC Directive, compliant with: EN 50081-2; Industrial Emissions EN 50082-2; Industrial Immunity European Union 73/23/EEC LVD Directive, compliant with: EN 61131-2; Programmable Controllers
	C-Tick[3]	Australian Radiocommunications Act, compliant with: AS/NZS 2064; Industrial Emissions
	ODVA	ODVA conformance tested to ODVA DeviceNet specifications
User Manual	1747–6.5.5	

[1]To remain compliant with UL/CSA certification, the DeviceNet power supply must meet NEC Class 2 requirements.

[2]Use this conductor category information for planning conductor routing as described in publication 1770-4.1, *Industrial Automation Wiring and Grounding Guidelines*.

[3]See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

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