BD-DEVNET USER'S GUIDE

Form 750-990421 – April, 1999

OPTO 22

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Opto 22 warrants all of its products to be free from defects in material or workmanship for 30 months from the manufacturing date code. This warranty is limited to the original cost of the unit only and does not cover installation, labor, or any other contingent costs. Opto 22 I/O modules and solid-state relays with date codes of 1/96 or later are guaranteed for life. This lifetime warranty excludes reed relay, SNAP serial communication modules, SNAP PID modules, and modules that contain mechanical contacts or switches. Opto 22 does not warrant any product, components, or parts not manufactured by Opto 22; for these items, the warranty from the original manufacturer applies. These products include, but are not limited to, the OptoTerminal-G70, OptoTerminal-G75, and Sony Ericsson GT-48; see the product data sheet for specific warranty information. Refer to Opto 22 form number 1042 for complete warranty information.

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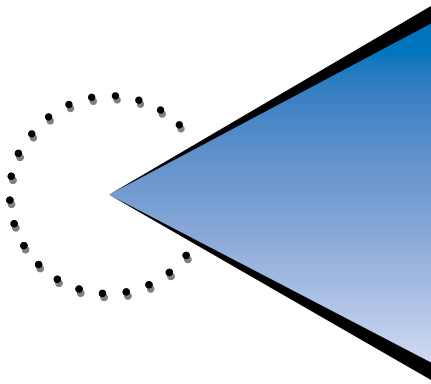


WELCOME

ABOUT BD-DEVNET

Thank you for purchasing a BD-DEVNET. BD-DEVNET allows DeviceNet customers to take advantage of the world's leading I/O hardware from Opto 22. The configuringable board, which can control up to 16 digital I/O points, connects easily with Opto 22's digital I/O mounting racks. Software parameters can be set using standard DeviceNet tools (node address and operaing speed may also be set by switches), allowing the board to communicate on a DeviceNet network.

ABOUT OPTO 22

Opto 22's goal to deliver total control to industrial automation customers dates back to its beginnings in 1974 with the introduction of optically-isolated solid-state relays. Today, Opto 22 is the number one provider of I/O systems, with more than 80 million points of I/O working reliably worldwide. After earning a reputation for consistent innovation and leadership in automation hardware, Opto 22 realized it was time to take a new approach to control software. In 1988, Opto 22 introduced the first flowchart-based control programming language. Opto 22 continues to deliver successively more advanced generations of hardware and software.

All Opto 22 products are manufactured in the U.S. at the company's headquarters in Temecula, California, and are sold through a global network of distributors, system integrators, and OEMs. Sales offices are located throughout the United States. For more information, contact Opto 22, 43044 Business Park Drive, Temecula, CA 92590-3614. Phone Opto 22 Inside Sales at 1-800-452-OPTO or Opto 22 headquarters at 951-695-3000. Fax us at 951-695-3095.

You can also visit our Web site at **www.opto22.com**.

ABOUT THIS MANUAL

This reference manual provides complete specifications and instructions to set up and install a BD-DEVNET DeviceNet card.

In this manual, you'll find:

- **Chapter 1: Introduction** — Overview of the DeviceNet card, a compatibility chart, and specifications.
- **Chapter 2: Installation and Configuration** — Drawings, settings, connections, and additional information regarding installation and configuration procedures.
- **Chapter 3: DeviceNet Inforamtion** — Additional information: Interfaces, data acccess, tables, etc.

INTRODUCTION

CHAPTER 1

OVERVIEW

The BD-DEVNET is a DeviceNet-compatible 16-channel digital I/O adapter that allows DeviceNet customers to integrate Opto 22 digital I/O mounting racks on the popular DeviceNet communication and power network.

The BD-DEVNET's brain board form-factor and standard 50-pin header connector allows the digital adapter to plug directly into Opto 22 digital I/O mounting racks similar to Opto 22's other 16-channel digital brain boards (B1, B5, and B100). The BD-DEVNET can be powered either from the 5V on the I/O rack or from the standard DeviceNet 24 VDC bus power.

Software parameters, set using standard DeviceNet tools, allow the unit to be configured to meet a wide range of industrial interface requirements. The BD-DEVNET's network node address and operating speed may be set up using an eight position switch or as software parameters. Network signals are connected using removable screw terminals, simplifying field installation. The CAN interface includes on-board circuitry to protect against wiring faults such as loss of ground and reverse polarity.

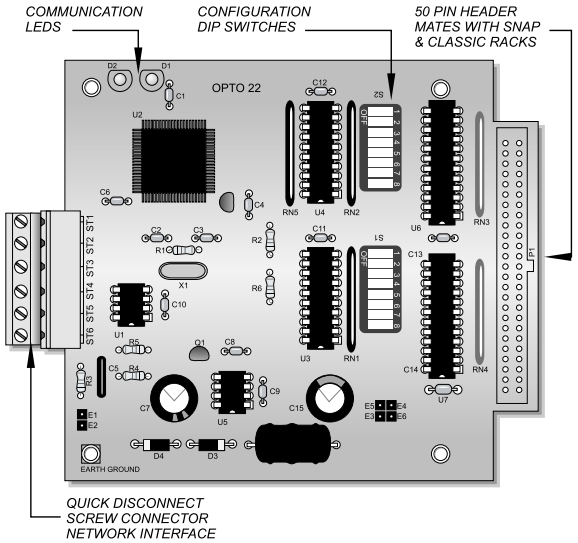


Figure 1-1: BD-DEVNET

SPECIFICATIONS

The BD-DEVNET DeviceNet application interface conforms to the specifications as published by the Open DeviceNet Vendor's Association.

Table 1-1: BD-DEVNET Specifications

Class	Min	Typ	Max	Units
Operating Voltage	18	24	28	VDC
Operating Current + ~10mA per I/O module installed	--	30	40	mA
Data Rates	125	--	500	kbit/sec
Operating Temperature	0	--	+60	°C
Digital I/O (driver to I/O module) Sink (output mode), Iol = 32mA	--	--	.55	VDC
Source (output mode), Iol = 12mA	2.4	--	--	VDC
V_{in} (low) (input mode), Iil = 1mA		--	.8	VDC
V_{in} (high) (input mode), Iih = 1mA	2	--	--	VDC

COMPATIBLE I/O

The BD-DEVNET Brain Board provides up to 16 bits of digital I/O in a DeviceNet-compatible network. The brain board is compatible with Opto 22 snap and classic digital I/O racks. Each heading in Table 1-2 lists Opto 22 I/O racks that are compatible with the BD-DEVNET. Under each heading are the module types compatible with those racks.

Table 1-2: Compatible Opto 22 I/O

PB4H, PB8H, PB16H, and PB16HC	
IAC5x*	IDC5x
OAC5x	ODC5x
G4PB8H and G4PB16H	
G4IAC5x	G4IDC5x
G4OAC5x	G4ODC5x
G4SWIN	G4SWOUT
PB16HQ	
IAC5QX	IDC5Qx
OAC5Qx	ODC5Qx
SNAPD4M, SNAPD4MC, and SNAP4MC-P	
SNAP-IAC5x	SNAP-IDC5
SNAP-OAC5	SNAP-ODC5SRC
SNAP-OCD5SNK	

*x specifies module voltage.

APPLICATION INTERFACE

The BD-DEVNET DeviceNet application interface conforms to the specifications as published by the Open DeviceNet Vendor's Association. Refer to Table 1-3.

Table 1-3: BD-DEVNET Application Interface

Class	Instances	Services	Description
Identity	1	Get/Reset	per DeviceNet standard, rev 1.1.
Router	1	Get	per DeviceNet standard, rev 1.1.
DevNet	1	Get/Set/Reset	per DeviceNet standard, rev 1.1.
Assembly	1	Get/Set	Static assembly. Returns states of all 16 digital I/O data, used by Poll I/O connections.
Connections	2	Get/Set/Reset	Supports Explicit Message connection and Poll connections.
Digital Input	16	Get/Set	Each data bit may be treated as an input or an output, depending on the type of I/O module used.
Digital Output	16	Get/Set	Each data bit may be treated as an input or an output, depending on the type of I/O module used.

CHAPTER 2

INSTALLATION AND CONFIGURATION

DIMENSIONS

Refer to Figure 2-1 for BD-DEVNET dimensions.

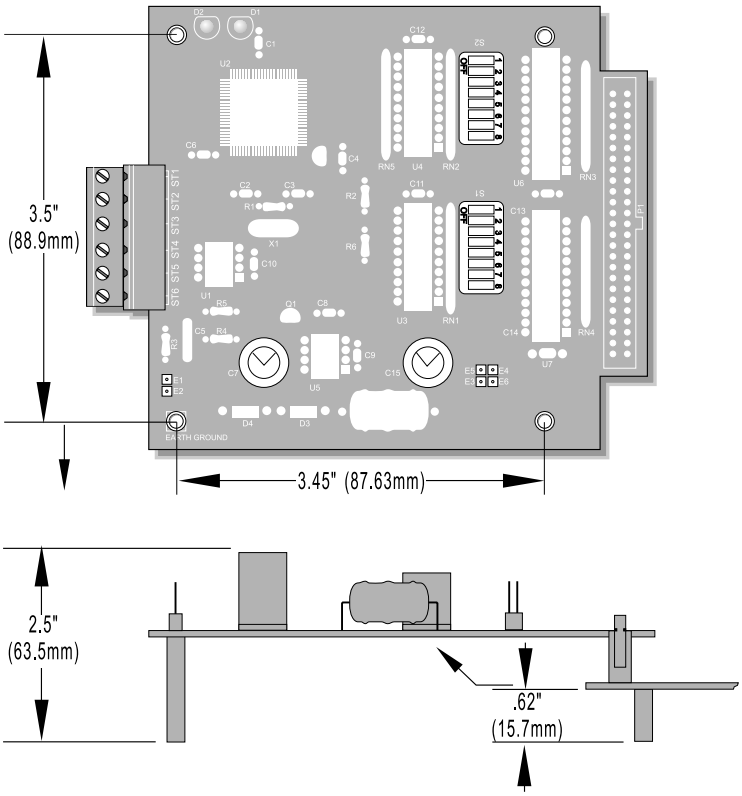


Figure 2-1: BD-DEVNET Dimensions

BD-DEVNET MOUNTING

Be sure that power to all devices is turned off before connecting or disconnecting boards.

The BD-DEVNET mounts to an Opto 22 digital I/O rack via a header connector. The BD-DEVNET board should be oriented away from the I/O rack, as shown in Figure 2-2. To avoid possible damage to the boards, be sure the BD-DEVNET is centered with the connector. The connector ends will close completely if the board is properly installed. Refer to the Opto 22 technical documentation on the particular I/O rack for additional mounting information.

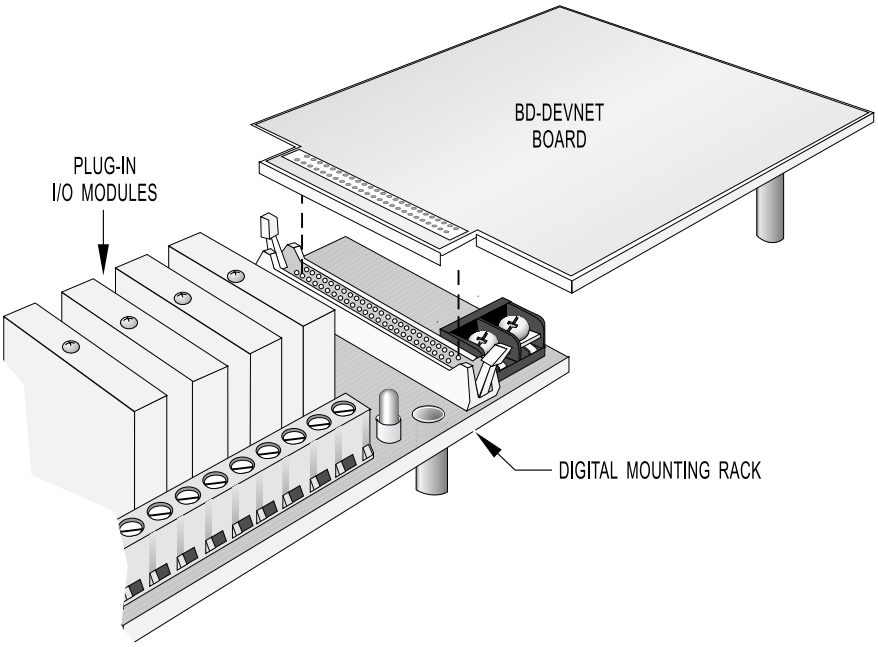


Figure 2-2: BD-DEVNET Installation

CONFIGURATION

Power Connectors

The adapter may be powered from the Opto 22 I/O racks or from the DeviceNet bus power. Refer to Table 2-2 for jumper settings. The factory default and recommended setting is supplying power directly from the rack.

The Opto 22 I/O racks must be powered from +5 volts, and the associated I/O modules must operate on 5 volts. Power requirements are 40 mA, 5 VDC plus the current required to drive the Opto 22 modules (typically 15 mA per module).

Table 2-2: Jumper Settings for Power Connectors

E3-E5	E4-E6	Description
NO	YES	+5 VDC I/O rack power to Node
YES	NO	Bus power to Node, Separate Rack power
YES	YES	Bus power to Node and Rack

Address

The BD-DEVNET has an eight-position switch that sets both the adapter address and the communications speed. The adapter address is set by switch S1, positions 1-6. If the switch is in the OFF position, it is read as zero. Refer to Table 2-3.

Table 2-3: Address Settings

S6	S5	S4	S3	S2	S1	Address
Off	Off	Off	Off	Off	Off	0
Off	Off	Off	Off	Off	On	1
Off	Off	Off	Off	On	Off	2
Off	Off	Off	Off	On	On	3
--- On	--- On	--- On	--- On	--- On	--- Off	--- 62
On	On	On	On	On	On	63

Communication Speed

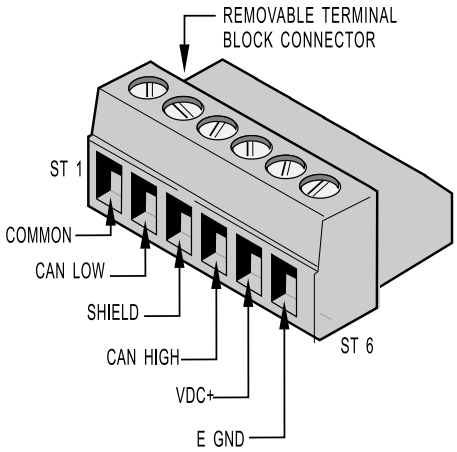
The communication speed is determined by switch S1, positions 7 and 8, as shown in Table 2-4.

Table 2-4: Communication Speed Settings

S8	S7	Description
Off	Off	125 Kbits/second
Off	On	250 Kbits/second
On	Off	500 Kbits/second
On	On	Software configurable speed/address

DEVICENET CONNECTOR

All DeviceNet signals are brought out to a 6 position detachable screw terminal.



HARDWARE RESET

The adapters will power on with all outputs in the OFF state. When the on-board processor is operating, the output states are determined by the DeviceNet commands.

LED INDICATORS

The BD-DEVNET has two LED indicators, referred to as the HEALTH and the COMM indicators. Refer to the DeviceNet specifications for a complete description of these LEDs. During the power up sequence, each LED will cycle from RED to GREEN as part of the self diagnostics firmware.

DEVICENET INFORMATION

CHAPTER 3

DATA ACCESS

DeviceNet reads and writes access the adapter data buffers. The buffers are open collector inverting drivers with inverting input bus transceivers providing data read capability. For a bit to act as an input, the corresponding output data buffer bit must have a zero written to it. This causes the open collector driver to be turned OFF, and the physical I/O bit will be pulled high by a pull-up resistor. External signals may then pull the input signal to ground, which will be read as a logic 1.

No status information is available for either the inputs or outputs.

The I/O drivers are fully compatible with Opto 22 I/O modules.

DEVICENET MODEL

The BD-DEVNET (16-bit Opto 22 Digital Adapter) device operates as a slave on the DeviceNet network. The unit supports Explicit Messages and Polled I/O Messages of the predefined master/slave connection set. It does not support the Explicit Unconnected Message Manager (UCMM).

DEVICENET MESSAGE TYPES

As a group 2 slave device, the BD-DEVNET supports the following message types.

Table 3-1: DeviceNet Message Types

CAN Identifier	Group 2 Message Type
10xxxxxx111	Duplicate MAC ID Check Message
10xxxxxx110	Unconnected Explicit Request Message
10xxxxxx101	Master I/O Poll Command Message
10xxxxxx100	Master Explicit Request Message

xxxxxx = Node Address

DEVICENET CLASS SERVICES

As a group 2 slave device, the BD-DEVNET supports the following class services and instance services.

Table 3-2: DeviceNet Class Services

Service Code	Service Name
0x05	Reset
0x0E	Get Attribute Single
0x10	Set Attribute Single
0x4B	Allocate Group 2 Identifier Set
0x4C	Release Group 2 Identifier Set

DEVICENET OBJECT CLASSES

The BD-DEVNET device supports the following DeviceNet object classes.

Table 3-3: DeviceNet Object Classes

Class Code	Object Type
0x01	Identity
0x02	Router
0x03	DeviceNet
0x04	Assembly
0x05	Connection
0x08	Digital Input Point
0x09	Digital Output Point

Identity Object Class Code: 01H

The Identity Object is required on all devices and provides identification of, and general information about, the device.

Table 3-4: Class Attributes

Attr	Access	Name	Type	Value
1	Get	Revision	UINT	1
2	Get	Max Object Instance	UINT	1
6	Get	Max Class ID	UINT	7
7	Get	Max Instance Attr.	UINT	7

Table 3-5: Identity Object, Instance 1 Attributes

Attr	Access	Name	Type	Value
1	Get	Vendor	UINT	58
2	Get	Product Type	UINT	7
3	Get	Product Code	UINT	25
4	Get	Revision	STRUCT of	
		Major Revision	USINT	1
		Minor Revision	USINT	0
5	Get	Device Status	UINT	*
6	Get	Serial Number	UDINT	**
7	Get	Product Name	STRUCT of	
		Length	USINT	5
		Name	STRING [5]	BD-DEVNET

* Device Status

bit 0	owned	0=not owned 1=owned (allocated)
bit 1	reserved	0
bit 2	configured	0
bit 3	reserved	0
bit 4-7	vendor specific	0
bit 8	minor cfg fault	0=no fault 1=minor fault
bit 9	minor dev. fault	0=no fault 1=minor device fault
bit 10	major cfg. fault	0=no fault 1=major cfg. fault
bit 11	major dev. fault	0=no fault 1=major device fault
bit 12-15	reserved	0

** Unique Serial Number

Table 3-6: Common Services

Service Code	Implemented for: Class	Implemented for: Instance	Service Name
0E	Yes	Yes	Get_Attribute_Single
05	No	Yes	Reset

Router Object Class Code: 02H

The Message Router Object provides a messaging connection point through which a client may address a service to any object class or instance residing in the physical device.

Table 3-7: Class Attributes

Attr	Access	Name	Type	Value
1	Get	Revision	UINT	1
6	Get	Max Class Attr.	UINT	7
7	Get	Max Instance Attr.	UINT	2

Table 3-8: Router Object, Instance 1 Attributes

Attr	Access	Name	Type	Value
2	Get	Number Connection	UIN	2

Table 3-9: Common Services

Service Code	Implemented for: Class	Instance	Service Name
0E	Yes	Yes	Get_Attribute_Single
10	No	Yes	Set_Attribute_Single

DeviceNet Object Class Code: 03H

Table 3-10: Class Attributes

Attr	Access	Name	Type	Value
1	Get	Revision	UINT	1

Table 3-11: DeviceNet Object, Instance 1 Attributes

Attr	Access	Name	Type	Value
1	Get/Set	MAC ID	USINT	*
2	Get/Set	Baud Rat	USINT	**
3	Get/Set	Bus Off Interrupt	BOOL	***
4	Get/Set	Bus Off Counter	USINT	****
5	Get/Spc	Allocation Info	STRUCT of	*****
		Choice Byte	BYTE	
		Master Node Addr.	USINT	

*Settable only if switch 7 and 8 are both in the ON position. Value returned will be switch 1..6 or last value set.

**Settable by switch 7 or 8 or through DeviceNet if switch 7 and 8 are both on.

Switch/Value	Speed
0	125 kbits
1	250 kbits
2	500 kbits
3	undefined

***Bus Off Interrupt (BOI) determines action if Bus Off state encountered. Following values are supported:

BOI	Action
0	Hold chip in OFF state (default)
1	If possible reset CAN chip

**** Bus Off Counter will be forced to zero whenever set, regardless of the data value provided.

***** Allocation_byte

bit 0	explicit	set to 1 to allocate
bit 1	polled	set to 1 to allocate
bit 2	strobed	(not supported)
bit 3-7	reserved	always 0

Table 3-12: Common Services

Service Code	Implemented for: Class	Implemented for: Instance	Service Name
0E	Yes	Yes	Get_Attribute_Single
10	No	Yes	Set_Attribute_Single
4B	No	Yes	Allocate_Master/Slave
4C	No	Yes	Release_Master/Slave

Assembly Object Class Code: 04H

The Assembly Objects bind attributes of multiple objects to allow data to or from each object to be sent or received over a single connection.

Table 3-13: Class Attributes

Attr	Access	Name	Type	Value
1	Get	Revision	UNIT	1
2	Get	Max Class ID	UNIT	2

Table 3-14: Assembly Object, Instance 1 Attributes

Attr	Access	Name	Type	Value
3	Get	Data (state)	UINT	*

Table 3-15: Assembly Object, Instance 2 Attributes

Attr	Access	Name	Type	Value
3	Get/Set	Data (state)	UINT	**

* Input Data:
bit 0 = DIP instance 1 state
bit 1 = DIP instance 2 state
bit 2 = DIP instance 3 state
bit 3 = DIP instance 4 state
bit 4 = DIP instance 5 state
bit 5 = DIP instance 6 state
bit 6 = DIP instance 7 state
bit 7 = DIP instance 8 state
bit 8 = DIP instance 9 state
bit 9 = DIP instance 10 state
bit 10 = DIP instance 11 state
bit 11 = DIP instance 12 state
bit 12 = DIP instance 13 state
bit 13 = DIP instance 14 state
bit 14 = DIP instance 15 state
bit 15 = DIP instance 16 state

** Output Data:
bit 0 = DOP instance 1 state
bit 1 = DOP instance 2 state
bit 2 = DOP instance 3 state
bit 3 = DOP instance 4 state
bit 4 = DOP instance 5 state
bit 5 = DOP instance 6 state
bit 6 = DOP instance 7 state
bit 7 = DOP instance 8 state
bit 8 = DOP instance 9 state
bit 9 = DOP instance 10 state
bit 10 = DOP instance 11 state
bit 11 = DOP instance 12 state
bit 12 = DOP instance 13 state
bit 13 = DOP instance 14 state
bit 14 = DOP instance 15 state
bit 15 = DOP instance 16 state

Table 3-16: Common Services

Service Code	Implemented for: Class	Implemented for: Instance	Service Name
0E	Yes	Yes	Get_Attribute_Single
10	No	Yes	Set_Attribute_Single

Connection Object Class Code: 05H

The Connection Objects manages the characteristics of each communication connection. As a Group II Only Slave device the unit supports one explicit and one POLL message connection.

Table 3-17: Class Attributes

Attr	Access	Name	Type	Value
1	Get	Revision	UINT	1

Table 3-18:Connection Object, Instance 1 Attributes (Explicit Message)

Attr	Access	Name	Type	Value
1	Get	State	USINT	*
2	Get	Instance Type	USINT	0=Exp Msg
3	Get	Transport Class Trig.	USINT	83H
4	Get	Prod. Connection ID	UINT	**
5	Get	Cons. Connection ID	UINT	**
6	Get	Initial Comm Char.	USINT	21H
7	Get	Prod. Conn. Size	UINT	7
8	Get	Cons. Conn. Size	UINT	7
9	Get	Expected Packet Rate	UINT	2,500 msec
12	Get	Watchdog Timeout Act	USINT	1=autodel
13	Get	Prod. Conn. Path. Lngth	USINT	0
14	Get	Prod. Conn. Path	USINT	(null)
15	Get	Cons. Conn. Path. Lngth	USINT	0
16	Get	Cons. Conn. Path	USINT	(null)

xxxxxx = Node Address

* Connection States:
0 = non-existent
1 = configuring
2 = established
3 = timed out

** Connection ID's:
Connection 1 Produced Connection ID: 10xxxxxx011
Connection 1 Consumed Connection ID: 10xxxxxx100
Connection 2 Produced Connection ID: 01111xxxxxx
Connection 2 Consumed Connection ID: 10xxxxxx101

Table 3-19: Connection Object, Instance 2 Attributes (I/O Messaging)

Attr	Access	Name	Type	Value
1	Get	State	USINT	*
2	Get	Instance Type	USINT	1=I/OMsg
3	Get	Transport Class Trig.	USINT	82H
4	Get	Prod. Connection ID	UINT	**
5	Get	Cons. Connection ID	UINT	**
6	Get	Initial Comm Char.	USINT	01H
7	Get	Prod. Conn. Size	UINT	2
8	Get	Cons. Conn. Size	UINT	2
9	Get	Expected Packet Rate	UINT	2,500 msec
12	Get	Watchdog Timeout Act.	USINT	***
13	Get	Prod. Conn. Path. Lngth	USINT	6
14	Get	Prod. Conn. Path	STRUCT of	
		Log. Seg., Class	USINT	20H
		Class Number	USINT	04H
		Log. Seg., Inst.	USINT	24H
		Inst. Number	USINT	01H
		Log. Seg., Attribute	USINT	30H
		Attr. Number	USINT	03H
15	Get	Prod. Conn. Path. Lngth	USINT	6
16	Get	Prod. Conn. Path	STRUCT of	
		Log. Seg., Class	USINT	20H
		Class Number	USINT	04H
		Log. Seg., Inst.	USINT	24H
		Inst. Number	USINT	02H
		Log. Seg., Attribute	USINT	30H
		Attr. Number	USINT	03H

xxxxxx = Node Address

* Connection States:
0 = non-existent
1 = configuring
3 = established
4 = timed out

** Connection ID's:
Connection 1 Produced Connection ID: 10xxxxxx011
Connection 1 Consumed Connection ID: 10xxxxxx100
Connection 2 Produced Connection ID: 01111xxxxxx
Connection 2 Consumed Connection ID: 10xxxxxx101

*** Watch Dog TimeOut Activity:
0 = Timeout
1 = Auto Delete (Explicit Messaging)
2 = Auto Reset (I/O Message default)

Table 3-20: Common Services

Service Code	Implemented for: Class	Instance	Service Name
0E	Yes	Yes	Get_Attribute_Single
10	No	Yes	Set_Attribute_Single
05	Yes	Yes	Reset

Discrete Input (DIP) Object Class Code: 08H

The Discrete Input Point (DOP) Object models discrete inputs in a product. You can use this object in applications as simple as a toggle switch or as complex as a discrete I/O control module. There is a separate instance for each discrete input available on the device.

Table 3-21: Class Attributes

Attr	Access	Name	Type	Value
1	Get	Revision	UINT	1
2	Get	Max Object Instance	UINT	6
6	Get	Max Class ID	UINT	7
7	Get	Max Instance Attr.	UINT	16

Table 3-22: DIP Object, Instance 1..n Attributes

Attr	Access	Name	Type	Value
3	Get	Value	BOOL	*
4	Get	Status	BOOL	*

*Input Value determines the overall condition of inputs. The status information will always be 0.

State x	Interpretation
0	Input is OFF
1	Input is ON

Table 3-23: Common Services

Service Code	Implemented for: Class	Instance	Service Name
0E	Yes	Yes	Get_Attribute_Single

Discrete Output (DOP) Object Class Code: 09H

The Discrete Output Point (DOP) Object models discrete outputs in a product. You can use this object in applications as simple as an indicator lamp or as complex as a discrete I/O control module. There is a separate instance for each discrete output available on the device.

Table 3-24: Class Attributes

Attr	Access	Name	Type	Value
1	Get	Revision	UINT	1
2	Get	Max Object Instance	UINT	4
6	Get	Max Class ID	UINT	7
7	Get	Max Instance Attr.	UINT	16

Table 3-25: DIP Object, Instance 1..n Attributes

Attr	Access	Name	Type	Value
3	Get	Value	BOOL	*
4	Get	Status	BOOL	*
5	Get	Fault State	BOOL	**
6	Get	Fault Value	BOOL	**
7	Get	Idle Sta	BOOL	***
8	Get	Idle Value	BOOL	***

Table 3-26: Common Services

Service Code	Implemented for: Class	Instance	Service Name
0E	Yes	Yes	Get_Attribute_Single
10	No	Yes	Set_Attribute_Single

*Input Value determines the overall condition of inputs. The status information will always be 0.

State x	Interpretation
0	Output is OFF
1	Output is ON
0	Output faulted

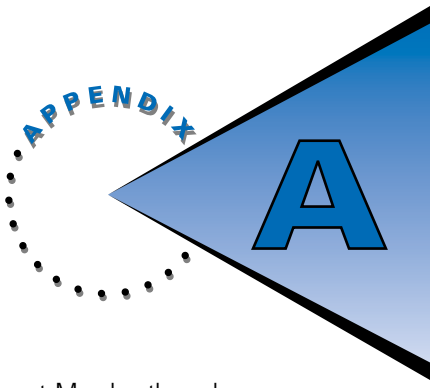
**The Fault Value and Fault State determine the unit's reaction to an output fault condition.

State	Value	Interpretation
0	0	Turn output OFF if faulted
0	1	Turn output ON if faulted
1	x	Leave output unchanged if faulted

***The Idle Value and Idle State determine the unit's reaction to an output idle condition.

State	Value	Interpretation
0	0	Turn output OFF if idle
0	1	Turn output ON if idle
1	x	Leave output unchanged if idle

PRODUCT SUPPORT



If you have any questions about this product, contact Opto 22 Product Support Monday through Friday, 8 a.m. to 5 p.m. Pacific Time.

Phone:	800-TEK-OPTO (835-6786) 951-695-3080
Fax:	951-695-3017
E-mail:	support@opto22.com
Opto 22 Web site:	www.opto22.com

When calling for technical support, be prepared to provide the following information about your system to the Product Support engineer:

- Software and version being used
- Controller firmware version
- PC configuration
- A complete description of your hardware and operating systems, including:
  — jumper configuration
  — accessories installed (such as expansion daughter cards)
  — type of power supply
  — types of I/O units installed
  — third-party devices installed (e.g., barcode readers)
- Specific error messages seen