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CDN391
DEVICENET
SPECIFICATIONS



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Revision History

Revision	Description of changes	Date
1.0	First Release	3/8/99
1.1	Fixed errors in Configuration object, # instances in DIP/DOP	3/24/99

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DN391 Overview

The CDN391 (Digital I/O) 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 Unconnected Message Manager (UCMM).

The CDN391 device supports 48 digital outputs with read-back capability.

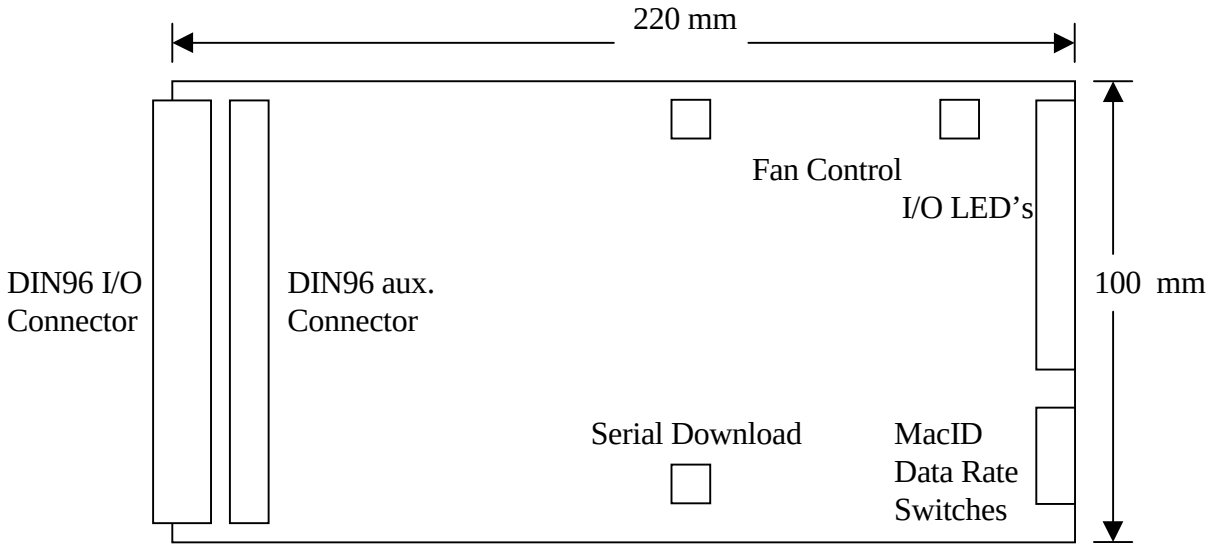
Onboard thermal management provides constant temperature monitoring and autonomous control for an external fan signal.

A configuration object (Class 64) allows the unit to be configured to provide a variable number of digital inputs and digital outputs.

The CDN391 includes the CCO object extensions to allow simple control programs to be loaded onto the unit that can operate independently from the DeviceNet control functions.

Hardware

The CDN391 is implemented on a 100 mm X 220 mm 3U Euro card. The module includes a 96 pin DIN connector for the I/O interface and switches and indicators for front panel control and monitoring.



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CDN391 DEVICE

Processor

The CDN391 is implemented using a Siemans C505 processor and WSI PSD813F memory component which provides RAM (2K bytes), Flash (128 Kbytes) and E2PROM (64 Kbytes). The hardware platform supports downloadable application code through a internal J-tag or asynchronous serial connection port. The processor power on reset/monitoring is implemented with an external DS1232 power monitor. An internal DS1620 temperature monitor is provided for external fan control and internal temperature monitoring.

The processor section is powered from an isolated DC-DC power supply powered from the regulated +5 Vdc derived from the DeviceNet power. The Processor section is isolated from the DeviceNet and Digital I/O.

DeviceNet Interface

The DeviceNet interface is isolated through HCPL0710 opto couplers to an 82C251 CAN transceiver. The Can transceiver is powered from a DC-DC converter driven by the DeviceNet power. The DeviceNet signals are routed to the DIN96 I/O connectors and an auxiliary 5 pin header.

Rotary switches accessible from the front of the card select the MacID and Baud Rate. The switch contacts are brought out in parallel to the DIN96 I/O connector for back plane configuration options. If the back plane configuration option is to be used all switches must be set to the '0' position.

Standard Red/Green DeviceNet Network and Module status LED's are mounted on the front of the board.

Digital I/O

The Digital I/O is optically coupled to the processor. The active low MIC59P60 output drivers are interfaced through a serial bit interface. The individual outputs will support up to 200 mA loads per channel. Based on package dissipation the maximum fully loaded output current is 100 mA (8 outputs) at 50 ^{o}C ambient. Each output is thermally protected for short circuit (500 mA typically) and includes under voltage protection. The output Fault State is accessible through software. External schottky diodes are provided for output transient protection and each I/O point is protected with a self-resetting poly fuse rated for 200 mA. Outputs default to the OFF condition during power up and processor reset conditions.

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The digital output read back signals (inputs) are active low, with current limiting resistors setting the short circuit current to 6 mA at 24 Vdc. The inputs are designed to retain the OFF State with currents below 2 mA and to ensure an ON state with currents above 4 mA. Each input circuit includes an indicator LED in series with the detection opto coupler. Both the detection opto coupler and the indicator LED are protected with a shunt diode against reverse voltage breakdown.

The digital I/O circuitry is powered from an external +24 Vdc power source. The control power for the output drivers is derived from a linear +12 Vdc regulator. An optically coupled signal is provided to the processor to allow detecting when the +24 Vdc signal drops below 18 Vdc. The +24 Vdc power is protected with a self-resetting poly fuse rated at 2.5 Amps and a 36 transient suppressor.

The digital I/O signals and +24 Vdc power is connected directly to the DIN96 I/O connector. An LED indicator on the front of the module indicates when the digital power (> +18 Vdc) is applied.

Thermal Management

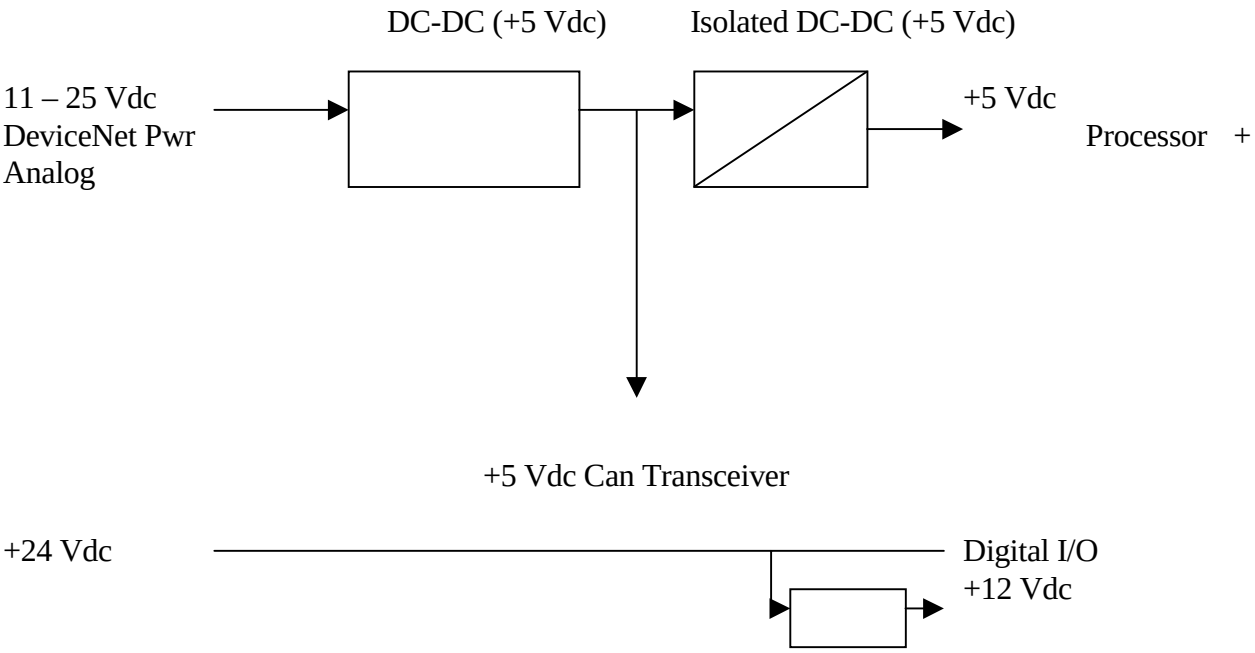
The CDN391 includes a DS1620 thermal monitoring and control circuit that provides the ambient temperature in degrees Celsius. An external isolated output is provided on the DIN96 connector and the FAN control connectors that are activated when the temperature exceeds a user settable threshold (Fan output). Full hysteresis control is provided on the output signal that operates independently from the processor.

Power Distribution

Power for the module is derived from the DeviceNet power (11 – 25 Vdc). Isolated DC-DC converters are used to derive secondary power requirements and to maintain isolation between the subsystems. The Digital I/O circuitry is fully isolated from the Processor and Analog I/O and is powered by an external +24 Vdc source.

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CDN391 DEVICE



Switches and Indicators

The CDN391 includes 48 Green I/O status LED's which are wired directly to the I/O points. The LED is ON if the corresponding I/O point is ON.

Two DeviceNet indicators are provided, Network Status and Device Status per the ODVA DeviceNet specification.

A power indicator is provided to indicate when adequate voltage has been applied to the +24 Vdc power used for digital I/O.

Two BCD switches are provided to allow setting the MacID. Values greater than 63 result in the switch being disabled and the last valid switch value will be used. The switches are read only during power up.

A BCD switch is provided to allow setting the Data Rate. Values greater than 2 result in the switch being disabled and the last valid switch value will be used. The switch is read only during power up.

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CDN391 DEVICE

Connectors

The CDN391 has 4 connector sets: a DIN96 set for I/O and DeviceNet signals, 2 fan support connectors, a serial interface (download support) and a J-TAG interface. Pin 1 of all connectors is identified using a square pad. All other pins use round pads.

Fan Control

Two connectors are provided for an external FAN (P4, P5) to allow supplying separate fan power. The fan power return is common to the digital I/O 24VCOM return path.

When the monitored board temperature exceeds the threshold set by Class 64, Attribute 9 (High setpoint) the FAN output goes active (low). When the temperature drops below the threshold set by Class 64, Attribute 8 (Low Setpoint) the FAN output goes inactive (high impedance).

The FAN output is capable of driving 100 mA @ 24 Vdc.

J4 Pin	Function
1	FAN_POWER – connects to J5-2
2	24VCOM

J5 Pin	Function
1	FAN_OUTPUT – also connects to DIN96 row B, pin 25
2	FAN_POWER – connects to J4-1

J-Tag Connector

A J-Tag connector (P2) pattern is supported for future options. This connector is not populated or supported at this time.

Asynchronous Download Port

An asynchronous serial channel (19.2 Kbaud) is provided to allow downloading future application firmware if required. This channel uses TTL level signals. A DIP064 TTL to RS232 interface assembly may be required.

DO NOT CONNECT THIS PORT DIRECTLY TO RS232 SIGNALS.

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CDN391 DEVICE

P1 Pin	Function
1	SER_TX – data transmitted from CDN391 – TTL Levels
2	SER_RX – data transmitted to CDN391 – TTL Levels
3	SER_COM – common return (processor ground)

DIN96 Connector

The CDN391 has a dual set of DIN96 connectors. One connector is mounted co-planer to the board and designed to mate to a back panel connector. The second connector is mounted at right angles to the board and is designed to allow the CDN391 to mount as a daughter board.

The pinout for the two DIN96 connectors is identical.

DIN CONN A ROW		DIN CONN B ROW		DIN CONN C ROW	
PIN #	FUNCTION	PIN #	FUNCTION	PIN #	FUNCTION
A1	DI/O 1	B1	RESERVED	C1	DI/O 0
A2	DI/O 3	B2	RESERVED	C2	DI/O 2
A3	DI/O 5	B3	RESERVED	C3	DI/O 4
A4	DI/O 7	B4	RESERVED	C4	DI/O 6
A5	DI/O 9	B5	RESERVED	C5	DI/O 8
A6	DI/O 11	B6	RESERVED	C6	DI/O 10
A7	DI/O 13	B7	RESERVED	C7	DI/O 12
A8	DI/O 15	B8	RESERVED	C8	DI/O 14
A9	DI/O 17	B9	RESERVED	C9	DI/O 16
A10	DI/O 19	B10	Fan Output	C10	DI/O 18
A11	DI/O 21	B11	**BAUD RATE 0 ***	C11	DI/O 20
A12	DI/O 23	B12	**BAUD RATE 1 ***	C12	DI/O 22
A13	DI/O 25	B13	**MACID 0 ***	C13	DI/O 24
A14	DI/O 27	B14	**MACID 1 ***	C14	DI/O 26
A15	DI/O 29	B15	**MACID 2 ***	C15	DI/O 28
A16	DI/O 31	B16	**MACID 3 ***	C16	DI/O 30
A17	DI/O 33	B17	**MACID 4 ***	C17	DI/O 32
A18	DI/O 35	B18	**MACID 5 ***	C18	DI/O 34
A19	DI/O 37	B19	**MACID 6 ***	C19	DI/O 36
A20	DI/O 39	B20	**CONFIG COMM ***	C20	DI/O 38
A21	DI/O 41	B21	**DNET V- ***	C21	DI/O 40
A22	DI/O 43	B22	**DNET CAN H ***	C22	DI/O 42
A23	DI/O 45	B23	**DNET CAN L ***	C23	DI/O 44
A24	DI/O 47	B24	**DNET V+ ***	C24	DI/O 46
A25	24VCOM	B25	SHIELD	C25	24VCOM
A26	24VCOM	B26	24VCOM	C26	24VCOM
A27	24VCOM	B27	24VCOM	C27	24VCOM
A28	24VCOM	B28	24VCOM	C28	24VCOM
A29	24VCOM	B29	**24VCOM ***	C29	24VCOM

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A30	24VCOM	B30	**24VCOM ***	C30	24VCOM
A31	24VCOM	B31	**24V ***	C31	24VCOM
A32	24VCOM	B32	**24V ***	C32	24VCOM

User Jumpers

Jumper JP1 allows the user to connect the Bus Shield signal through a 0.01 uF/1 meg resistor circuit to a mounting hole. Alternatively, a cable assembly can be connected to the jumpers to provide a hard earth ground connection.

Manufacturing Jumpers

The following jumpers are 'hardwired' during manufacturing.

24V Source

Jumper JP5 (installed) connects the 24V signal from the DIN96 I/O connector to the digital +24 Vdc power.

Test Points

Two test points are identified on the module.

Test Point	Function
TP1	Digital I/O Ground
TP2	Processor Ground

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Specifications

Specification	Min	Typ.	Max	Description/notes
DeviceNet				ISO 11898 transceiver, optically coupled
MacID	0		63	Hardware settable (switch/backplane), Software settable
Data Rate	125		500	Kbit/second, hardware or software settable
Vpwr	11		25	Vdc
Ipwr		250	400	mA at 24 Vdc
Digital Inputs				24 Channels, linked to Digital Outputs
Ion	-4			mA
Ioff			-2	mA – Corresponding output must be in OFF state
Vin	-1		28	Vdc
Digital Outputs				24 Channels, linked to Digital Inputs
Ion		100	200	Individual channels will drive up to 200 mA. Dissipation should be limited to 800 mA for each group of 8 channels, averaging 100 mA / channel.
Ioff			.1 mA	Off leakage current for voltages less than V_{DIO}
V_{OL}		.9 1.1	1.1 1.2	@ 100 mA load @ 200 mA load
Digital Power				
V_{DIO}	18	24	28	Vdc.
I_{DIO}		40		mA + 6 mA / active I/O point
Fan Output				
Vol			1	Vdc @ 100 mA
Voh			28	Vdc (off condition)
Ion			100	MA @ 24 Vdc

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Firmware

The CDN391 supports DeviceNet using ODVA standard Digital Input Points (DIP's) and Digital Output Points (DOP's). The unit operates as a group II Slave. Additional objects include a User Defined configuration object and a set of Combinatorial Control Objects (CCO) that allow control programs to be executed directly on the module.

DeviceNet Message Types

The CDN391 supports the following Group 2 message types.

CAN IDENTIFIER	GROUP 2 Message Type
10xxxxxx111	Duplicate MACID Check Message
10xxxxxx110	Unconnected Explicit Request Message
10xxxxxx101	Master I/O Poll Command Message
10xxxxxx100	Master Explicit Request Message

xxxxxx = Node Address

The CDN391 supports the Group 4 Offline Connection set.

CAN IDENTIFIER	GROUP 2 Message Type
11111101100	Communication Faulted Response Message
11111101101	Communication Faulted Request Message
11111101110	Communication Ownership Response Message
11111101111	Communication Ownership Request Message

DeviceNet Class Services

The CDN391 supports the following class services and instance services.

SERVICE CODE	SERVICE NAME
05 (0x05)	Reset
14 (0x0E)	Get Attribute Single
16 (0x10)	Set Attribute Single
75 (0x4B)	Allocate Group 2 Identifier Set
76 (0x4C)	Release Group 2 Identifier Set

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DeviceNet Object Classes

The CDN391 device supports the following DeviceNet object classes.

CLASS CODE	OBJECT TYPE
01 (0x01)	Identity
02 (0x02)	Router
03 (0x03)	DeviceNet
04 (0x04)	Assembly
05 (0x05)	Connection
08 (0x08)	Digital Input Point
09 (0x09)	Digital Output Point
50 (0x32)	Device Supervisor Object
64 (0x40)	Configuration Object
80 (0x50)	Virtual Processor Object *
81 (0x51)	Counter Object *
82 (0x52)	Timer Object *
83 (0x53)	Comparator Object *

Refer to the D.I.P. CCO Support documentation for further information on CCO control functions.

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Identity Object — Class Code: 01 (0x01)

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

Identity Object Class Attributes

Attribute	Access	Name	Type	Value
1	Get	Revision	UINT	1
2	Get	Max Object Instance	UINT	1
6	Get	Max Class Identifier	UINT	7
7	Get	Max Instance Attribute	UINT	7

Identity Object Instance Attributes

Attribute	Access	Name	Type	Value
1	Get	Vendor	UINT	59
2	Get	Product Type	UINT	0 = Generic Device
3	Get	Product Code	UINT	6256
4	Get	Revision	STRUCT OF	
		Major Revision	USINT	
		Minor Revision	USINT	
5	Get	Device Status	UINT	
6	Get	Serial Number	UINT	
7	Get	Product Name	STRUCT OF	
		Length	USINT	6
		Name	STRING [6]	CDN391
8	Get	State	USINT	

Identity Object Common Services

Service Code	Class	Instance	Service Name
05 (0x05)	No	Yes	Reset
14 (0x0E)	Yes	Yes	Get_Attribute_Single

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Identity Object Attributes

Product Code – Attribute 3

The Product code is fixed at 6256 for the CDN391. The product code is used within the Electronic Data Sheet format to uniquely identify the product type.

Revision Information – Attribute 4

D.I.P. maintains strict version control. The major revision number will increment as functional enhancements are implemented. The minor firmware revision control number is incremented if minor changes are incorporated.

Device Status – Attribute 5

Bit Number	Name	Meaning
0	Owned	= 0, not owned = 1, allocated
1	Reserved	
2	Configured	= 0, not configured – this bit is not supported
3	Reserved	
4-7	User defined	
8	Minor Recoverable fault	= 0, no fault = 1, minor recoverable faults (DOP short circuit)
9	Minor Unrecoverable fault	= 0, no fault = 1, minor unrecoverable faults
8	Major Recoverable fault	= 0, no fault = 1, major recoverable faults (Loss of +24 Vdc)
9	Major Unrecoverable fault	= 0, no fault = 1, major unrecoverable faults (Checksum)
12-15	Reserved	

Serial Number – Attribute 6

The serial number is encoded in the product during the manufacturing cycle and is guaranteed to be unique across all product lines produced by D.I.P.

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CDN391 DEVICE

Device Name – Attribute 7

The DeviceName provides a character arry containing the short string CDN391.

Device State – Attribute 8

The Device State reflects whether any errors have occurred and the severity. The following states are supportted. The only exit from a Major Unrecoverable fault condition is power cycling the device.

State	Interpretation	Causes
0	Non-existent	
1	Self Test	
2	Standby	
3	Operating	Normal operating mode
4	Major Recoverable fault	Loss of +24 Vdc power
5	Major Unrecoverable fault	Memory Checksum failure

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Router Object — Class Code: 02 (0x02)

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.

Router Object Class Attributes

Attribute	Access	Name	Type	Value
1	Get	Revision	UINT	1
6	Get	Max Class Identifier	UINT	7
7	Get	Max Instance Attribute	UINT	2

Router Object, Instance 1 Attributes

Attribute	Access	Name	Type	Value
2	Get	Number of Connections	UINT	2

Router Object Common Services

Service Code	Class	Instance	Service Name
14 (0x0E)	Yes	Yes	Get_Attribute_Single

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DeviceNet Object Class Code: 03 (0x03)

The DeviceNet Object defines how the node interfaces to the DeviceNet system.

DeviceNet Object Class Attributes

Attribute	Access	Name	Type	Value
1	Get	Revision	UINT	1

DeviceNet Object, Instance 1 Attributes

Attribute	Access	Name	Type	Value
1	Get/Set	MACID	USINT	(1)
2	Get/Set	Baud Rate	USINT	(2)
3	Get/Set	Bus Off Interrupt	BOOL	(3)
4	Get/Set	Bus Off Counter	USINT	(4)
5	Get/Spc	Allocation Information	STRUCT of	(5)
		Choice Byte	BYTE	
		Master Node Addr.	USINT	
6	Get	Mac Switch Changed	BOOLEAN	
7	Get	Baud Switch Changed	BOOLEAN	
8	Get	Current Mac Switch	USINT	
9	Get	Current Baud Switch	USINT	

DeviceNet Object Common Services

Service Code	Class	Instance	Service Name
14 (0x0E)	Yes	Yes	Get_Attribute_Single
16 (0x10)	No	Yes	Set_Attribute_Single
75 (0x4B)	No	Yes	Allocate Master/Slave
76 (0x4C)	No	Yes	Release Master/Slave

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DeviceNet Object Attributes

MacID – Attribute 1

The MACID is set using two BCD rotary switches located on the front panel. Valid MACID addresses are 0 to 63 (0 to 3F Hex). Setting the switch address to a value greater than 63 will disable the switch and allow software setting of the MACID. The software setting defaults to the last hardware setting. The switch is only read during power up.

The MacID may also be set through connections on the DIN96 I/O connections (B13-B20). These active low inputs form a BCD encoded value in the range 00 – 79. Connecting an input signal (B13..B19) to the Config Common (B20) signal turns the corresponding bit 'ON'.

Data Rate – Attribute 2

The Data Rate is set using a BCD rotary switch located on the front panel. Valid Data Rates are 0 to 2. Setting the switch address to a value greater than 2 will disable the switch and allow software setting of the Data Rate. The software setting defaults to the last hardware setting. The switch is only read during power up.

The Data Rate may also be set through connections on the DIN96 I/O connections (B11-B12). These active low inputs form a BCD encoded value in the range 00 – 2. Connecting an input signal (B11..B12) to the Config Common (B20) signal turns the corresponding bit 'ON'.

Bus Off Interrupt – Attribute 3

Bus Off Interrupt (BOI) determines the action if a Bus Off state is encountered.

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

Bus Off Counter – Attribute 4

Bus Off Counter will be forced to 0 whenever set regardless of the data value provided.

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Allocation Byte – Attribute 5

Allocation_byte

bit 0	explicit set to 1 to allocate
bit 1	polled set to 1 to allocate
bit 2-7	reserved (always 0)

Mac Switch Changed – Attribute 6

The Mac Switch Changed flag will be set if the Mac Switch has changed since the last power up sequence. Note that if the Mac Switch is set in the 'disabled' or 'program' position it is considered to be removed from the circuit and reading this attribute will result in an 'Attribute Not Supported' error response.

Baud Switch Changed – Attribute 7

The Baud Switch Changed flag will be set if the Baud Switch has changed since the last power up sequence. Note that if the Baud Switch is set in the 'disabled' or 'program' position it is considered to be removed from the circuit and reading this attribute will result in an 'Attribute Not Supported' error response.

Mac Switch Value – Attribute 8

The Mac Switch Value attribute returns the actual state of the Mac Switch. Note that if the Mac Switch is set in the 'disabled' or 'program' position it is considered to be removed from the circuit and reading this attribute will result in an 'Attribute Not Supported' error response.

Baud Switch Value – Attribute 9

The Baud Switch Value attribute returns the actual state of the Baud Switch. Note that if the Baud Switch is set in the 'disabled' or 'program' position it is considered to be removed from the circuit and reading this attribute will result in an 'Attribute Not Supported' error response.

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Assembly Object Class Code: 04 (0x04)

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.

Assembly Object Class Attributes

Attribute	Access	Name	Type	Value
1	Get	Revision	UINT	1
2	Get	Max Class ID	UINT	101

Assembly Object, Instance 100 Attributes

Attribute	Access	Name	Type	Value
3	Get	Data	STRUCT of	(1)
		Supervisor Status	BYTE	See Configuration Class
		Temperature	SINT	See Configuration Class
		Digital Inputs	BYTE[]	See Configuration Class

Assembly Object, Instance 101 Attributes

Attribute	Access	Name	Type	Value
3	Get/Set	Data	STRUCT of	(3)
		Digital Outputs	BYTE	See Configuration Class

Assembly Object Common Services

Service Code	Class	Instance	Service Name
14 (0x0E)	Yes	Yes	Get_Attribute_Single
16 (0x10)	No	Yes	Set_Attribute_Single

Assembly Instance 100

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Assembly instance 100 is used to generate the POLL response packet and consists of a variable number of bytes as determined by the configuration object.

Device Status

The Device Status byte, if included, provides overall information on the device as defined in the Device Supervisor object.

Operating Temperature

The Temperature value, if included, provides the current operating temperature of the module as defined in the Configuration object.

Digital Inputs

The digital input byte(s) provide information on the digital input states. The number of bytes included is defined in the configuration object.

Assembly Instance 101

Assembly instance 101 is used to consume the POLL request packet and consists of a variable number of digital output states.

Digital Outputs

The digital output byte(s) set the state of the digital outputs. The number of bytes included is defined in the configuration object.

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Connection Object Class Code: 05 (0x05)

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

Connection Object Class Attributes

Attribute	Access	Name	Type	Value
1	Get	Revision	UINT	1

Connection Object, Instance 1 Attributes (Explicit Message)

Attribute	Access	Name	Type	Value
1	Get	State	USINT	(1)
2	Get	Instance Type	USINT	0 = Explicit Message
3	Get	Transport Class Trigger	USINT	0x83
4	Get	Production Connection	UINT	(2)
5	Get	Consumed Connection	UINT	(2)
6	Get	Initial Comm. Char.	USINT	0x21
7	Get	Production Size	UINT	22
8	Get	Consumed Size	UINT	24
9	Get/Set	Expected Packet Rate	UINT	default 2500 msec
12	Get/Set	Timeout Action	USINT	(3)
13	Get	Prod. Path Length	USINT	0
14	Get	Production Path		(null)
15	Get	Cons. Path Length	USINT	0
16	Get	Consumed Path		(null)

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Connection Object, Instance 2 Attributes (POLL connection)

Attribute	Access	Name	Type	Value
1	Get	State	USINT	(1)
2	Get	Instance Type	USINT	1 = I/O Message
3	Get	Transport Class Trigger	USINT	0x83
4	Get	Production Connection	UINT	(2)
5	Get	Consumed Connection	UINT	(2)
6	Get	Initial Comm. Char.	USINT	0x1
7	Get	Production Size	UINT	See Configuration Class
8	Get	Consumed Size	UINT	See Configuration Class
9	Get/Set	Expected Packet Rate	UINT	default 2500 msec
12	Get/Set	Timeout Action	USINT	(3)
13	Get	Prod. Path Length	USINT	6
14	Get	Production Path	STRUCT of	
		Log. Seg., Class	USINT	0x20
		Class Number	USINT	0x04
		Log.Seg., Instance	USINT	0x24
		Instance Number	USINT	0x100
		Log.Seg., Attribute	USINT	0x30
		Attribute Number	USINT	0x03
15	Get	Cons. Path Length	USINT	6
16	Get	Consumed Path	STRUCT of	
		Log. Seg., Class	USINT	0x20
		Class Number	USINT	0x04
		Log.Seg., Instance	USINT	0x24
		Instance Number	USINT	0x101
		Log.Seg., Attribute	USINT	0x30
		Attribute Number	USINT	0x03

Connection Object Common Services

Service Code	Class	Instance	Service Name
05 (0x05)	Yes	Yes	Reset
14 (0x0E)	Yes	Yes	Get_Attribute_Single
16 (0x10)	No	Yes	Set_Attribute_Single

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Connection Object Attributes

Connection Status – Attribute 1

Connection State	Interpretation
0	Non-existent
1	Configuring
3	Established
4	Timed Out

Connection ID – Attribute 4 and 5

Connection 1 Produced Connection ID: 10xxxxxx011
Connection 1 Consumed Connection ID: 10xxxxxx100

Connection 2 Produced Connection ID: 01111xxxxxx
Connection 2 Consumed Connection ID: 10xxxxxx101

xxxxxx = Node Address.

Watch Dog Activity – Attribute 9

Watch Dog Timeout Activity:

0 = Timeout (I/O Messaging default)
1 = Auto Delete (Explicit Messaging, fixed value)
2 = Auto Reset

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Discrete Input Point (DIP) Object Class Code: 08 (0x08)

The Discrete Input Point (DIP) 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.

DIP Object Class Attributes

Attribute	Access	Name	Type	Value
1	Get	Revision	UINT	2
2	Get	Max Object Instance	UINT	64
6	Get	Max Class Identifier	UINT	7
7	Get	Max Instance Attribute	UINT	3

DIP Object, Instance 1..64 Attributes

Attribute	Access	Name	Type	Value
3	Get	Value	BOOL	0 == OFF, 1 == ON
4	Get	Status	BOOL	0 == okay, 1 == fault

DIP Object Common Services

Service Code	Class	Instance	Service Name
14 (0x0E)	Yes	Yes	Get_Attribute_Single

DIP Object Attributes

Input State – Attribute 3

Attribute 3 provides the state of the specific digital input. A value of 0 indicates an OFF state and a value of 1 indicates an ON state. The Digital inputs provide feedback of the digital output states. If the corresponding output state is set to 0 these points may be used as inputs.

Instance 1..48 correspond to physical inputs. Instance 49..64 are provided for use with CCO as intermediate registers.

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Input Status – Attribute 4

The Input status bit indicates if an error has occurred associated with a physical input. If the +24 Vdc power is not present the circuitry cannot accurately determine the state of the inputs and will set the Input Status bits of inputs 1..48 to 1.

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Discrete Output Point (DOP) Object Class Code: 09 (0x09)

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

DOP Object Class Attributes

Attribute	Access	Name	Type	Value
1	Get	Revision	UINT	1
2	Get	Max Object Instance	UINT	64
6	Get	Max Class Identifier	UINT	7
7	Get	Max Instance Attribute	UINT	8

DOP Object, Instance 1..64 Attributes

Attribute	Access	Name	Type	Value
3	Get/Set	Value	BOOL	State of Output
4	Get/Set	Status	BOOL	Status of Output
5	Get/Set	Fault State	BOOL	0=fault value, 1=no chg
6	Get/Set	Fault Value	BOOL	0=Off, 1=On
7	Get/Set	Idle State	BOOL	0=Idle value, 1=no chg
8	Get/Set	Idle Value	BOOL	0=Off, 1=On

DOP Object Common Services

Service Code	Class	Instance	Service Name
14 (0x0E)	Yes	Yes	Get_Attribute_Single
16 (0x10)	No	Yes	Set_Attribute_Single

DOP Object Attributes

Output State – Attribute 3

The digital outputs are active low. Setting a DOP state to 1 forces the corresponding output pin low. The state of each DOP may be read back using the DOP state or the corresponding

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DIP state. The DIP state reflects the state of the I/O pin. If an I/O point is to be used as an input the corresponding DOP state must be set to 0 (off).

Instance 1..48 correspond to physical outputs. Instances 49..64 are provided for use by CCO as intermediate registers.

Output Status – Attribute 4

The output status bit indicates a fault condition. The output status of instances 1..48 will be set to 1 if the I/O power drops below 18 Vdc or if a short circuit condition is detected on any of the outputs. The low voltage status bit may be read through Class 64, Instance 1, Attribute 7. Determining which particular output is shorted may done through examining the state of the individual DOP and corresponding DIP I/O points. If a DOP is ON and the corresponding DIP is OFF it indicates a short condition.

Fault State – Attribute 5

The Fault State determines what action is taken if a software fault condition is detected due to a connection timeout.

Fault State	Action Taken
0	Set the output to the stated determined by the Fault Value
1	Leave the output in the current state

Fault Value – Attribute 6

The Fault Value determines DOP output state if the Fault State is clear during a fault.

Idle State – Attribute 7

The Idle State determines what action is taken if an idle condition is detected. Idle conditions occur if a Poll request packet is received with less than the calculated number of bytes. Refer to the Configuration object to determine the size of the Poll Request packets. A poll request of 0 bytes is typically used to force an idle condition.

Idle State	Action Taken
0	Set the output to the stated determined by the Idle Value
1	Leave the output in the current state

Idle Value – Attribute 8

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The Fault Value is used to set the output if the Idle State bit is clear and an idle condition occurs.

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Device Supervisor Object Class Code: 50 (0x32)

The Device Supervisor object provides summary information on the Device.

Device Supervisor Object Class Attributes

Attribute	Access	Name	Type	Value
1	Get	Revision	UINT	1
2	Get	Max Object Instance	UINT	1
6	Get	Max Class Identifier	UINT	7
7	Get	Max Instance Attribute	UINT	16

Configuration Object, Instance 1 Attributes

Attribute	Access	Name	Type	Value
3	Get	Manufacturer Type	SSTRING	DIGITAL
4	Get	Semi Revision Level	SSTRING	E00-0000
5	Get	Manufacturer Name	SSTRING	D.I.P. Inc.
6	Get	Manufacturer Model	SSTRING	CDN391
7	Get	Software Revision	SSTRING	XX.YYY (see below)
8	Get	Hardware Revision	SSTRING	XX.YYY (see below)
11	Get	Device Status	USINT	See Below
12	Get	Exception Status	USINT	
13	Get	Exception Detail	STRUCT of	
		Common Detail	STRUCT of	
		Size	USINT	2
		Detail	BYTE[2]	
		Device Detail	STRUCT of	
		Device Size	USINT	20
		DIP Status	STRUCT of	
		Number DIP	USINT	64 == Number of DIP
		DIP Status	BYTE[8]	See Below
		DOP Status	STRUCT of	
		Number DOP	USINT	64 == Number of DOP
		DOP Status	BYTE[8]	See Below
		AIP Status	STRUCT of	
		Number AIP	USINT	0
		AOP Status	STRUCT of	

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		Number AOP	USINT	0
		Man. Detail	STRUCT of	
		Man. Detail Size	USINT	1
		Detail	BYTE	See Below
14	Get	Warning Detail	STRUCT of	
		Common Detail	STRUCT of	
		Common Size	USINT	2
		Common Detail	BYTE[2]	
		Device Detail	STRUCT of	
		Device Size	USINT	0
		Man. Detail	STRUCT of	
		Man. Size	USINT	1
		Man. Detail	USINT	See Below
15	Get/Set	Alarm Enable	BOOLEAN	
16	Get/Set	Warning Enable	BOOLEAN	

Device Supervisor Object Common Services

Service Code	Class	Instance	Service Name
14 (0x0E)	Yes	Yes	Get_Attribute_Single
16 (0x10)	No	Yes	Set_Attribute_Single

Device Supervisor Object Attributes

Manufacturer Model – Attribute 6

The Manufacturer Model string will be CDN391 based on the product code (see Identity Object, Class 1, Instance 1, Attribute 3).

Software Revision – Attribute 7

The Software Revision will be a text string of the Major and Minor revision information of the Identity object. It will have the format XX.YYY, where XX is the major revision and YYY is the Minor revision. The revision code will match that provided by the Identity object.

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Hardware Revision – Attribute 8

The Hardware Revision will be a text string reflecting the current revision of the hardware. It will have the format XX.YYY, where XX is the major revision and YYY is the Minor revision.

Device Status – Attribute 9

The Device Status reflects the current state of the Device Supervisor object.

Attribute Value	State
0	Undefined
1	Self Testing
2	Idle
3	Self-Test Exception
4	Executing
5	Abort
6	Critical Fault
7-50	Reserved – unused on CDN391
51-99	Device Specific – unused on CDN391
100-255	Vendor Specific – unused on CDN391

Exception Status – Attribute 12

The Exception status provides information on the current alarm and warning status of the device. This byte may be optionally reported as part of the Poll Response message. The byte provides a summary of the state of the Exception and Alarm Detail attributes and has the following interpretation.

Status Bit	Function
0	ALARM / Device Common
1	ALARM / Device Specific
2	ALARM / Manufacturer – specific
3	0
4	WARNING / Device Common
5	WARNING / Device Specific
6	WARNING / Manufacturer – specific
7	1 == Expanded Mode

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Exception Details – Attribute 13

The Exception Detail contains information on Common exception conditions, General Purpose I/O Device exception conditions and CDN391 specific exception conditions.

The General Purpose I/O Device exception conditions provide 4 nested structures containing status information from each of the available DIP and DOP object instances. For the CDN391 DIP and DOP structures each contain 48 *bits*.

For the AIP and AOP the number of status *bits* is 0.

Note that the status information is contained in a bit packed format. The number of bytes may be calculated as:

Number of bytes = ((number of status bits) + 7) / 8

The Manufacturer exception detail contains a single byte which reflects the state of the 4 error bits derived from the configuration object (Class 64, Instance 1, Attribute 7).

Warning Details – Attribute 14

The Warning Detail contains information on common warning conditions, General Purpose I/O Device exception conditions and CDN391 specific exception conditions.

The General Purpose I/O Device contains no warning status information.

The Manufacturer warning detail contains a single byte which reflects the state of the 4 warning bits derived from the configuration object (Class 64, Instance 1, Attribute 7). Note that the Temperature Low condition does not cause a warning condition.

Alarm Enable – Attribute 15

The Alarm enable bit enables the reporting of alarm conditions. Clearing this bit causes alarm bits to be cleared. Setting the bit causes the alarm monitoring to be enabled.

Warning Enable – Attribute 16

The Alarm enable bit enables the reporting of alarm conditions. Clearing this bit causes alarm bits to be cleared. Setting the bit causes the alarm monitoring to be enabled.

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Configuration Object Class Code: 64 (0x40)

The CDN391 poll request/response packets are large. In some applications it may be desired to reduce the packet size if not all the I/O channels are in use. The configuration object will adjust the poll request/response packet sizes. In addition, the configuration object gives access to several operational parameters such as power supply and temperature conditions.

Configuration Object Class Attributes

Attribute	Access	Name	Type	Value
1	Get	Revision	UINT	1
2	Get	Max Object Instance	UINT	1
6	Get	Max Class Identifier	UINT	7
7	Get	Max Instance Attribute	UINT	9

Configuration Object, Instance 1 Attributes

Attribute	Access	Name	Type	Value
1	Get/Set	Mode	USINT (1)	Configuration mode
2	Get/Set	Num Digital Input	USINT (1)	Poll response count
3	Get/Set	Num Digital Output	USINT (1)	Poll request count
4	Get/Set	Num Analog Input	USINT (1)	Fixed at 0
5	Get/Set	Num Analog Output	USINT (1)	Fixed at 0
6	Get	Operating Temperature	SINT	Degrees Celsius
7	Get/Set	Status Flags	USINT	Temp/volt flags
8	Get/Set	Lo Temp Threshold	SINT (2)	Degrees Celsius
9	Get/Set	Hi Temp Threshold	SINT (2)	Degrees Celsius

Configuration Object Common Services

Service Code	Class	Instance	Service Name
05 (0x05)	No	Yes	Reset
14 (0x0E)	Yes	Yes	Get_Attribute_Single
16 (0x10)	No	Yes	Set_Attribute_Single

NOTE 1: Changing the configuration object will cause the CONSUMED and PRODUCED size of the POLL connection to be changed. These values are retained in E2 memory and may only be set when the POLL connection is not in the RUNNING state.

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NOTE 2: Values retained in external temperaturing monitor non volatile storage.

Configuration Reset Service

The Reset service causes the device configuration to return to a preset condition. The Reset service accepts a single byte to determine the configuration desired following the reset command.

Reset Command Byte	Reset Description
0	Reset to provide full configuration (all I/O options included in Poll transactions)

The CDN391 configuration uses the following configuration setup.

Attribute	Value	Description
Mode	0C4H	Include DSUP and TEMP in poll response. No I/O updated between poll request and poll response.
Num Digital Input	48	Returns 6 bytes (48 bits) during POLL response
Num Digital Output	48	Expects 6 bytes (48 bits) during POLL request
Num Analog Input	0	Returns 0 bytes during POLL response
Num Analog Output	0	Expects 0 bytes during POLL request

Configuration Object Attributes

Mode Byte – Attribute 1

The Mode byte determines the format of the POLL request and response packets and the overall operation of the unit during the I/O scanning function. The Mode byte consists of three bits with the following interpretation. Bits 0..1, 3..5 should be set to 0.

Bit 7	Bit 6	Bit5	Bit4	Bit3	Bit 2	Bit 1	Bit 0
IncludeDSUP	IncludeTEMP	0	0	0	NoPollUpdate	0	0

If the NoPollUpdate bit is set then the I/O is not updated between the POLL REQUEST and the POLL RESPONSE operations. Digital input data will reflect data collected immediately prior to the current Poll request. Digital output data will be updated after the POLL RESPONSE is generated. Note that data aging is ~ 2 msec.

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If the IncludeTEMP bit is set the current operating temperature is included in the POLL response. The Temperature is presented as a signed, 8 bit value, indicating the current temperature in degrees Celsius.

If the IncludeDSUP bit is set the POLL response will include the Device Supervisor Status information in the Poll response.

Num Digital Input – Attribute 2

The Num Digital Input attribute determines the number of input channels to be returned in the POLL RESPONSE packet. The maximum number 64 bits. The number of poll response bytes can be calculated as:

Number of bytes = ((number of channels) + 7) / 8

Num Digital Output – Attribute 3

The Num Digital Output attribute determines the number of output bytes to be processed in the POLL REQUEST packet. The maximum number is 64 bits. The number of poll response bytes can be calculated as:

Number of bytes = ((number of channels) + 7) / 8

Num Analog Input – Attribute 4

The Num Analog Input attribute must be set to 0.

Num Analog Output – Attribute 5

The Num Analog Output attribute must be set to 0.

Operating Temperature – Attribute 6

The current operating temperature of the CDN391 may be read as an 8 bit signed value, indicating temperature in degrees Celsius.

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Status Flags – Attribute 7

The status flag bits include two flags to indicate whether a temperature extreme has ever been experienced and the current status of the +24 Vdc monitoring used for the digital I/O power.
The lower 4 bits are considered error conditions and are reported as part of the Device Supervisor Exception Detail information (Class 50, Instance 1, Attribute 13). The upper 4 bits are considered warning conditions and are reported as part of the Device Supervisor Warning Detail information (Class 50, Instance 1, Attribute 14).

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Temp Hi Flag	Temp Lo Flag	0	0	0	0	+24V Fault

The Temp Hi Flag is set if the temperature has ever exceeded the high temperature threshold. Writing a 0 in the corresponding bit position of the Status Flag attribute will clear the flag bit. The Temp Hi flag status is reported as part of the Device Supervisor Manufacturer specific warning flags.

The Temp Lo Flag is set if the temperature has ever been less than the low temperature threshold. Writing a 0 in the corresponding bit position of the Status Flag attribute will clear the flag bit. The Temp Lo Flag is not reported as part of the Device Supervisor warnings.

The +24V Fault flag is set if the +24 Vdc power for the Digital I/O drops below 18 Vdc. The flag bit will only clear if the +24V power is restored. The failure of the +24 V power is considered a Major Recoverable Fault condition and will be reflected in the Identity object and Device Supervisor object.

Lo Threshold – Attribute 8

The Lo Temperature threshold determines at what temperature the FAN output should shut off. It is presented as a signed, 8 bit value measuring degrees Celsius.

Hi Threshold – Attribute 9

The Hi Temperature threshold determines at what temperature the FAN output should turn on. It is presented as a signed, 8 bit value measuring degrees Celsius. If the on board temperature exceeds this threshold the FAN output will become active and will remain active until the temperature drops below the Lo Threshold temperature.

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Poll Packet Sizes

The Poll Request and Response formats are determined by the configuration class attributes.

[DOUT(0..8)]

DOUT will be 0..8 bytes, determined by the Num Digital Output attribute.

[DSUP] [TEMP] [DIN(0..8)]
DSUP will be 1 byte, determined by Mode IncludeDSUP bit
TEMP will be 1 byte, determined by Mode IncludeTEMP bit
DIN will be 0..8 bytes, determined by the Num Digital Input attribute.

If the Num Digital Output is 0 then the CONSUMED SIZE for the POLL connection will be 0. In this case there is no POLL IDLE condition.

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