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# CDN491
# DEVICENET
# SPECIFICATIONS

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# Revision History

| Revision | Description of changes | Date |
|---|---|---|
| | | |
| 1.0 | First Release | 6/1/1999 |
| | | |
| | | |
| | | |
| | | |



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# DN491 Overview

The CDN491 (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 CDN491 device supports 48 digital outputs with read-back capability.

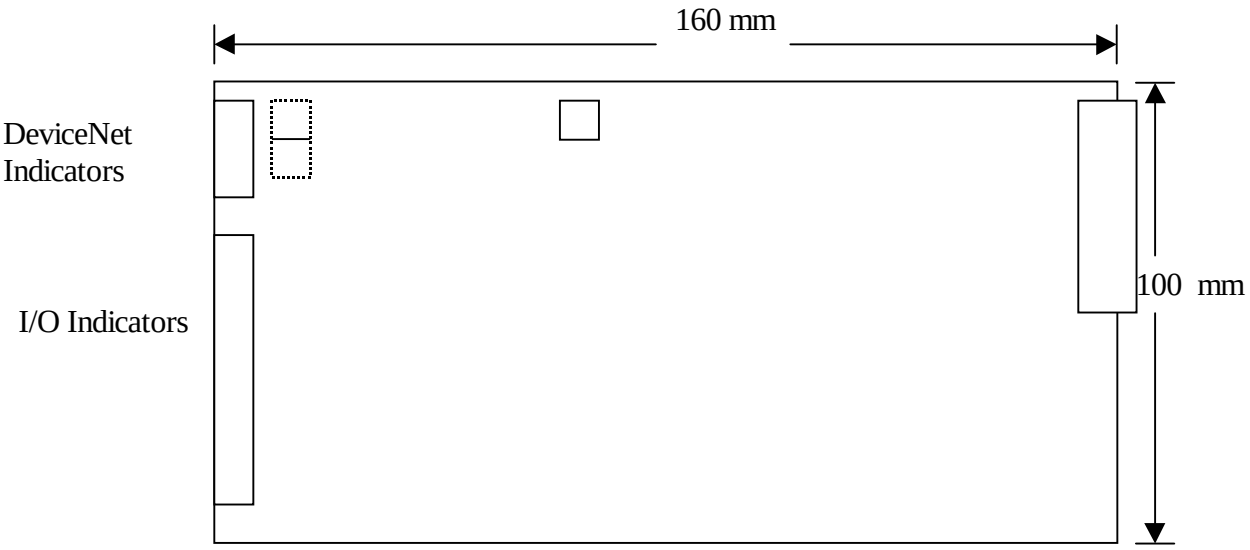
Onboard thermal management provides constant temperature monitoring and autonomous control for an external fan signal.

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

The CDN491 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 CDN491 are implemented on a 100 mm X 160 mm 3U Euro card. The module includes a cPCI connector for I/O and switches and indicators for front panel control and monitoring.




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# CDN491 DEVICE

## Processor

The CDN491 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 an 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 CPCI I/O connectors and an auxiliary 5 pin header.

Optional rotary switches may be mounted on the card to select the MacID. Jumpers may be installed to select the Baud Rate. The switch and jumper contacts are brought out in parallel to the CPCI I/O connector for back plane configuration options. If the back plane configuration option is to be used all board jumpers must be removed and the 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 CPCI I/O connector. An LED indicator on the front of the module indicates when the digital power ( > +18 Vdc) is applied.

**Thermal Management**

The CDN491 includes a DS1620 thermal monitoring and control circuit that provides the ambient temperature in degrees Celsius. An external isolated output is provided on the CPCI connector that is 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.

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.

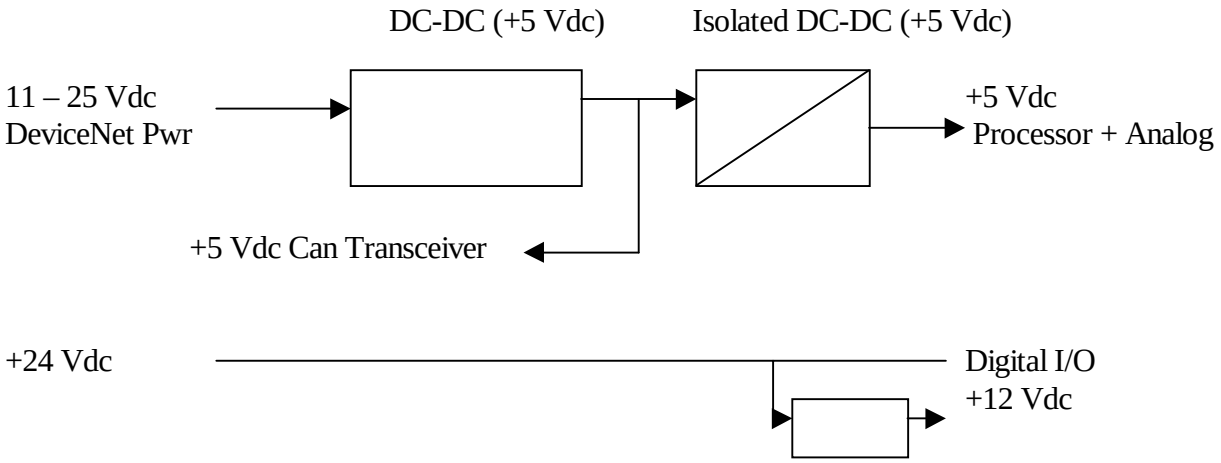
**Power Distribution**

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 is powered by an external +24 Vdc source.



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# CDN491 DEVICE




**Switches and Indicators**

The CDN491 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.

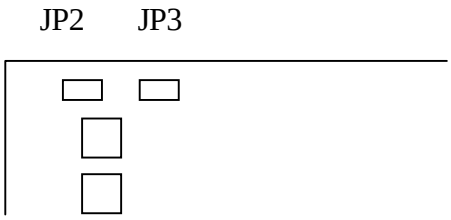
**MacID/BaudRate Option 1**

Two optional BCD switches (S5 and S6) may be installed on the board to allow setting the MacID. These switches are positioned horizontally on the board and require that the unit be removed from the card rack for adjustment. 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.



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Two optional jumbers may be installed on the board to allow setting the Data Rate. Installing both jumpers results in the jumpers being disabled and the last valid baud rate value will be used. The jumper settings are read only during power up.




| Switch | Function |
|---|---|
| S4 | MSD of MacID |
| S5 | LSD of MacID |

**MacID/BaudRate Option 2**

Two optional BCD switches S1 (MSD) and S2 (LSD) may be installed on the board to allow setting the MacID. These switches are positioned to allow front panel access. 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.

An optional BCD switch S3 may be installed on the board to allow setting the Baud Rate. This switch is positioned to allow front panel access. Values greater than 2 result in the switch being disabled and the last valid switch value will be used. The switches are read only during power up.

| Switch | Function |
|---|---|
| S2 | MSD of MacID |
| S3 | LSD of MacID |
| S6 | BaudRate |



**Connectors**

The CDN491 has 2 connector sets: a CPCI set for I/O and DeviceNet signals and a serial interface (download support). Pin 1 of all connectors is identified using a square pad. All other pins use round pads.



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# CDN491 DEVICE

### 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.

| P1 Pin | Function |
|---|---|
| 1 | SER_TX – data transmitted from CDN491 – TTL Levels |
| 2 | SER_RX – data transmitted to CDN491 – TTL Levels |
| 3 | SER_COM – common return (processor ground) |

### CPCI Connector

The CDN491 has a CPCI connector installed in the J2 position.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Z | A | B | C | D | E | F |
| 22 | cPCI_GND | MacID 4 / GID 4 | MacID 3 / GID 3 | MacID 2 / GID 2 | MacID 1 / GID 1 | MacID 0 / GID 0 | cPCI_GND |
| 21 | cPCI_GND | Reserved | Reserved | Reserved | Reserved | Reserved | cPCI_GND |
| 20 | cPCI_GND | | | | | | cPCI_GND |
| 19 | cPCI_GND | DI/O 44 | DI/O 45 | DI/O 46 | DI/O 47 | | cPCI_GND |
| 18 | cPCI_GND | DI/O 39 | DI/O 40 | DI/O 41 | DI/O 42 | DI/O 43 | cPCI_GND |
| 17 | cPCI_GND | DigSignCom | DigSignCom | DigSignCom | DigSignCom | DigSignCom | cPCI_GND |
| 16 | cPCI_GND | DI/O 34 | DI/O 35 | DI/O 36 | DI/O 37 | DI/O 38 | cPCI_GND |
| 15 | cPCI_GND | DI/O 29 | DI/O 30 | DI/O 31 | DI/O 32 | DI/O 33 | cPCI_GND |
| 14 | cPCI_GND | DI/O 24 | DI/O 25 | DI/O 26 | DI/O 27 | DI/O 28 | cPCI_GND |
| 13 | cPCI_GND | DigSignCom | DigSignCom | DigSignCom | DigSignCom | DigSignCom | cPCI_GND |
| 12 | cPCI_GND | | | | | | cPCI_GND |
| 11 | cPCI_GND | | | | | | cPCI_GND |
| 10 | cPCI_GND | DI/O 20 | DI/O 21 | DI/O 22 | DI/O 23 | | cPCI_GND |
| 9 | cPCI_GND | DigSignCom | DigSignCom | DigSignCom | DigSignCom | DigSignCom | cPCI_GND |
| 8 | cPCI_GND | DI/O 15 | DI/O 16 | DI/O 17 | DI/O 18 | DI/O 19 | cPCI_GND |
| 7 | cPCI_GND | DI/O 10 | DI/O 11 | DI/O 12 | DI/O 13 | DI/O 14 | cPCI_GND |
| 6 | cPCI_GND | DI/O 5 | DI/O 6 | DI/O 7 | DI/O 8 | DI/O 9 | cPCI_GND |
| 5 | cPCI_GND | DI/O 0 | DI/O 1 | DI/O 2 | DI/O 3 | DI/O4 | cPCI_GND |
| 4 | cPCI_GND | 24V | 24Vret | 24V | 24Vret | FAN OUTPUT | cPCI_GND |
| 3 | cPCI_GND | MacID 5 | MacID 6 | CONFIG COMM | BAUD RATE 0 | BAUD RATE 1 | cPCI_GND |
| 2 | cPCI_GND | DNet V+ | DNet CAN H | SHLD | DNet CAN L | DNet V- | cPCI_GND |
| 1 | cPCI_GND | 3.3V | 3.3V | 3.3V | 5V | 5V | cPCI_GND |



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# CDN491 DEVICE

**User Jumpers**

Jumper JP1 allows the user to connect the Bus Shield signal through a 0.01 uF/1 meg resistor circuit to a chassis ground.

**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<br>1.1 | 1.1<br>1.2 | @ 100 mA load<br>@ 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 CDN491 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 CDN491 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 CDN491 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 CDN491 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 CDN491 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 | 7856 |
| 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] | CDN491 |
| 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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# CDN491 DEVICE

### Identity Object Attributes

### Product Code – Attribute 3

The Product code is fixed at 7856 for the CDN491. 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<br>= 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<br>= 1, minor recoverable faults (DOP short circuit) |
| 9 | Minor Unrecoverable fault | = 0, no fault<br>= 1, minor unrecoverable faults |
| 8 | Major Recoverable fault | = 0, no fault<br>= 1, major recoverable faults (Loss of +24 Vdc) |
| 9 | Major Unrecoverable fault | = 0, no fault<br>= 1, major unrecoverable faults (Checksum, A/D) |
| 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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# CDN491 DEVICE

**Device Name – Attribute 7**

The DeviceName provides a character array containing the short string CDN491.

**Device State – Attribute 8**

The Device State reflects whether any errors have occurred and the severity. The following states are supported. 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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# CDN491 DEVICE

**DeviceNet Object Attributes**

**MacID – Attribute 1**

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

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

**Data Rate – Attribute 2**

The Data Rate is set using a two jumpers on the module. Valid Data Rates are 0 to 2. Setting both jumpers will disable the jumper settings and allow software setting of the Data Rate. The software setting defaults to the last hardware setting. The jumpers are only read during power up.

The Data Rate may also be set through connections on the CPCI I/O connections. These active low inputs form a encoded value in the range 0 – 2. Connecting an input signal to the Config Common 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**

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.



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### 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 as determined by the configuration object.

### 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 | 30 |
| 8 | Get | Consumed Size | UINT | 35 |
| 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. Instances 49..64 are mapped to internal control registers for use in CCO application programs. These instances will reflect the state last written to digital output instances 49..64.



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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. The status bits are cleared when the +24 Vdc power is restored.



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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 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).



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Instance 1..48 correspond to physical outputs. Instances 49..64 are mapped to internal control registers for use in CCO application programs. These instances will reflect the state last written to digital output instances 49..64.

**Output Status – Attribute 4**

The output status bit indicates a fault condition. The output status 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 the state of the DOP output if the Fault State bit is clear and a fault condition occurs.

**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 |



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**Idle Value – Attribute 8**

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 | CDN491 |
| 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 | 18 |
| | | DIP Status | STRUCT of | |
| | | Number DIP | USINT | 64 == Number of DIP |
| | | DIP Status | BYTE[4] | See Below |
| | | DOP Status | STRUCT of | |
| | | Number DOP | USINT | 64 == Number of DOP |
| | | DOP Status | BYTE[4] | See Below |
| | | AIP Status | STRUCT of | |
| | | Number AIP | USINT | 0 |



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| | | | | |
|---|---|---|---|---|
| | | AOP Status | STRUCT of | |
| | | 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 CDN491.

**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 CDN491 |
| 51-99 | Device Specific – unused on CDN491 |
| 100-255 | Vendor Specific – unused on CDN491 |

**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 CDN491 specific exception conditions.

The General Purpose I/O Device exception conditions provide 4 nested structures containing status information from each of the available DIP an d DOP object instances. For the the DIP and DOP structures each contain 64 *bits*.

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 CDN491 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 CDN491 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) | Must be 0 |
| 5 | Get/Set | Num Analog Output | USINT (1) | Must be 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 temperature 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 CDN491 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 | |
| Num Analog Output | 0 | |

### 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 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 | Reserved 0 | Reserved 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 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 CDN491 does not support Analog inputs. This attribute must be 0.

**Num Analog Output – Attribute 5**

The CDN491 does not support Analog Outputs. This attribute must be 0.

**Operating Temperature – Attribute 6**

The current operating temperature of the CDN491 may be read as an 8 bit signed value, indicating temperature in degrees Celsius.

**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.



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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 | Reserved 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.

**Poll Packet Sizes**

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



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**Poll Request**

[DOUT(0..8)]

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

**Poll Response**

[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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