USER MANUAL UMAX0318x1
Version 1

12 Discrete Input, 8 Relay Output Controller with CANopen®

USER MANUAL

P/N: AX031801
P/N: AX031851

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ACRONYMS

AO	Analog Output (Universal)
CAN	Controller Area Network
CANopen®	CANopen® is a registered community trademark of CAN in Automation e.V.
CAN-ID	CAN 11-bit Identifier
COB	Communication Object
CTRL	Control
DI	Digital Input
DO	Digital Output
EDS	Electronic Data Sheet
EMCY	Emergency
LSB	Least Significant Byte (or Bit)
LSS	Layer Settling Service
MSB	Most Significant Byte (or Bit)
NMT	Network Management
RO	Read Only Object
RPDO	Received Process Data Object
RW	Read/Write Object
SDO	Service Data Object
TPDO	Transmitted Process Data Object
WO	Write Only Object

REFERENCES

[DS-301]	CiA DS-301 V4.1 – CANopen® Application Layer and Communication Profile. CAN in Automation 2005
[DS-305]	CiA DS-305 V2.0 – Layer Setting Service (LSS) and Protocols. CAN in Automation 2006
[DS-401]	CiA DS-401 V3.0 – Device profile for generic I/O modules

These documents are available from the CAN in Automation e.V. website http://www.can-cia.org/.

NOTE: When a description is **bolded**, this refers to the name of a user configurable object (variable). If it is *italicized*, it refers to an option for the associated object.
For example: **DO Type** sets to *Digital Input*

Contents

1. OVERVIEW OF CONTROLLER

1.1 Introduction to AX0318x1 Features

The Discrete Input-Output controller (DIO) is designed to provide a simple interface between CANopen® and discrete electronic devices in a power generator set or industrial environment. The hardware of the DIO supports 12 discrete inputs and 8 normally-open/normally-closed relay outputs.

Depending on how the controller is configured, the DIO can have its relay outputs respond to CANopen® messages, discrete inputs, relay outputs or have them all disabled.

A front panel bi-colour LED indicator allows the user to observe the current state of DIO and easily identify a normal operating condition and situations when there is a network error or absence of network traffic.

If an error occurs, power glitch or other emergency cases occurs on the network, the DIO will self-recover immediately after the normal condition is restored.

The various function blocks supported by the DIO controller are outlined in the following sections. All objects are user configurable using standard commercially available tools that can interact with a CANopen® Object Dictionary via an .EDS file.

1.2 Digital Input Function Blocks

The 12 digital inputs of the DIO controller have a fixed 5kOhm pull-up resistor. The signals going into the DIO controller are interpreted as 0 or 1. The turn ON-signal (1) is reached at 3.75V input level while the turn OFF-signal (0) is reached at 0.8V input level. The discrete inputs can be used as control sources for relay outputs.

The sub sections below explain in more details the functionality and available objects of the discrete inputs.

1.2.1 Digital Input Functionality

The object 6010h **DI Active State** allows the user to select how the controller responds to the behaviour of the digital input. **Table 1** shows the different *Active High/Active Low* options with the default being highlighted.

Value	Meaning
0	***Active High***
1	*Active Low*

Table 1: Active High/Low

The inputs of the DIO have a fixed 5kOhm pull-up resistor. Given that by default, the inputs are configured to *Active High* and an ON response by the DIO is achieved when the input is grounded.

1.2.2 Debounce Time

The object 2003h **DI Debounce Time** is a useful object in cases where the digital input signal coming in to the controller is noisy. **Figure 1** shows how the debounce time helps detect a correct input signal.

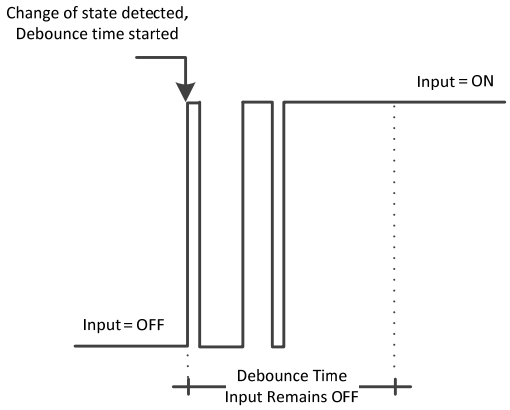

Figure 1: Digital Input Debounce Time

1.2.3 Digital Input Type

The object 6011h **DI Type** allows for flexibility in the response of the input. **Table 2** shows the options available for this object.

Value	Meaning
0	*Input Not Implemented*
1	**Normal Logic**
2	*Inverse Logic*
3	*Latched Logic*

Table 2 Digital Input Types

By default, the *Normal Logic* type is used for the digital input.

In *Normal Logic* mode, the input state is 1 in case the input signal is interpreted as an ON-signal. The input state turns 0 if the input signal is interpreted as an OFF-signal.

For the *Inverse Logic* type, the opposite behavior applies. If the input signal is ON, the state turns 0 and if the input signal is OFF, the state turns 1.

Setting the Input to *Latched Logic*, the input state is toggled between 1 and 0 every time the input signal of the respective digital input changes from OFF to ON.

1.3 Relay Output Function Block

There are 8 relay outputs available in the DIO controller which are 2Amp rated. The following sub sections will explain in more details the functionalities and available objects.

1.3.1 Relay Output Functionality

All 8 relay outputs have 2 states: Normally Open and Normally Closed. Each relay output has 3 pins associated with it: Normally Closed (NC), Normally Open (NO), and Common (C). The object 6201h **DO Type** allows for flexibility in the response of the output. Table 3 shows the options available for this object.

Value	Meaning
0	*Output Not Implemented*
1	***Normal Logic***
2	*Inverse Logic*
3	*Latched Logic*
4	*Inverse Latched Logic*
5	*Toggle Logic*

Table 3: Relay Output Type

By default, *Normal Logic* response is used for the relay outputs.

In *Normal Logic* response, the Common pin is connected to the Normally Closed pin when the source of the respective relay output is triggered ON. The Common pin is connected to the Normally Open pin when the source is triggered off.

In the case of *Inverse Logic* response, the Common pin is connected to the Normally Open pin when the source of the respective relay output is triggered ON. When the source of the respective relay output is triggered OFF, the Common pin is connected to the Normally Closed pin.

In the case of *Latched Logic* response, the Common pin is toggled between Normally Closed and Normally Open pins every time the source of the respective relay output goes from OFF to ON. The opposite behavior applies for the *Inverse Latched Logic*. If the output switches from ON to OFF, the output state changes.

The *Toggle Logic* lets the relay output toggle between Normally closed and Normally Open pins for a configured frequency. The time for switching from one state to the other state can be configured with the object 6330h **DO Toggle Frequency** which is in milliseconds and 500ms by default.

1.3.2 Relay Output Control/Enable/Override/Unlatch Sources

The relay outputs can be configured to be commanded/enabled/overridden/unlatched by the control sources listed in **Table .** This table also displays the number associated to the control sources which can be selected.

For the control function, objects 2210h **DO Control Source** and 2211h **DO Control Number** are used. For the enable function, objects 2220h **DO Enable Source** and 2221h **DO Enable**

Number are used. For the override function, objects 2360h **DO Override Source** and 2361h **DO Override Number** are used. Lastly, for the unlatch function, objects 2231h **DO Unlatch Source** and 2232h **DO Unlatch Number** are used.

The default Control Source is highlighted in Table 4 while the default Enable/Override/Unlatch Source are configured to *Source Not Used.* The source together with the number determine which signal is used to drive the output. For example, setting Control Source to *Digital Input* and Control Number to *1*, connects the configured stage to respond to the signal sent by Digital Input 1.

Value	Meaning	Number Range
0	*Source Not Used*	*[0]*
1	***Digital Input***	***[1…12]***
2	*Digital Relay Output*	*[1…8]*
3	*Power Supply Voltage Fault State*	*[0]*
4	*Temperature Fault State*	*[0]*
5	*CAN RPDO Timeout*	*[0]*
6	*CANopen® Messages*	*[1…8]*

Table 4: Relay Output Control/Enable/Override/Unlatch Source

The selected source in the object 2210h **DO Control Source** is the main commanding source of the relay output based on the output type. For Control Source 3,4 and 5, it will command the output to be high if there's a corresponding fault detected. The object 2380h **DO Enable Response Delay** can be used to enable/disable delays for both output states. In case the output state should turn low after a certain amount of time, the object 2382h **Turn OFF Delay** can be used. Whereas the object 2381h **Turn ON Delay** can be configured to set a delay before switching from the OFF-state to ON-state. Both delays are configurable in milliseconds.

1.3.3 Relay Output Enable

The Enable Source is used to determine whether the relay output will be commanded by the Control Source. There are six different options for the object 2222h **DO Enable Response** in which the enable signal can be used. These responses are listed in **Table** , where the default value is highlighted.

Value	Meaning
0	***Enable When ON***
1	*Enable When OFF*
2	*Disable When ON*
3	*Disable When OFF*
4	*Enable When ON Else Keep State*
5	*Enable When OFF Else Keep State*

Table 5: Enable Response

When the **it** is set to *Enable When ON* or *Disable When OFF***,** the relay output will be commanded according to the signal of the Control Source/Number and the output type only when the signal of

the Enable Source/Number is ON. Otherwise, the relay output is commanded to the OFF state (output type selected).

Similarly, when the Enable Response is set to *Enable When OFF* or *Disable When ON*, the relay output will be commanded according to the Control Source/Number and the output type only when the signal of the Enable Source/ Number is OFF. Otherwise, the relay output is commanded to the OFF state (output type selected).

In case the Enable Response is *Enable When ON Else Keep State*, the relay output will be commanded according to the signal of the Control Source/Number and the output type only when the signal of the Enable Source/Number is ON. If the Enable Source is OFF, the relay output will keep the previous state.

Likewise, when the Enable Response is configured to *Enable When OFF Else Keep State*, the relay output will be commanded according to the Control Source/Number and the output type only when the Enable Source/Number is OFF. Otherwise, the relay output holds the previous state.

In this case, the Turn ON/OFF delays are valid for the enable state and the control state.

1.3.4 Relay Output Override

The object 2360h **DO Override Source** is used to determine whether the relay output will be commanded by the Control Source. This Source has a higher priority than the Enable Source.

The object 2363h **DO Override State** is used to configure the override state. Table 6 shows the two options for it and the default value is highlighted. In case of *Override State OFF*, the relay output switches to Normally Open. Only if *Override State ON* is configured, the relay output changes to Normally closed and it will be commanded according to the Control Source and the object 2362h **DO Override Response** selected.

Value	Meaning
0	**Override State OFF**
1	Override State ON

Table 63: Override State

There are two different options for Override Response in which the override signal can be used. These responses are listed in Table 7, where the default value is highlighted.

Value	Meaning
0	Override When OFF
1	**Override When ON**

Table 7: Override Responses

When the Override Response is configured to *Override When ON*, the relay output will be commanded when the signal of the Control Source/Number is ON. If the Override Response is set to Override When OFF, the relay output will be commanded when the signal of the Control Source/Number is OFF.

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1.3.5 Unlatch Source

This Source can only be modified if output type is set to *Latched Logic* or *Inverse Latched Logic*. When output type is set *Latched Logic*, the output state will be turned to OFF if the state of the object 2231h **DO Unlatch Source** is high. If Unlatch Source state turns low afterwards, the output state will still be OFF in case the output state is high before. Only if the state of Control Source is changed back to low, the output state works like before in *Latched Logic*. The opposite behavior is valid for the *Inverse Latched Logic*.

If the state of the Unlatch Source triggers and the output state is low, the output state will change to high. If the Unlatch Source state turns low afterwards, the output state will still be ON. Only if the state of the Control Source is changed back to high, the Output state works in *Inverse Latched Logic* mode again.

1.4 Miscellaneous Function Block

1.4.1 Power Supply and Processor Temperature

Objects 5020h **Power Supply FV** and 5030h **Processor Temperature FV** are available as read-only feedback for additional diagnostics. Object 5021h is used to enable or disable detection of Power Supply faults. If object 5021h is enabled (1), then objects 5022h, **Under Voltage Threshold**, and 5023h, **Over Voltage Threshold** are used by the controller. These two configurable objects hold the desired values to trigger a supply fault. They can be set in range of 9 to 36 Volts. Object 5024h, **Hysteresis to Clear Fault**, is the number of Volts required for the supply to increase above or decrease below from the voltage entered in objects 5022h and 5023h, respectively. Similarly, object 5031h enables or disables faults by the Processor Temperature measured. An **Over Temperature value** can be entered in object 5032h which, when reached and exceeded, will trigger a temperature fault. The temperature will need to decrease a value of **Hysteresis to Clear Temperature Fault,** object 5033h, below the temperature set in object 5032h.

Both diagnostics, Power Supply and Temperature, have an object to disable all outputs. In case all outputs should be disabled when an overvoltage or undervoltage is measured, the object 5025h **Power Fault Disables Outputs** must be set to true. Whereas the object 5034h **Over Temperature Shutdown** disables the outputs when the unit is overheating.

1.4.2 Start in Operational Mode

The last object 5555h **Start in Operational** is provided as a ‘cheat’ when the unit is not intended to work with a CANopen® network (i.e. a stand-alone control) or is working on a network comprised solely as slaves so the OPERATION command will never be received from a master. By default, this object is disabled (FALSE).

When using the DIO as a stand-alone controller where 5555h is set to TRUE, it is recommended to disable all TPDOs (set the Event Timer to zero) so that it does not run with a continuous CAN error when not connected to a bus.

1.5 **LED Control**

A bi-colour red and green LED lamp is mounted on the DIO front panel. It can be used to inform the user of the status the controller is in. The structure of the LED Function Block is based on stages. The DIO provides the user with up to five different stages in order to provide more flexibility to the functionality.

Each of the four stages consists of its independent control source and digital response. However, only one stage can be active at a time. For this reason, the 5-stage structure is based on priority in which the Stage 1 has the highest priority while Stage 4 has the lowest. In other words:
if the 4 stages are all set to true, the response set for stage 1 will be used to drive the LED. In the instance, when none of the stages is active (ON), the LED function block has another group which the default stage is. When none of the stages are active, the user can configure the default stage to command the LED in various ways if none of the stages are active.

Table 8 shows the settings for stage 1 to 4 while the **Default** stage has no Control Source or Number because it is supposed to show the controller is On and without.

Stage Settings
Control Source
Output Type
Response Type
Blink Rate

Table 8: LED Stages Settings

1.5.1 LED Control Sources

The control sources that can be used to command each of the four stages are listed in Table 9. Objects 2A00h and 2A01h correspond to the **LED Control Source** and **LED Control Number**, respectively for each stage.

Value	Meaning
0	Control Source Not Used
1	Global Output Fault
2	Power Supply Fault
3	Processor Temperature Fault
4	CANopen® Fault

Table 9: LED Control Sources

Setting the stage to **Control Source Not Used** has no effect on the LED.

The **Global Output Fault** indicates a Power Supply Fault, Processor Temperature Fault, and CAN Receive Fault at one stage. An overvoltage or undervoltage error can be shown with the source **Power Supply Fault**, while an overheating can be detected with the **Processor Temperature Fault**. On condition the LED should report an CANopen® error, the source CANopen® Fault should be selected.

1.5.2 LED Output/Response Type

The output types available for the LED for each stage are listed in Table 10 below per object 2A01h:

Value	Output Type
0	LEDs Disabled
1	Green
2	Red
3	Toggle Green/Red

Table 4: LED Output Types

The LED is off in case the Output Type is set to **LEDs Disabled**. If the type is set to **Green**, the LED will shine only green for the selected stage. The same behavior is valid for the **Red** type. In case the **Toggle Green/Red** type is selected, the LED will blink in the two colors when the Response Type is configured to **Blinking Logic**. Table 11 shows the possible response types for each stage and output type per object 2A02h.

Value	Response Type
0	Normal OFF
1	Normal ON
2	Blinking Logic

Table 51: LED Response Types

In *Blinking Logic* response type, the output will toggle at a period of **Digital Blink Rate** per object 2A03h for as long as the input command is ON. It is described in milliseconds.

2.1 Dimensions and Pinout

2.1.1 AX031801

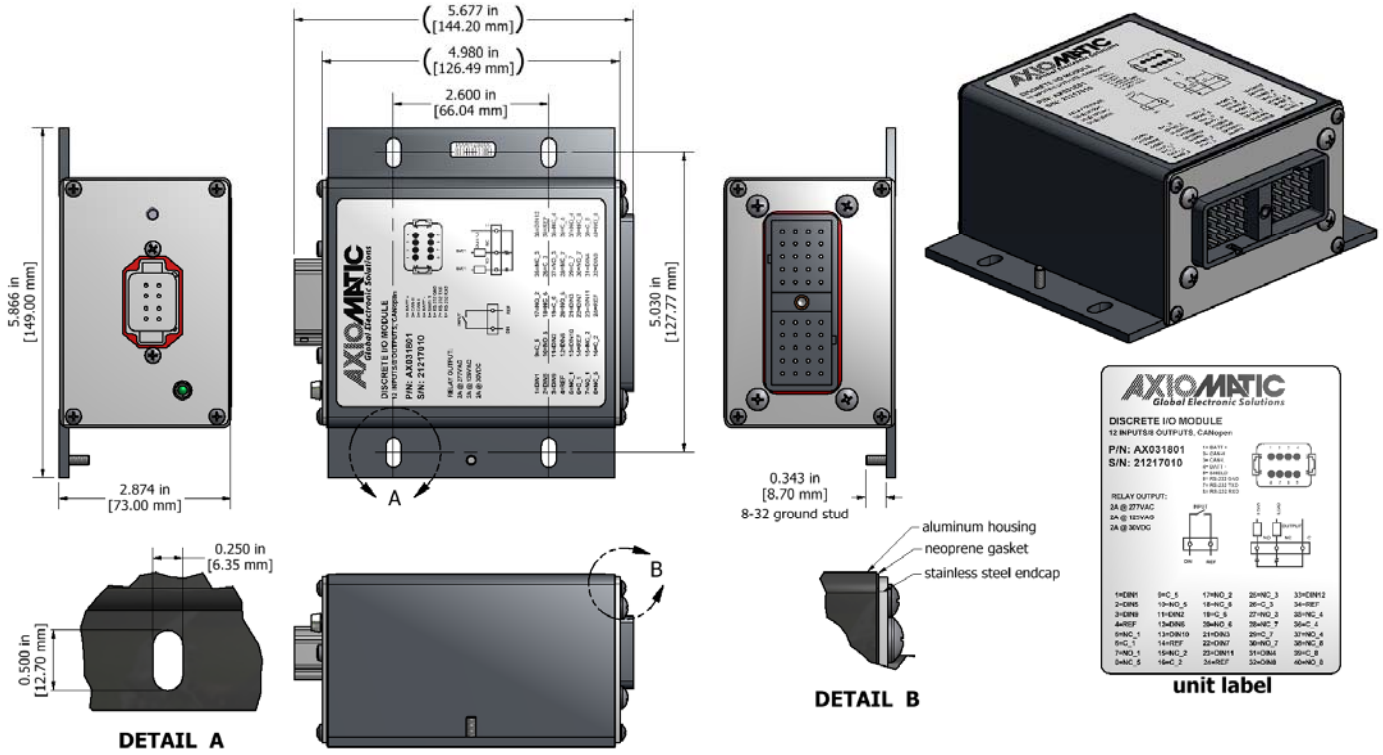


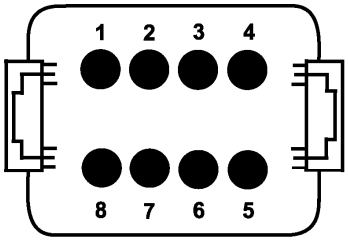
Figure 16 – Dimension Drawing for AX031801

A mating plug kit, P/N: **AX070200**, is available. This kit includes the following items. *NB. The sealing plugs are only needed in cases where less than the 40 pins are required.*

Deutsch IPD P/N:	*Description:*
0462-201-16141	48 16AWG SOCKETS SOLID 16-20AWG WIRE 6mm
114017	24 SEALING PLUGS SIZE 12-16 CAVITIES 12-18 AWG
DRC16-40S	40-PIN PLUG, No Key
DT06-08SA	DT SERIES PLUG 8 CONTACT
W8S	WEDGELOCK FOR DT 8 PIN PLUG

These items are also available from a local Deutsch IPD distributor.
A crimping tool from Deutsch IPD is required to connect wiring to the sockets, P/N: HDT 48-00 or equivalent (not supplied).

Typical Connections – Power and CAN

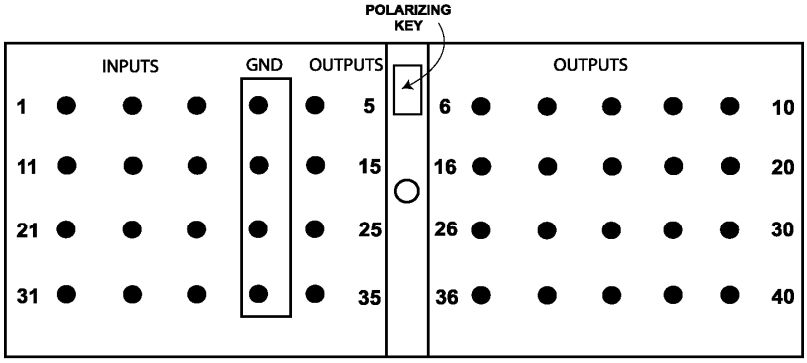


1 = PWR+ 5 = SHIELD
2 = CAN-H 6 = RS-232 GND
3 = CAN-L 7 = RS-232 TXD
4 = PWR- 8 = RS-232 RXD

FRONT VIEW
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DT13-08PA
(Mating plug is DT06-08SA with wedge W8S and sockets 0462-201-16141)

Typical Connections – Inputs and Outputs

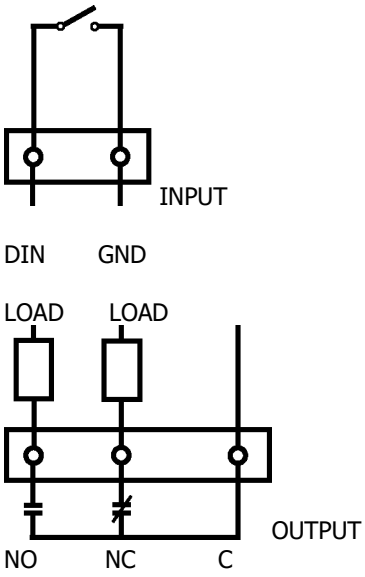
FRONT VIEW OF
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DRC13-40PB



NO - Normally Open
NC - Normally Closed
C - Common

INPUTS	Pin	OUTPUTS	Pin
DIN1	1	NC_1	5
DIN2	11	C_1	6
DIN3	21	NO_1	7
DIN4	31	NC_2	15
DIN5	2	C_2	16
DIN6	12	NO_2	17
DIN7	22	NC_3	25
DIN8	32	C_3	26
DIN9	3	NO_3	27
DIN10	13	NC_4	35
DIN11	23	C_4	36
DIN12	33	NO_4	37
GND	4	NC_5	8
GND	14	C_5	9
GND	24	NO_5	10
GND	34	NC_6	18
		C_6	19
		NO_6	20
		NC_7	28
		C_7	29
		NO_7	30
		NC_8	38
		C_8	39
		NO_8	40

Connections – I/O



2.1.2 AX031851

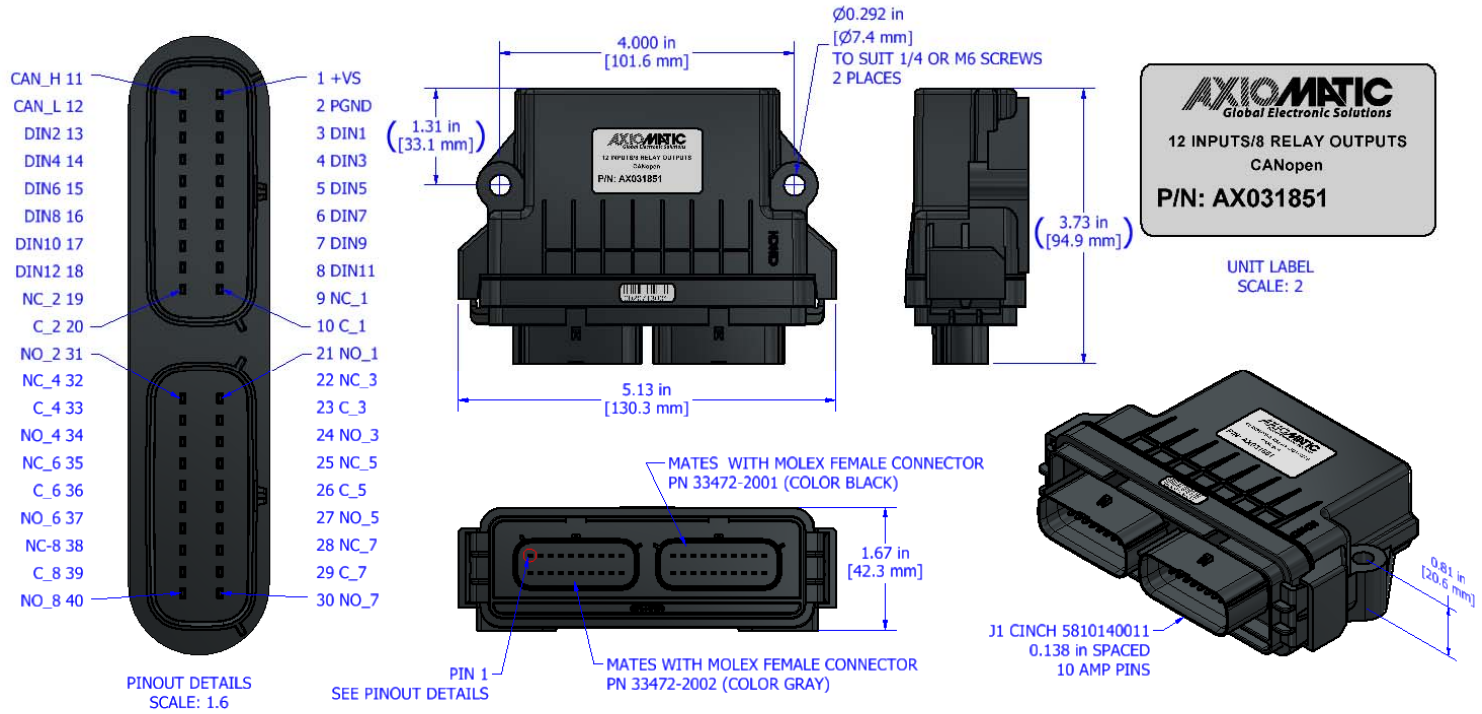


Figure 17 – Dimension Drawing for AX031851

A mating plug kit, P/N: **AX070147**, is available. This kit includes the following items.

Mating Plug Kit	AX070147 Comprised of: 1 Molex 33472-2001 (Key A) 1 Molex 33472-2002 (Key B) 40 Molex 33012-2002 Receptacle Terminals (for crimping) for 18AWG wire 6 Molex 34345-0001 Cavity Plugs To crimp wires onto the receptacle terminals, please use the recommended crimping tools from Molex.

2.2 Installation Instructions

NOTES & WARNINGS

- Do not install near high-voltage or high-current devices.
- Ground the chassis for safety purposes and proper EMI shielding.
- Note the operating temperature range. All field wiring must be suitable for that temperature range.
- Install the unit with appropriate space available for servicing and for adequate wire harness access (15 cm) and strain relief (30 cm).
- Do not connect or disconnect the unit while the circuit is live, unless the area is known to be non-hazardous.

MOUNTING

The module is designed for mounting on the engine. If it is mounted without an enclosure, the DIO should be mounted vertically with connectors facing left and right to reduce likelihood of moisture entry.

The I/O wires and CAN communication cable are considered intrinsically safe. The power wires are not considered intrinsically safe.

Mask all labels if the unit is to be repainted, so label information remains visible.

Mounting ledges include holes sized for M6 or ¼ inch bolts. The bolt length will be determined by the end-user's mounting plate thickness. Typically 20 mm (3/4 inch) is adequate.

If the module is mounted off-engine, no wire or cable in the harness should exceed 30 meters in length. The power input wiring should be limited to 10 meters.

CONNECTIONS

Use the following Deutsch IPD mating plugs to connect to the integral receptacles. Wiring to these mating plugs must be in accordance with all applicable local codes. Suitable field wiring for the rated voltage and current must be used. The rating of the connecting cables must be at least 85°C. Use field wiring suitable for both minimum and maximum ambient temperature.

NOISE – ELECTRICAL CONNECTIONS

To reduce noise, separate all I/O wires from power wires. Shielded I/O wires will protect against ignition and injector noise.

GROUNDING

Protective Earth (PE) must be connected to the module's grounding lug to reduce the risk of electric shock. The conductor providing the connection must have a ring lug and wire larger than or equal to 4 mm^2 (12 AWG). The ring lug should be placed between the nut and a star washer.

All chassis grounding should go to a single ground point designated for the engine and all related equipment.

The ground strap that provides a low impedance path for EMI should be a ½ inch wide, flat, hollow braid, no more than 12 inches long with a suitable sized ring lug for the module's grounding lug. It may be used in place of the PE grounding conductor and would then perform both PE and EMI grounding functions.

SHIELDING

The I/O and CAN wiring should be shielded using a twisted conductor pair. All I/O wire shields should be terminated on the shield wire available on the 40-pin connector. The I/O wires should not be exposed for more than 50 mm (2 inches) without shielding. The shield may be cut off at the DIO end as it does not require termination at that end.

Shields can be AC grounded at one end and hard grounded at the opposite end to improve shielding effectiveness.

If the module is installed in a cabinet, shielded wiring can be terminated at the cabinet (earth ground), at the entry to the cabinet or at the DIO.

INPUT POWER

The main input to the power supply must be of low-impedance type for proper operation. If batteries are used, an alternator or other battery-charging device is necessary to maintain a stable supply voltage.

Central suppression of any surge events should be provided at the system level.

The installation of the equipment must include overcurrent protection between the power source and the DIO by means of a series connection of properly rated fuses or circuit breakers. Input power switches must be arranged external to the DIO.

The power input wiring should be limited to 10 meters.

Note the operating temperature range. All field wiring must be suitable for that temperature range.

INPUT WIRING

Wiring for the inputs must be shielded cable, 16 or 18 AWG. Cable lengths should be less than 30 meters. Shielding should be unbroken.

CAN WIRING

The CAN port is electrically isolated from all other circuits. The isolation is SELV rated with respect to product safety requirements. Refer to the CAN specification for more information.

Use CAN compatible cabling.

Shielded CAN cable is required. The DIO provides the CAN port shield connection ac coupled to chassis ground. The chassis ground stud located on the mounting foot must be tied directly to Earth Ground.

FUSING

When installing the unit, an external 3A, 32Vdc fuse is required.

NETWORK CONSTRUCTION

Axiomatic recommends that multi-drop networks be constructed using a "daisy chain" or "backbone" configuration with short drop lines.

TERMINATION

It is necessary to terminate the network. An external CAN termination is required. No more than 2 network terminations are recommended on any one network. Termination is a 121 Ohm, 0.25 W, 1% metal film resistor placed between CAN_H and CAN_L terminals at the end two units on the network.

3 CANOPEN® OBJECT DICTIONARY

The CANopen® object dictionary of the DIO Controller is based on CiA device profile DS-401 V3.0 (device profile for generic I/O modules). The object dictionary includes Communication Objects beyond the minimum requirements in the profile, as well as several manufacturer-specific objects for extended functionality.

3.1 NODE ID and BAUDRATE

By default, the DIO Controller ships factory programmed with a Node ID = 127 (0x7F) and with Baudrate = 125 kbps.

3.1.1 LSS Protocol to Update

The only means by which the Node-ID and Baudrate can be changed is to use Layer Settling Services (LSS) and protocols as defined by CANopen® standard DS-305.

Follow the steps below to configure either variable using LSS protocol. If required, please refer to the standard for more detailed information about how to use the protocol.

3.1.2 Setting Node-ID

- Set the module state to LSS-configuration by **sending** the following message:

Item	***Value***	
COB-ID	0x7E5	
Length	2	
Data 0	0x04	(cs=4 for switch state global)
Data 1	0x01	(switches to configuration state)

- Set the Node-ID by **sending** the following message:

Item	***Value***	
COB-ID	0x7E5	
Length	2	
Data 0	0x11	(cs=17 for configure node-id)
Data 1	Node-ID	(set new Node-ID as a hexadecimal number)

- The module will send the following response (any other response is a failure):

Item	***Value***	
COB-ID	0x7E4	
Length	3	
Data 0	0x11	(cs=17 for configure node-id)
Data 1	0x00	
Data 2	0x00	

- Save the configuration by **sending** the following message:

Item	***Value***
COB-ID	0x7E5
Length	1
Data 0	0x17 (cs=23 for store configuration)

- The module will send the following response (any other response is a failure):

Item	***Value***
COB-ID	0x7E4
Length	3
Data 0	0x17 (cs=23 for store configuration)
Data 1	0x00
Data 2	0x00

- Set the module state to LSS-operation by **sending** the following message:
  (Note, the module will reset itself back to the pre-operational state)

Item	***Value***
COB-ID	0x7E5
Length	2
Data 0	0x04 (cs=4 for switch state global)
Data 1	0x00 (switches to waiting state)

3.1.3 Setting Baudrate

- Set the module state to LSS-configuration by **sending** the following message:

Item	***Value***
COB-ID	0x7E5
Length	2
Data 0	0x04 (cs=4 for switch state global)
Data 1	0x01 (switches to configuration state)

- Set the baudrate by **sending** the following message:

Item	***Value***
COB-ID	0x7E5
Length	3
Data 0	0x13 (cs=19 for configure bit timing parameters)
Data 1	0x00 (switches to waiting state)
Data 2	Index (select baudrate index per table 12)

Index	*Bit Rate*
0	1 Mbit/s
1	800 kbit/s
2	500 kbit/s
3	250 kbit/s
4	125 kbit/s (default)
5	reserved (100 kbit/s)
6	50 kbit/s
7	20 kbit/s
8	10 kbit/s

Table 12 – LSS Baudrate Indexes

- The module will send the following response (any other response is a failure):

Item	*Value*
COB-ID	0x7E4
Length	3
Data 0	0x13 (cs=19 for configure bit timing parameters)
Data 1	0x00
Data 2	0x00

- Activate bit timing parameters by **sending** the following message:

Item	*Value*
COB-ID	0x7E5
Length	3
Data 0	0x15 (cs=19 for activate bit timing parameters)
Data 1	<delay_lsb>
Data 2	<delay_msb>

The delay individually defines the duration of the two periods of time to wait until the bit timing parameters switch is done (first period) and before transmitting any CAN message with the new bit timing parameters after performing the switch (second period). The time unit of switch delay is 1 ms.

- Save the configuration by **sending** the following message (on the NEW baudrate):

Item	*Value*
COB-ID	0x7E5
Length	1
Data 0	0x17 (cs=23 for store configuration)

- The module will send the following response (any other response is a failure):

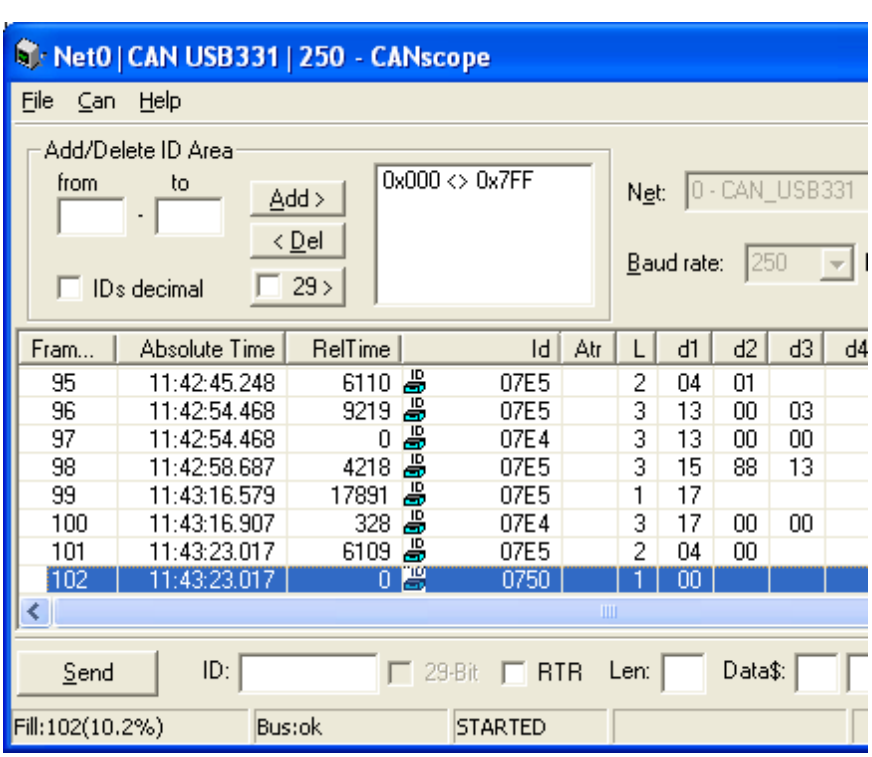
Item	***Value***
COB-ID	0x7E4
Length	3
Data 0	0x17 (cs=23 for store configuration)
Data 1	0x00
Data 2	0x00

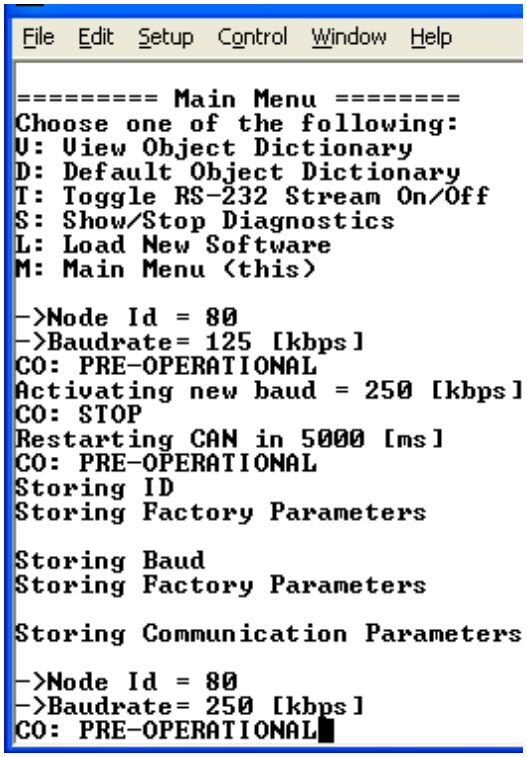
- Set the module state to LSS-operation by **sending** the following message:
  (Note, the module will reset itself back to the pre-operational state)

Item	***Value***
COB-ID	0x7E5
Length	2
Data 0	0x04 (cs=4 for switch state global)
Data 1	0x00 (switches to waiting state)

The following screen capture (left) shows the CAN data was sent (7E5h) and received (7E4h) by the tool when the baudrate was changed to 250 kbps using the LSS protocol. The other image (right) shows what was printed on an example debug RS-232 menu while the operation took place.

Between CAN Frame 98 and 99, the baudrate on the CAN Scope tool was changed from 125 to 250 kbps.





3.2 **COMMUNICATION OBJECTS (DS-301)**

The communication objects supported by the DIO Controller are listed in the following table. A more detailed description of some of the objects is given in the following subchapters. Only those objects that have device-profile specific information are described. For more information on the other objects, refer to the generic CANopen® protocol specification DS-301.

Index (hex)	***Object***	***Object Type***	***Data Type***	***Access***	***PDO Mapping***
1000	Device Type	VAR	UNSIGNED32	RO	No
1001	Error Register	VAR	UNSIGNED8	RO	No
1002	Manufacturer Status Register	VAR	UNSIGNED32	RO	No
1003	Pre-Defined Error Field	ARRAY	UNSIGNED32	RO	No
100C	Guard Time	VAR	UNSIGNED16	RW	No
100D	Life Time Factor	VAR	UNSIGNED8	RW	No
1010	Store Parameters	ARRAY	UNSIGNED32	RW	No
1011	Restore Default Parameters	ARRAY	UNSIGNED32	RW	No
1016	Consumer Heartbeat Time	ARRAY	UNSIGNED32	RW	No
1017	Producer Heartbeat Time	VAR	UNSIGNED16	RW	No
1018	Identity Object	RECORD		RO	No
1020	Verify Configuration	ARRAY	UNSIGNED32	RO	No
1029	Error Behaviour	ARRAY	UNSIGNED8	RW	No
1400	RPDO1 Communication Parameter	RECORD		RW	No
1401	RPDO2 Communication Parameter	RECORD		RW	No
1402	RPDO3 Communication Parameter	RECORD		RW	No
1403	RPDO4 Communication Parameter	RECORD		RW	No
1600	RPDO1 Mapping Parameter	RECORD		RW	No
1601	RPDO2 Mapping Parameter	RECORD		RW	No
1602	RPDO3 Mapping Parameter	RECORD		RW	No
1603	RPDO4 Mapping Parameter	RECORD		RW	No
1800	TPDO1 Communication Parameter	RECORD		RW	No
1801	TPDO2 Communication Parameter	RECORD		RW	No
1802	TPDO3 Communication Parameter	RECORD		RW	No
1803	TPDO4 Communication Parameter	RECORD		RW	No
1A00	TPDO1 Mapping Parameter	RECORD		RW	No
1A01	TPDO2 Mapping Parameter	RECORD		RW	No
1A02	TPDO3 Mapping Parameter	RECORD		RW	No
1A03	TPDO4 Mapping Parameter	RECORD		RW	No

3.2.1 **Object 1000h: Device Type**

This object contains information about the device type as per device profile DS-401. The 32-bit parameter is divided into two 16-bit values, showing General and Additional information as shown below.

MSB	LSB
Additional Information = 0x8003	**General Information** = 0x0191 (401)

DS-401 defines the Additional Information field in the following manner:
0000h = reserved
0001h = digital input block
0002h = digital output block
0004h = analog input block
0008h = analog output block
0010h = controller block (aka PID)
0020h = alarm block
0040h … 4000h = reserved
8000h = miscellaneous block (manufacturer-specific)

Object Description

Index	1000h
Name	Device Type
Object Type	VAR
Data Type	UNSIGNED32

Entry Description

Access	RO
PDO Mapping	No
Value Range	0x80030191
Default Value	0x80030191

3.2.2 **Object 1001h: Error Register**

This object is an error register for the device. Any time there is an error detected by the DIO Controller, the Generic Error Bit (bit 0) is set. Only if there are no errors in the module will this bit will be cleared. No other bits in this register are used by the DIO Controller.

Object Description

Index	1001h
Name	Error Register
Object Type	VAR
Data Type	UNSIGNED8

Entry Description

Access	RO
PDO Mapping	No
Value Range	00h or 01h
Default Value	0

3.2.3 Object 1002h: Manufacturer Status Register

This object is used for manufacturer debug purposes.

3.2.4 Object 1003h: Pre-Defined Error Field

This object provides an error history by listing the errors in the order that they have occurred. An error is added to the top of the list when it occurs and is immediately removed when the error condition has been cleared. The latest error is always at sub-index 1, with sub-index 0 containing the number of errors currently in the list. When the device is in an error-free state, the value of sub-index 0 is zero.

The error list may be cleared by writing a zero to sub-index 0, which will clear all errors from the list, regardless of whether they are still present or not. Clearing the list does NOT mean that the module will return to the error-free behavior state if at least one error is still active.

The DIO Controller has a limitation of a maximum of 5 errors in the list. If the device registers more errors, the list will be truncated, and the oldest entries will be lost.

The error codes stored in the list are 32-bit unsigned numbers, consisting of two 16-bit fields. The lower 16-bit field is the EMCY error code, and the higher 16-bit field is a manufacturer-specific code. The manufacturer-specific code is divided into two 8-bit fields, with the higher byte indicating the error description, and the lower byte indicating the channel on which the error occurred.

MSB LSB

Error Description	**Channel-ID**	**EMCY Error Code**

If node-guarding is used (not recommended per the latest standard) and a lifeguard event occurs, the manufacturer-specific field will be set to 0x1000. On the other hand, if a heartbeat consumer fails to be received within the expected timeframe, the Error Description will be set to 0x80 and the Channel-ID (nn) will reflect the Node-ID of the consumer channel that was not producing. In this case, the manufacturer-specific field will therefore be 0x80nn. In both cases, the corresponding EMCY Error Code will be the Guard Error 0x8130.

When an error appeared, the Error Description will reflect what channel(s) is at fault using the following table. Also, if an RPDO is not received within the expected “Event Timer” period, an RPDO timeout will be flagged. Table 13 outlines the EMCY Error Codes and their meanings supported by this module.

Error Field Code	Error Description	Meaning	ID	Meaning	EMCY Code	Meaning
00000000h	EMCY Error Reset (fault no longer active)					
00008100h	00h	RPDO Timeout	00h	Unspecified	8100h	Communication - generic
10008130h	10h	Lifeguard Event	00h	Unspecified	8130h	Lifeguard/Heartbeat Error
80nn8130h	80h	Heartbeat Timeout	nn	Node-ID	8130h	Lifeguard/Heartbeat Error

Table 13 – Pre-Defined Error Field Codes

Object Description

Index	1003h
Name	Pre-Defined Error Field
Object Type	ARRAY
Data Type	UNSIGNED32

Entry Description

Sub-Index	0h
Description	Number of entries
Access	RW
PDO Mapping	No
Value Range	0 to 5
Default Value	0

Sub-Index	1h to 5
Description	Standard error field
Access	RO
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	0

3.2.5 **Object 100Ch: Guard Time**

The objects at index 100Ch and 100Dh shall indicate the configured guard time respective to the life time factor. The life time factor multiplied with the guard time gives the life time for the life guarding protocol described in DS-301. The Guard Time value shall be given in multiples of ms, and a value of 0000h shall disable the life guarding.

It should be noted that this object, and that of 100Dh are only supported for backwards compatibility. The standard recommends that newer networks do not use the life guarding protocol, but rather heartbeat monitoring instead. Both life guarding and heartbeats can NOT be active simultaneously.

Object Description

Index	100Ch
Name	Guard Time
Object Type	VAR
Data Type	UNSIGNED16

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	0 to 65535
Default Value	0

3.2.6 Object 100Dh: Lifetime Factor

The life time factor multiplied with the guard time gives the life time for the life guarding protocol. A value of 00h shall disable life guarding.

Object Description

Index	100Dh
Name	Life time factor
Object Type	VAR
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	0 to 255
Default Value	0

3.2.7 Object 1010h: Store Parameters

This object supports the saving of parameters in non-volatile memory. In order to avoid storage of parameters by mistake, storage is only executed when a specific signature is written to the appropriate sub-index. The signature is “save”.

The signature is a 32-bit unsigned number, composed of the ASCII codes of the signature characters, according to the following table:

MSB			LSB
e	v	a	s
65h	76h	61h	73h

On reception of the correct signature to an appropriate sub-index, the DIO Controller will store the parameters in non-volatile memory, and then confirm the SDO transmission.

By read access, the object provides information about the module’s saving capabilities. For all sub-indexes, this value is 1h, indicating that the DIO Controller saves parameters on command. **This means that if power is removed before the Store object is written, changes to the Object Dictionary will NOT have been saved in the non-volatile memory and will be lost on the next power cycle.**

Object Description

Index	1010h
Name	Store Parameters
Object Type	ARRAY
Data Type	UNSIGNED32

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	4
Default Value	4

Sub-Index	1h
Description	Save all parameters
Access	RW
PDO Mapping	No
Value Range	0x65766173 (write access) 1h (read access)
Default Value	1h

Sub-Index	2h
Description	Save communication parameters
Access	RW
PDO Mapping	No
Value Range	0x65766173 (write access) 1h (read access)
Default Value	1h

Sub-Index	3h
Description	Save application parameters
Access	RW
PDO Mapping	No
Value Range	0x65766173 (write access) 1h (read access)
Default Value	1h

Sub-Index	4h
Description	Save manufacturer parameters
Access	RW
PDO Mapping	No
Value Range	0x65766173 (write access) 1h (read access)
Default Value	1h

3.2.8 Object 1011h: Restore Parameters

This object supports the restoring of the default values for the object dictionary in non-volatile memory. In order to avoid restoring of parameters by mistake, the device restores the defaults only when a specific signature is written to the appropriate sub-index. The signature is “load”.

The signature is a 32-bit unsigned number, composed of the ASCII codes of the signature characters, according to the following table:

MSB			LSB
d	a	o	l
64h	61h	6Fh	6Ch

On reception of the correct signature to an appropriate sub-index, the DIO Controller will restore the defaults in non-volatile memory, and then confirm the SDO transmission. **The default values are set valid only after the device is reset or power-cycled.** This means that the DIO Controller will NOT start using the default values right away, but rather continue to run from whatever values were in the Object Dictionary prior to the restore operation.

By read access, the object provides information about the module’s default parameter restoring capabilities. For all sub-indexes, this value is 1h, indicating that the DIO Controller restores defaults on command.

Object Description

Index	1011h
Name	Restore Default Parameters
Object Type	ARRAY
Data Type	UNSIGNED32

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	4
Default Value	4

Sub-Index	1h
Description	Restore all default parameters
Access	RW
PDO Mapping	No
Value Range	0x64616F6C (write access), 1h (read access)
Default Value	1h

Sub-Index	2h
Description	Restore default communication parameters
Access	RW
PDO Mapping	No
Value Range	0x64616F6C (write access), 1h (read access)
Default Value	1h

Sub-Index	3h
Description	Restore default application parameters
Access	RW
PDO Mapping	No
Value Range	0x64616F6C (write access), 1h (read access)
Default Value	1h

Sub-Index	4h
Description	Restore default manufacturer parameters
Access	RW
PDO Mapping	No
Value Range	0x64616F6C (write access), 1h (read access)
Default Value	1h

3.2.9 **Object 1016h: Consumer Heartbeat Time**

The DIO Controller can be a consumer of heartbeat objects for up to four modules. This object defines the expected heartbeat cycle time for those modules, and if set to zero, it is not used. When non-zero, the time is a multiple of 1ms and monitoring will start after the reception of the first heartbeat from the module. If the DIO Controller fails to receive a heartbeat from a node in the expected timeframe, it will indicate a communication error, and respond as per object 1029h.

Bits	31-24	23-16	15-0
Value	Reserved 00h	Node-ID	Heartbeat time
Encoded as		UNSIGNED8	UNSIGNED16

Object Description

Index	1016h
Name	Consumer heartbeat time
Object Type	ARRAY
Data Type	UNSIGNED32

Entry Description

Sub-Index	0h
Description	Number of entries
Access	RO
PDO Mapping	No
Value Range	4
Default Value	4

Sub-Index	1h to 4h
Description	Consumer heartbeat time
Access	RW
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	0

3.2.10 **Object 1017h: Producer Heartbeat Time**

The DIO Controller could be configured to produce a cyclical heartbeat by writing a non-zero value to this object. The value will be given in multiples of 1ms, and a value of 0 shall disable the heartbeat.

Object Description

Index	1017h
Name	Producer heartbeat time
Object Type	VAR
Data Type	UNSIGNED16

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	10 to 65535
Default Value	0

3.2.11 Object 1018h: Identity Object

The identity object indicates the data of the DIO Controller, including vendor id, device id, software and hardware version numbers, and the serial number.

In the Revision Number entry at sub-index 3, the format of the data is as shown below

MSB LSB

Major revision number (object dictionary)	Major Revision Software Version	Minor Revision Software Version	Minor Revision Hardware Version

Object Description

Index	1018h
Name	Identity Object
Object Type	RECORD
Data Type	Identity Record

Entry Description

Sub-Index	0h
Description	Number of entries
Access	RO
PDO Mapping	No
Value Range	4
Default Value	4

Sub-Index	1h
Description	Vendor ID
Access	RO
PDO Mapping	No
Value Range	0x00000055
Default Value	0x00000055 (Axiomatic)

Sub-Index	2h
Description	Product Code
Access	RO
PDO Mapping	No
Value Range	0xAA0318x1
Default Value	0xAA0318x1

Sub-Index	3h
Description	Revision Number
Access	RO
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	0x00010001

Sub-Index	4h
Description	Serial Number
Access	RO
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	118001

3.2.12 Object 1020h: Verify Configuration

This object can be read to see what date the software (version identified in object 1018h) was compiled. The date is represented as a hexadecimal value showing day/month/year as per the format below. The time value at sub-index 2 is a hexadecimal value showing the time in a 24-hour clock

MSB LSB

Day (in 1-Byte Hex)	Month (in 1-Byte Hex)	Year (in 2-Byte Hex)
00	00	Time (in 2-Byte Hex)

For example, a value of 0x10082010 would indicate that the software was compiled on August 10th, 2010. A time value of 0x00001620 would indicate it was compiled at 4:20pm.

Object Description

Index	1020h
Name	Verify configuration
Object Type	ARRAY
Data Type	UNSIGNED32

Entry Description

Sub-Index	0h
Description	Number of entries
Access	RO
PDO Mapping	No
Value Range	2
Default Value	2

Sub-Index	1h
Description	Configuration date
Access	RO
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	No

Sub-Index	2h
Description	Configuration time
Access	RO
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	No

3.2.13 Object 1029h: Error Behaviour

This object controls the state that the DIO Controller will be set into in case of an error of the type associated with the sub-index.

A network fault is flagged when an RPDO is not received within the expected time period defined in the “Event Timer” of the associated communication objects, (see Section 3.2.14 for more information) or if a lifeguard or heartbeat message is not received as expected.

For all sub-indexes, the following definitions hold true:

0 = Pre-Operational (node reverts to a pre-operational state when this fault is detected)
1 = No State Change (node remains in the same state it was in when the fault occurred)
2 = Stopped (node goes into stopped mode when the fault occurs)

Object Description

Index	1029h
Name	Error Behavior
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Number of entries
Access	RO
PDO Mapping	No
Value Range	5
Default Value	5

Sub-Index	1h
Description	Communication Fault
Access	RW
PDO Mapping	No
Value Range	See above
Default Value	1 (No State Change)

Sub-Index	2h
Description	Digital Input Fault
Access	RW
PDO Mapping	No
Value Range	See above
Default Value	1 (No State Change)

Sub-Index	3h
Description	Analog Input Fault (not used)
Access	RW
PDO Mapping	No
Value Range	See above
Default Value	1 (No State Change)

Sub-Index	4h
Description	Digital Output Fault
Access	RW
PDO Mapping	No
Value Range	See above
Default Value	1 (No State Change)

Sub-Index	5h
Description	Analog Output Fault (not used)
Access	RW
PDO Mapping	No
Value Range	See above
Default Value	1 (No State Change)

3.2.14 RPDO Behaviour

Per the CANopen ® standard DS-301, the following procedure shall be used for re-mapping, and is the same for both RPDOs and TPDOs.

a) Destroy the PDO by setting bit **exists** (most significant bit) of sub-index 01h of the according PDO communication parameter to 1b

b) Disable mapping by setting sub-index 00h of the corresponding mapping object to 0

c) Modify the mapping by changing the values of the corresponding sub-indices

d) Enable mapping by setting sub-index 00h to the number of mapped objects

e) Create the PDO by setting bit **exists** (most significant bit) of sub-index 01h of the according PDO communication parameter to 0b

The DIO Controller can support up to four RPDO messages. All RPDOs on the DIO Controller use the similar default communication parameters, with the PDO IDs set according to the pre-defined connection set described in DS-301. Most RPDOs do not exist, there is no RTR allowed, they use 11-bit CAN-IDs (base frame valid) and they are all event-driven. While all four have valid default mappings defined (see below) only RPDO1 is enabled by default (i.e. RPDO exists).

RPDO1 Mapping at Object 1600h: Default ID 0x200 + Node ID

Sub-Index	***Value***	***Object***
0	1	Number of mapped application objects in PDO
1	0x62000108	Digital Output 1 to 8 Write State
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

RTPDO2 Mapping at Object 1601h: Default ID 0x300 + Node ID

Sub-Index	***Value***	***Object***
0	0	Number of mapped application objects in PDO
1	0	Not used by default
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

RPDO3 Mapping at Object 1602h: Default ID 0x400 + Node ID

Sub-Index	***Value***	***Object***
0	0	Number of mapped application objects in PDO
1	0	Not used by default
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

RPDO4 Mapping at Object 1603h: Default ID 0x500 + Node ID

Sub-Index	Value	Object
0	0	Number of mapped application objects in PDO
1	0	Not used by default
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

None of them have the timeout feature enabled, i.e. the “Event Timer” on sub-index 5 is set to zero. When this is changed to a non-zero value, if the RPDO has not been received from another node within the time period defined (while in Operational mode), a network fault is activated, and the controller will go to the operational state define in Object 1029h sub-index 4.

Object Description

Index	1400h to 1403h
Name	RPDO communication parameter
Object Type	RECORD
Data Type	PDO Communication Record

Entry Description

Sub-Index	0h
Description	Number of entries
Access	RO
PDO Mapping	No
Value Range	5
Default Value	5

Sub-Index	1h
Description	COB-ID used by RPDO
Access	RW
PDO Mapping	No
Value Range	See value definition in DS-301
Default Value	40000000h + RPDO1 + Node ID C0000000h + RPDOx + Node-ID

X	***RPDOx ID***
1	0200h
2	0300h
3	0400h
4	0500h

Node-ID = Node-ID of the module. The RPDO COB-IDs are automatically updated if the Node-ID is changed by LSS protocol.
80000000h in the COB-ID indicates that the PDO does not exist (destroyed)
04000000h in the COB-ID indicates that there is no RTR allowed on the PDO

Sub-Index	2h
Description	Transmission type
Access	RO
PDO Mapping	No
Value Range	See value definition in DS-301
Default Value	255 (FFh) = Event Driven

Sub-Index	3h
Description	Inhibit Time
Access	RW
PDO Mapping	No
Value Range	See value definition in DS-301
Default Value	0

Sub-Index	4h
Description	Compatibility entry
Access	RW
PDO Mapping	No
Value Range	UNSIGNED8
Default Value	0

Sub-Index	5
Description	Event-timer
Access	RW
PDO Mapping	No
Value Range	See value definition in DS-301
Default Value	0

Recall: A non-zero event timer for an RPDO means that it will result in a network fault being flagged if it has not been received within this timeframe while in Operational mode.

3.2.15 TPDO Behaviour

The DIO Controller can support up to four TPDO messages. All TPDOs use the similar default communication parameters, with the PDO IDs set according to the pre-defined connection set described in DS-301. Most TPDOs do not exist, there is no RTR allowed, they use 11-bit CAN-IDs (base frame valid) and they are all time-driven. While all four have valid default mappings defined (see below) only TPDO1 is enabled by default (i.e. TPDO exists).

TPDO1 Mapping at Object 1A00h: Default ID 0x180 + Node ID

Sub-Index	***Value***	***Object***
0	2	Number of mapped application objects in PDO
1	0x60000108	Digital Input 1 to 8 Read State
2	0x60000208	Digital Input 9 to 12 Read State
3	0	Not used by default
4	0	Not used by default

TPDO2 Mapping at Object 1A01h: Default ID 0x280 + Node ID

Sub-Index	***Value***	***Object***
0	0	Number of mapped application objects in PDO
1	0	Not used by default
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

TPDO3 Mapping at Object 1A02h: Default ID 0x380 + Node ID

Sub-Index	***Value***	***Object***
0	0	Number of mapped application objects in PDO
1	0	Not used by default
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

TPDO4 Mapping at Object 1A03h: Default ID 0x480 + Node ID

Sub-Index	Value	Object
0	2	Number of mapped application objects in PDO
1	0x50200020	Power Supply Field Value (measured)
2	0x50300020	Processor Temperature Field Value (measured)
3	0	Not used by default
4	0	Not used by default

Since all but TPDO1 has a zero value transmission rate (i.e. Event Timer in sub-index 5 of communication object), only TPDO1 will be automatically broadcasted when the unit goes into OPERATIONAL mode.

Object Description

Index	1800h to 1803h
Name	TPDO communication parameter
Object Type	RECORD
Data Type	PDO Communication Record

Entry Description

Sub-Index	0h
Description	Number of entries
Access	RO
PDO Mapping	No
Value Range	5
Default Value	5

Sub-Index	1h
Description	COB-ID used by TPDO
Access	RW
PDO Mapping	No
Value Range	See value definition in DS-301
Default Value	40000000h + TPDO1 + Node-ID C0000000h + TPDOx + Node-ID

X	*TPDOx ID*
1	0180h
2	0280h
3	0380h
4	0480h

Node-ID = Node-ID of the module. The TPDO COB-IDs are automatically updated if the Node-ID is changed by LSS protocol.
80000000h in the COB-ID indicates that the PDO does not exist (destroyed)
04000000h in the COB-ID indicates that there is no RTR allowed on the PDO

Sub-Index	2h
Description	Transmission type
Access	RO
PDO Mapping	No
Value Range	See value definition in DS-301
Default Value	254 (FEh) = Event Driven

Sub-Index	3h
Description	Inhibit Time
Access	RW
PDO Mapping	No
Value Range	See value definition in DS-301
Default Value	0

Sub-Index	4h
Description	Compatibility entry
Access	RW
PDO Mapping	No
Value Range	UNSIGNED8
Default Value	0

Sub-Index	5
Description	Event-timer
Access	RW
PDO Mapping	No
Value Range	See value definition in DS-301
Default Value	100ms (on TPDO1) 0ms (on TPDO2, TPDO3, TPDO4)

3.3 **APPLICATION OBJECTS (DS-401)**

Index (hex)	***Object***	***Object Type***	***Data Type***	***Access***	***PDO Mapping***
6000	DI Read State Input Line	ARRAY	UNSIGMED8	RO	Yes
6010	DI Active State Input Line	ARRAY	UNSIGNED8	RW	No
6011	DI Type Input Line	ARRAY	UNSIGNED8	RW	No
6200	DO Write State Output Line	ARRAY	UNSIGNED8	RO	Yes
6201	DO Type Output Line	ARRAY	UNSIGNED8	RW	No
6330	DO Toggle Frequency	ARRAY	UNSIGNED16	RW	No

3.3.1 Object 6000h: DI Read State 8 Bit Input Line

This read only object has the states of all the relay inputs and 1 bit for each. Each sub index has 8 bits which means sub index 1 has the states for input 1 to 8 and sub index 2 has the states for input 9 to 12. The 13th to 16th bits in sub index 2 are not used.

Object Description

Index	6000h
Name	DI Read State 8 Bit Input Line
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	2
Default Value	2

Sub-Index	1h to 2h
Description	DI Read State
Access	RO
PDO Mapping	Yes
Value Range	0x00…0xFF
Default Value	0 (ALL OFF)

3.3.2 Object 6010h: DI Active State Input Line

This object defines the relationship between the logic state and the drive state of a single digital output, as described in Section 1.2.1.

Object Description

Index	6010h
Name	DI Active State Input Line
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	12
Default Value	12

Sub-Index	1h to 12h (x=1 to 12)
Description	DIx Active State
Access	RW
PDO Mapping	No
Value Range	See Table 1
Default Value	0 (Active High)

3.3.3 Object 6011h: DI Type Input Line

This object specifies the type of digital input, as defined in Table 2.

Object Description

Index	6240h
Name	DI Type Input Line
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	12
Default Value	12

Sub-Index	1h to 12h (x=1 to 12)
Description	DIx Type
Access	RW
PDO Mapping	No
Value Range	See Table 2
Default Value	1 (Normal Logic)

3.3.4 Object 6200h: DO Write State 8 Bit Output Line

This object shall set a single digital output logic state when the corresponding DO is being controlled by a CANopen® Message. Each bit represents 1 output which means it holds the states of all 8 outputs in one sub index.

Object Description

Index	6200h
Name	DO Write State 8 Bit Output Line
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	1
Default Value	1

Sub-Index	1h
Description	DO Write State
Access	RO
PDO Mapping	Yes
Value Range	0x00…0xFF
Default Value	0x00 (ALL OFF)

3.3.5 Object 6201h: DO Type Output Line

This object specifies the type of analog output, as defined in Table 3.

Object Description

Index	6201h
Name	DO Type Output Line
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x=1 to 8)
Description	DOx Type
Access	RW
PDO Mapping	No
Value Range	See Table 3
Default Value	1 (Normal Logic)

3.3.6 Object 6330h: DO Toggle Frequency Output Line

This object is meant to be used only when the output type is selected as *Toggle Logic*. It defines the frequency that will be used when the output toggles between Normally Closed and Normally Open. The physical unit for this object is milliseconds.

Object Description

Index	6330h
Name	DO Toggle Frequency Output Line
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x=1 to 8)
Description	DOx Toggle Frequency
Access	RW
PDO Mapping	No
Value Range	0…60000 [ms]
Default Value	500 [ms]

3.4 **MANUFACTURER OBJECTS**

Index (hex)	***Object***	***Object Type***	***Data Type***	***Access***	***PDO Mapping***
2003	DI Debounce Time Input Line	ARRAY	UNSIGNED16	RW	No
2210	DO Control Source Output Line	ARRAY	UNSIGNED8	RW	No
2211	DO Control Number Output Line	ARRAY	UNSIGNED8	RW	No
2220	DO Enable Source	ARRAY	UNSIGNED8	RW	No
2221	DO Enable Number	ARRAY	UNSIGNED8	RW	No
2222	DO Enable Response	ARRAY	UNSIGNED8	RW	No
2230	DO Enable Unlatch	ARRAY	UNSIGNED8	RW	No
2231	DO Unlatch Source	ARRAY	UNSIGNED8	RW	No
2232	DO Unlatch Number	ARRAY	UNSIGNED8	RW	No
2360	DO Override Source	ARRAY	UNSIGNED8	RW	No
2361	DO Override Number	ARRAY	UNSIGNED8	RW	No
2362	DO Override Response	ARRAY	UNSIGNED8	RW	No
2363	DO Override State	ARRAY	UNSIGNED8	RW	No
2380	DO Enable Response Delay	ARRAY	UNSIGNED8	RW	No
2381	DO ON Delay	ARRAY	UNSIGNED32	RW	No
2382	DO OFF Delay	ARRAY	UNSIGNED32	RW	No
2A00	LED Control Source	ARRAY	UNSIGNED8	RW	No
2A04	LED Control Number	ARRAY	UNSIGNED8	RW	No
2A01	LED Type	ARRAY	UNSIGNED8	RW	No
2A02	LED Response	ARRAY	UNSIGNED8	RW	No
2A03	LED Blink Rate	ARRAY	UNSIGNED16	RW	No
5020	Power Supply Field Value	VAR	FLOAT32	RO	Yes
5021	Enable Error Detection on Power Supply	VAR	UNSIGNED8	RW	No
5022	Under Voltage Threshold	VAR	UNSIGNED8	RW	No
5023	Over Voltage Threshold	VAR	UNSIGNED8	RW	No
5024	Hysteresis to Clear Supply Fault	VAR	UNSIGNED8	RW	No
5025	Enable Power Supply Fault Disables Outputs	VAR	UNSIGNED8	RW	No
5030	Processor Temperature Field Value	VAR	FLOAT32	RO	Yes
5031	Enable Error Detection on Temperature	VAR	UNSIGNED8	RW	No
5032	Over Temperature Threshold	VAR	UNSIGNED8	RW	No
5033	Hysteresis to Clear Temperature Fault	VAR	UNSIGNED8	RW	No
5034	Enable Temperature Fault Shutdown	VAR	UNSIGNED8	RW	No
5555	Start in Operational Mode	VAR	UNSIGNED8	RW	No
5B50	Change Baud Rate	VAR	UNSIGNED8	RW	No
5B51	Change Node ID	VAR	UNSIGNED8	RW	No

3.4.1 **Object 2003h: DI Debounce Time Input Line**

This object is used to define the debounce time for the digital input in case where the digital input signal coming into the controller is noisy. See Figure 1 for more information. The physical unit is milliseconds.

Object Description

Index	2003h
Name	DI Debounce Time Input Line
Object Type	ARRAY
Data Type	UNSIGNED16

Entry Description

Sub-Index	0h
Description	Number of Entries
Access	RO
PDO Mapping	No
Value Range	12
Default Value	12

Sub-Index	1h to 12h (x=1 to 12)
Description	DIx Debounce Time
Access	RW
PDO Mapping	No
Value Range	0…50000 [ms]
Default Value	250[ms]

3.4.2 **Object 2210h: DO Control Source Output Line**

This object defines the type of input that will be used to control the digital outputs. The available control sources on the DIO controller are listed in Table 4. Not all sources would make sense to control the DO, and it is the user's responsibility to select a source that makes sense for the application.

Object Description

Index	2210h
Name	DO Control Source Output Line
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Number of Entries
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Control Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	1 (Digital Input)

3.4.3 **Object 2211h: DO Control Number Output Line**

This object defines the number of the source that will be used to control the analog (or digital) output as shown in the logic flowchart in Figure 6. The available control numbers are dependent on the source selected, as shown in Table 5. Once selected, the control represents the process value (X-Axis input) in Figure 5. Objects 6302h, 7320h, 7322h should therefore be updated to match the scaling limits defined by the control source/number, as listed in Table 6.

Object Description

Index	2211h
Name	DO Control Number Output Line
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Number of Entries
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Control Number
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	1 (Digital Input 1)

3.4.4 **Object 2220h: DO Enable Source**

This object defines the type of input that will be used to enable/disable the digital outputs. The available control sources on the DIO controller are listed in Table 4. Not all sources would make sense to enable the DO, and it is the user's responsibility to select a source that makes sense for the application.

Object Description

Index	2220h
Name	DO Enable Source
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Number of Entries
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Enable Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (control not used)

3.4.5 Object 2221h: DO Enable Number

This object defines the number of the source that will be used to enable/disable the digital outputs. The available control numbers are dependent on the source selected, as shown in Table 4. Once selected, the control will be interpreted as a digital input.

Object Description

Index	2221h
Name	DO Enable Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Enable Number
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (null source selected)

3.4.6 **Object 2222h: DO Enable Response**

This object determines if the input will act as an enable or safety interlock (i.e. input must be ON to engage the output) or a disable signal (i.e. the output will shutoff when the input is ON.) The options for this object are listed in Table 9.

Object Description

Index	2222h
Name	DO Enable Response
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Enable Response
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 (enable when input on)

3.4.7 **Object 2230h: DO Enable Unlatch**

This object defines if the unlatch function is enabled/disabled. Unlatch will only take effect when this object is set to be true (and when output type is selected as Latched Logic or Inverse Latched Logic only).

Object Description

Index	2230h
Name	DO Enable Unlatch
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Enable Unlatch
Access	RW
PDO Mapping	No
Value Range	0 (Disable) / 1 (Enable)
Default Value	0

3.4.8 Object 2231h: DO Unlatch Source

This object defines the type of input that will be used to active the unlatch signal for the digital outputs (when the output type is set to Latched Logic or Inverse Latched Logic only). The available unlatch sources on the DIO controller are listed in Table 4. Not all sources would make sense to unlatch the DO, and it is the user's responsibility to select a source that makes sense for the application.

Object Description

Index	2231h
Name	DO Unlatch Source
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Unlatch Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (control not used)

3.4.9 Object 2232h: DO Unlatch Number

This object defines the number of the source that will be used to unlatch the digital outputs. The available unlatch numbers are dependent on the source selected, as shown in Table 4. Once selected, the unlatch will be interpreted as a digital input.

Object Description

Index	2232h
Name	DO Unlatch Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Unlatch Number
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (control not used)

3.4.10 Object 2360h: DO Override Source

This object defines the type of input that will be used to active the override value for the digital outputs. The available override sources on the DIO controller are listed in Table 4. Not all sources would make sense to enable the DO, and it is the user's responsibility to select a source that makes sense for the application.

Object Description

Index	2360h
Name	DO Override Source
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Override Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (control not used)

3.4.11 Object 2361h: DO Override Number

This object defines the number of the source that will be used to override the digital outputs. The available override numbers are dependent on the source selected, as shown in Table 4. Once selected, the control will be interpreted as a digital input.

Object Description

Index	2361h
Name	DO Override Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Override Number
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (null source selected)

3.4.12 Object 2362h: DO Override Response

This object determines how the override command will respond to the input state. The options for this object are listed in Table 10.

Object Description

Index	2362h
Name	DO Override Response
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Override Response
Access	RW
PDO Mapping	No
Value Range	See Table 7
Default Value	1 (override when input on)

3.4.13 Object 2363h: DO Override State

This object determines if the override state is ON (Normally Closed) or OFF (Normally Open). The options for this object are listed in Table 6.

Object Description

Index	2363h
Name	DO Override State
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Override State
Access	RW
PDO Mapping	No
Value Range	See Table 6
Default Value	0 (override state off)

3.4.14 Object 2380h: DO Enable Response Delay

This object defines if a time delay for output states (ON/OFF) is enabled/disabled.

Object Description

Index	2380h
Name	DO Enable Response Delay
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx Enable Response Delay
Access	RW
PDO Mapping	No
Value Range	0 (Disable)/ 1 (Enable)
Default Value	0

3.4.15 Object 2381h: DO ON Delay

This object defines the length of time delay configured before turning ON the outputs. The unit is in milliseconds.

Object Description

Index	2381h
Name	DO ON Delay
Object Type	ARRAY
Data Type	UNSIGNED32

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx ON Delay
Access	RW
PDO Mapping	No
Value Range	0…86400000 (24hrs) [ms]
Default Value	0

3.4.16 Object 2382h: DO OFF Delay

This object defines the length of time delay configured before turning OFF the outputs. The unit is in milliseconds.

Object Description

Index	2382h
Name	AO Override Input Source
Object Type	ARRAY
Data Type	UNSIGNED32

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	8
Default Value	8

Sub-Index	1h to 8h (x= 1 to 8)
Description	DOx OFF Delay
Access	RW
PDO Mapping	No
Value Range	0…86400000 (24hrs) [ms]
Default Value	0

3.4.17 **Object 2A00h: LED Control Source**

This object along with object 2A04h define the source commanding the LED depending on stage trigger. For more details on this object please refer to Section 1.5.

Object Description

Index	2A00h
Name	LED Control Source
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	5
Default Value	5

Sub-Index	1h
Description	LED Stage 1 Control Source
Access	RW
PDO Mapping	No
Value Range	See Table 9
Default Value	2 (Power Supply Fault)

Sub-Index	2h
Description	LED Stage 2 Control Source
Access	RW
PDO Mapping	No
Value Range	See Table 9
Default Value	3 (Temperature Fault)

Sub-Index	3h
Description	LED Stage 3 Control Source
Access	RW
PDO Mapping	No
Value Range	See Table 9
Default Value	4 (CAN Fault)

Sub-Index	4h
Description	LED Stage 4 Control Source
Access	RW
PDO Mapping	No
Value Range	See Table 9
Default Value	0 (Control Not Used)

Sub-Index	5h
Description	LED Default Stage Control Source
Access	RO
PDO Mapping	No
Value Range	0
Default Value	0 (control not used)

3.4.18 Object 2A04h: LED Control Number

This object along with object 2A00h define the source commanding the LED depending on stage trigger. For more details on this object please refer to Section 1.5.

Object Description

Index	2A04h
Name	AO Enable Input Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	5
Default Value	5

Sub-Index	1h to 3h
Description	LED Stage x Control Number
Access	RW
PDO Mapping	No
Value Range	1
Default Value	1

Sub-Index	4h
Description	LED Stage 4 Control Number
Access	RW
PDO Mapping	No
Value Range	0/1
Default Value	0

Sub-Index	5h
Description	LED Default Stage Control Number
Access	RO
PDO Mapping	No
Value Range	0
Default Value	0 (null source selected)

3.4.19 **Object 2A01h: LED Type**

This object defines the type/color of the LED when it is commanded ON by its control source. For more details on this object please refer to Section 1.5.

Object Description

Index	2A01h
Name	AO Enable Response
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	5
Default Value	5

Sub-Index	1h to 2h
Description	LED Stage x Type
Access	RW
PDO Mapping	No
Value Range	See Table 10
Default Value	2 (Red)

Sub-Index	3h
Description	LED Stage 3 Type
Access	RW
PDO Mapping	No
Value Range	See Table 10
Default Value	3 (Toggle Green/Red)

Sub-Index	4h
Description	LED Stage 4 Type
Access	RW
PDO Mapping	No
Value Range	See Table 10
Default Value	0 (Disabled)

Sub-Index	5h
Description	LED Default Stage Type
Access	RW
PDO Mapping	No
Value Range	See Table 10
Default Value	1 (Green)

3.4.20 **Object 2A02h: LED Response**

This object defines the behavior of the LED when it is commanded ON by its control source. For more details on this object please refer to Section 1.5.

Object Description

Index	2A02h
Name	LED Response
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	5
Default Value	5

Sub-Index	2h
Description	LED Stage 2 Response
Access	RW
PDO Mapping	No
Value Range	See Table 11
Default Value	1 (LED ON)

Sub-Index	1h, 3h
Description	LED Stage x Response
Access	RW
PDO Mapping	No
Value Range	See Table 11
Default Value	3 (LED Blinking)

Sub-Index	4h
Description	LED Stage 4 Response
Access	RW
PDO Mapping	No
Value Range	See Table 11
Default Value	0 (LED off)

Sub-Index	5h
Description	LED Default Stage Response
Access	RW
PDO Mapping	No
Value Range	See Table 11
Default Value	3 (LED Blinking)

3.4.21 **Object 2A03h: LED Blink Rate**

This object defines the rate at which the dual LED will blink when it is commanded ON by its control source if the **LED Response** object 2A02 is set to *Blink Logic*. For more details on this object please refer to Section 1.5.

Object Description

Index	2A03h
Name	LED Blink Rate
Object Type	ARRAY
Data Type	UNSIGNED16

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	5
Default Value	5

Sub-Index	1h ,3h
Description	LED Stage x Blink Rate
Access	RW
PDO Mapping	No
Value Range	0…60000 [ms]
Default Value	500[ms]

Sub-Index	2h ,4h
Description	LED Stage x Blink Rate
Access	RW
PDO Mapping	No
Value Range	0…60000 [ms]
Default Value	0 [ms]

Sub-Index	5h
Description	LED Default Stage Blink Rate
Access	RW
PDO Mapping	No
Value Range	0…60000 [ms]
Default Value	500[ms]

3.4.22 **Object 5020h: Power Supply Field Value**

This read-only object is available for diagnostic feedback purposes. It reflects the measured voltage powering the controller. The physical unit for this object is volts.

Object Description

Index	5020h
Name	Power Supply Field Value
Object Type	VARIABLE
Data Type	FLOAT32

Entry Description

Sub-Index	0h
Access	RO
PDO Mapping	Yes
Value Range	0…36 [V]
Default Value	No

3.4.23 Object 5021h: Enable Error Detection on Power Supply

This write-able object is available to enable faults on power supply measured in the system. When this object is enabled, objects 5022h-5025h are used to determine fault triggers and fault clear thresholds. For more information please refer to Section 1.4.1.

Object Description

Index	5021h
Name	Enable Error Detection on Power Supply
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	FALSE; TRUE
Default Value	TRUE (1)

3.4.24 Object 5022h: Under Voltage Threshold

This object is used to set the value at which a supply fault will trigger if the measured supply falls below it. If object 5021h is disabled, this value is ignored. For more information please refer to Section 1.4.1.

Object Description

Index	5022h
Name	Under Voltage Threshold
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	8V… Object 5023h
Default Value	9 (V)

3.4.25 Object 5023h: Over Voltage Threshold

This object is used to set the value at which a supply fault will trigger if the measured supply falls above it. If object 5021h is disabled, this value is ignored. For more information please refer to Section 1.4.1.

Object Description

Index	5023h
Name	Over Voltage Threshold
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	Object 5022h… 36V
Default Value	36 (V)

3.4.26 Object 5024h: Hysteresis to Clear Supply Fault

This object is used to set the value by which the supply voltage needs to increase or decrease to clear the fault set by an under voltage or over voltage, respectively. If object 5021h is disabled, this value is ignored. For more information please refer to Section 1.4.1.

Object Description

Index	5024h
Name	Hysteresis to Clear Supply Fault
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	0.01V…30V
Default Value	1 (V)

3.4.27 Object 5025h: Enable Power Supply Fault Disables Outputs

This write-able object is available to enable disable on all the outputs when there are faults on power supply measured in the system. For more information please refer to Section 1.4.1.

Object Description

Index	5025h
Name	Enable Power Supply Fault Disables Outputs
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	FALSE; TRUE
Default Value	TRUE (1)

3.4.28 Object 5030h: Processor Temperature Field Value

This read-only object is available for diagnostic feedback purposes. It reflects the measured temperature of the processor, which will always run approximately 10°C to 20°C above ambient. The physical unit for this object is degrees Celsius.

Object Description

Index	5030h
Name	Processor Temperature Field Value
Object Type	VARIABLE
Data Type	FLOAT32

Entry Description

Sub-Index	0h
Access	RO
PDO Mapping	Yes
Value Range	-50 to 150 [°C]
Default Value	No

3.4.29 Object 5031h: Enable Error Detection on Temperature

This write-able object is available to enable faults on temperature measured in the system. When this object is enabled, objects 5032h-5034h are used to determine fault triggers and fault clear thresholds. For more information please refer to Section 1.4.1.

Object Description

Index	5031h
Name	Enable Error Detection on Temperature
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	FALSE; TRUE
Default Value	TRUE (1)

3.4.30 Object 5032h: Over Temperature Threshold

This object is used to set the value at which a temperature fault will trigger if the measured microcontroller temperature falls above it. If object 5031h is disabled, this value is ignored. For more information please refer to Section 1.4.1.

Object Description

Index	5032h
Name	Over Temperature Threshold
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	50…150 (DegC)
Default Value	125 (DegC)

3.4.31 Object 5033: Hysteresis to Clear Temperature Fault

This object is used to set the value by which the temperature needs to decrease to clear the fault set by an over temperature event. If object 5031h is disabled, this value is ignored. For more information please refer to Section 1.4.1.

Object Description

Index	5033h
Name	Hysteresis to Clear Temperature Fault
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	1…50 (DegC)
Default Value	5 (DegC)

3.4.32 Object 5034h: Enable Temperature Fault Shutdown

This write-able object is available to enable shutdown when there are faults on temperature measured in the system. For more information please refer to Section 1.4.1.

Object Description

Index	5034h
Name	Enable Temperature Fault Shutdown
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	FALSE; TRUE
Default Value	TRUE (1)

3.4.33 **Object 5555h: Start in Operational Mode**

This object allows the unit to start in Operational mode without requiring the presence of a CANopen® Master on the network. It is intended to be used only when running the DIO controller as a stand-alone module. This should always be set FALSE whenever it is connected to a standard master/slave network.

Object Description

Index	5555h
Name	Start in Operational Mode
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	0 (FALSE) or 1 (TRUE)
Default Value	0 [FALSE]

3.4.34 Object 5B50h: Change Baud Rate

The DIO Controller could be configured to different baud rates by changing the value in this object. The options for this object are defined in Table 12.

Object Description

Index	5B50h
Name	Change Baud Rate
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	0…8
Default Value	4 (125k)

3.4.35 Object 5B51h: Change Node ID

This object is used to configure the node ID of the module.

Object Description

Index	5B51h
Name	Change Node ID
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	Unsigned8
Default Value	32

4 TECHNICAL SPECIFICATIONS

1. Technical Specifications:

Power	DIO is a battery powered device with special ability to withstand long time engine cranking. Reverse polarity and transient protected. • Supply voltage: 9-32 V. Nominal: 12Vdc and 24Vdc. • Typical supply current at 12V: 42 mA + 50mA per active relay • Typical supply current at 24V: 23 mA + 30mA per active relay
Digital Inputs	12 digital active-low inputs with pull-up resistors. • ON voltage level: 0-0.8 V • OFF voltage level: 3.75V to +BAT • Input resistance: more than 5 kOhm The inputs have internal over and under voltage protection.
Relay Outputs	**AX031801:** 8 Form C relay outputs. Resistive load: • 2A NO)/2 A (NC) at 277 VAC • 2 A (NO)/2 A (NC) at 125 VAC • 2 A (NO)/2 A (NC) at 30 VDC Dielectric strength: • 4,000 VAC, 50/60 Hz for 1 min between coil and contacts • 750 VAC, 50/60 Hz for 1 min between contacts of same polarity There is no special overcurrent/overvoltage protection on the relay outputs. The user is advised to provide a fast acting 3A fuse or an adequate external protection if necessary.
	AX031851: Sets 8 Form C relay outputs. Resistive load: • 5A (NO)/5 A (NC) at 30 VDC Dielectric strength: • 4,000 VAC, 50/60 Hz for 1 min between coil and contacts • 750 VAC, 50/60 Hz for 1 min between contacts of same polarity There is no special overcurrent/overvoltage protection on the relay outputs. The user is advised to provide a fast acting 6A fuse or an adequate external protection if necessary.
CAN	Bosch CAN protocol specification, Rev.2.0, Part A and B. Baud Rate: AX0318x1: 125 bit/sec Other requirements – according to CANopen® standard.
Indicator	Front panel Red-Green Bi-LED indicator. (Model AX031801)
Control Logic	User programmable functionality.
User Interface	EDS File Standard CANopen® tools
CAN	Model AX0318x1: 1 CANopen® For SAE J1939 models, refer to TDAX031800.
RS-232	1 RS-232 port available, ASCII Text Format, 115200 Baud Rate Data – 8 bit, Parity – None, Stop – 1 bit. Flow Control – Xon/Xoff. Short circuit protection to ground.
Operating Temperature Range	-40 to 85 ºC (-40 to 185 ºF)
Storage Temperature Range	-50 to 120 ºC (-58 to 248 ºF)
Humidity	Protected against 95% humidity non-condensing, 30 ºC to 60 ºC
Enclosure	Rugged aluminum housing, stainless steel end plates, neoprene gaskets Conformal coated PCB assemblies and partially encapsulated 145.30 x 149.00 x 73.00 mm (5.72 x 5.86 x 2.87") L x W x H Connectors, Deutsch IPD P/N: 1 8-pin DT13-08PA, 1 40-pin DRC13-40PB
Protection	IP67

<table>
<tr><td>Weight</td><td>AX031801:
2.73 lb. (1.24 kg)
AX031851:
0.45 lb. (0.204 kg)2.73 lbs. (1.24 kg)</td></tr>
<tr><td>Vibration and Shock</td><td>Model AX031801: 4.3 G for off-engine mounting

Model AX031851:<table><tr><td>Vibration</td><td>MIL-STD-202G, Test 204D and 214A (Sine and Random)
10 g peak (Sine); 7.86 Grms peak (Random)</td></tr><tr><td>Shock</td><td>MIL-STD-202G, Test 213B, 50 g</td></tr></table></td></tr>
<tr><td>Compliance</td><td>CE marking</td></tr>
</table>

5 VERSION HISTORY

User Manual Version	Date	Author	Modifications
1	Jan 23th, 2019	Jessica Chen	Initial Draft
-	March 29, 2019	Amanda Wilkins	Marketing Review, drawing added
-	April 30, 2019	Jessica Chen	Added information for AX031851
-	July 29, 2020	Amanda Wilkins	Added CE marking, Added vibration compliance. Added weight of AX031851

OUR PRODUCTS

Actuator Controls

Automotive Ethernet Converters

Battery Chargers

CAN bus Controls

CAN/Wifi, CAN/Bluetooth

Current/Voltage Converters

DC/DC Power Converters

Engine Temperature Scanners

Ethernet/CAN Converters, Switches

Fan Drive Controllers

Gateways, CAN/Modbus Protocols

Gyroscope Inclinometers

Hydraulic Valve Controllers

Inclinometers, Triaxial

I/O Controls

LVDT Simulators

Machine Controls

Modbus Controls

Motor Controls

Power Supplies

PWM Signal Converters/Isolators

Resolver Signal Conditioners

Service Tools

Signal Conditioners, Converters

Strain Gauge CAN Controls

Surge Suppressors

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Axiomatic provides electronic machine controls, components, and systems to the off-highway, commercial vehicle, electric vehicle, power generator set, material handling, renewable energy and industrial OEM markets.

We innovate with engineered and off-the-shelf machine controls that add value for our customers. We emphasize service and partnership with our customers, suppliers, and employees to build long term relationships and mutual trust.

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All products to be returned to Axiomatic require a Return Materials Authorization Number (RMA#). Please request an RMA# from sales@axiomatic.com.

Please provide the following information when requesting an RMA number:

- Serial number, part number
- Axiomatic invoice number and date
- Hours of operation, description of problem
- Wiring set up diagram, application
- Other comments as needed

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