16 Analog I/O

With CANopen®

USER MANUAL

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VERSION HISTORY

Version	Date	Author	Modifications
1.0.0	December 2, 2010	Antti Keränen	Initial Draft
1.0.1	December 17, 2010	Antti Keränen	2103h type fixed, limits for 2001h updated. 2113h added, 6310h type updated. Limits for 2100h, 2101h and 2102h updated.
1.0.2	June 8, 2012	Amanda Wilkins	Updated dimensional drawing
1.0.3	December 15, 2016	Antti Keränen	3003h, 7120h, 7122h, 7300h, 7320h and 7322h descriptions corrected. Section 1.4 updated, table 7 added.

ACRONYMS

AI	Analog Input (Universal)
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
PID	Proportional-Integral-Derivative Control
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-404] CiA DS-404 V1.2 – CANopen profile for Measurement Devices and Closed Loop Controllers. CAN in Automation 2002

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

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1. OVERVIEW OF CONTROLLER

1.1. Description of 16 Analog I/O Controller

The 16 Analog I/O (16AIO) is a device intended to provide control of up to eight analog signal level outputs over CANopen ® network. Each output channel could be independently configured to be either a –5V to 5V, 0 to 5V, -10V to 10V, 0 to 10V, 0 to 20mA or 4 to 20mA output. Each output has associated with it an AGND reference pin.

The 16AIO also has eight analog inputs which can be independently configured to accept a 0 to 5V, 0 to10V, 0(4)-20mA, PWM, Frequency/RPM, 16-bit Counter, or an active high digital input. Each input has associated with it an Analog Ground (AGND) reference pin, and a +5V or 20mA reference pin.

As an alternative to being controlled by messages received from the CAN bus, an output could be configured to use any of the on board inputs as either a control signal or an enable signal.

The various functions supported by the 16AIO 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 Block

The digital input (DI) function block only becomes applicable on the input when object 6112h, **AI Operation**, is set to a digital input response.

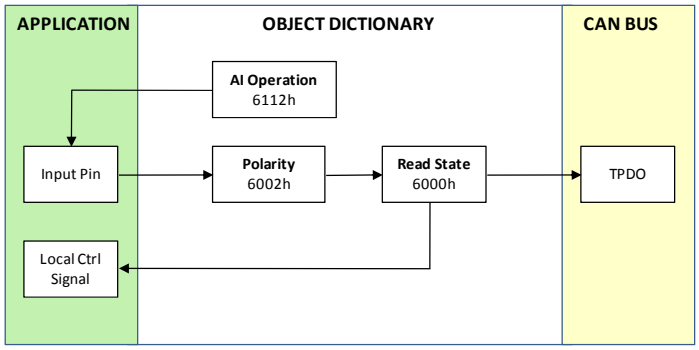


Figure 1 – Digital Input Objects

Once the raw state of the input has been evaluated, the logical state is determined by **object 6002h DI Polarity Bitmap.** The options for object 6002h are shown in Table 3. The 'calculated' state of the DI that will be written to read-only object 6000h **DI Read State Bitmap** will be a combination of active highs/lows and the polarities selected.

Bit Value	Meaning	Active High	Active Low	State
0	**Normal On/Off**	HIGH	LOW	ON
		LOW or Open	HIGH or Open	OFF
1	Inverse On/Off	HIGH	LOW	OFF
		LOW or Open	HIGH or Open	ON

Table 1 – DI Polarity Options versus DI State

1.3. Analog Input Function Block

Each analog input can be configured for any one of the following options, and the properties and behavior of the input in each mode is described below. Unless noted otherwise, the reference pin associated with each input channel is set to +5V.

Input Disabled: The input is not used.

0 to 5 Volt: The input is configured to accept a voltage input in the range of 0 to 5V. Signals above 5V will be rectified to 5V. Error detection objects will be interpreted in millivolts.

0 to 10 Volt: The input is configured to accept a voltage input in the range of 0 to 10V. Signals above 10V will be rectified to 10V. Error detection objects will be interpreted in millivolts.

0(4) to 20 Milliamp: The input is configured to accept a current input in the range of 0 to 20 mA. Signals above 20mA will be rectified to 20mA. Error detection objects will be interpreted in milliamps. In this mode, the reference pin associate with the input channel will source a constant 20mA.

PWM Duty Cycle: The input is configured to measure the duty cycle of a pulse width modulated (PWM) signal in the range of 0 to 100%dc. Error detection objects will be interpreted in %dc.

Frequency/RPM: The input is configured to count the number of pulses that occur over the period of the AI Input Measuring Window object (2090h), and calculate the frequency of the pulses. Error detection objects will be interpreted in hertz. If the AI Input Pulse per Revolution objects (2001h) is non-zero the frequency will be converted into an RPM input. In this case, the error detection objects will be interpreted in RPM.

NOTE: The difference between Frequency and Counter mode is that the Frequency mode measures the number of pulses that occur in the Measuring Window period and calculates frequency, while the counter gives the period of time (in milliseconds) it takes for the number of pulses in the Measuring Window to be read at the input.

NOTE: If the Input Maximum object (2070h) is set for a low frequency (<=50Hz), the controller will use a different technique to measure the frequency. Instead of measuring the pulses in the Measuring Window (this parameter is ignored) it will measure the time between rising edges of the signal. If more than 10 seconds pass without a transition, the input will be read as zero. The frequency range in this mode is 0.5-50Hz, with up to 2 decimal places of resolution.

16-bit Counter: The input is configured to count pulses on the input until the value in the AI Input Measuring Window object (2090h) is reached. While the counter is active, a timer with a 1ms resolution is running in the background. When the count has been reached, the value in the 1ms timer is captured and updated to the input feedback variable. The timer is reset until the count value once

again reaches the AI Input Measuring Window. Input and error detection objects are not used, since error detection is not possible in this mode, and a counter input cannot be used to control an output.

WARNING: If set to be a 16-bit counter, the input can no longer be used as either a control signal or an enable input to any of the outputs on the 16AIO.

Digital (High): The input is configured to read the state of an active high digital input. (Switch is connected to a +V signal when ON.) Error detection objects are not used, since error detection is not possible in this mode. See previous section (1.2) for more info.

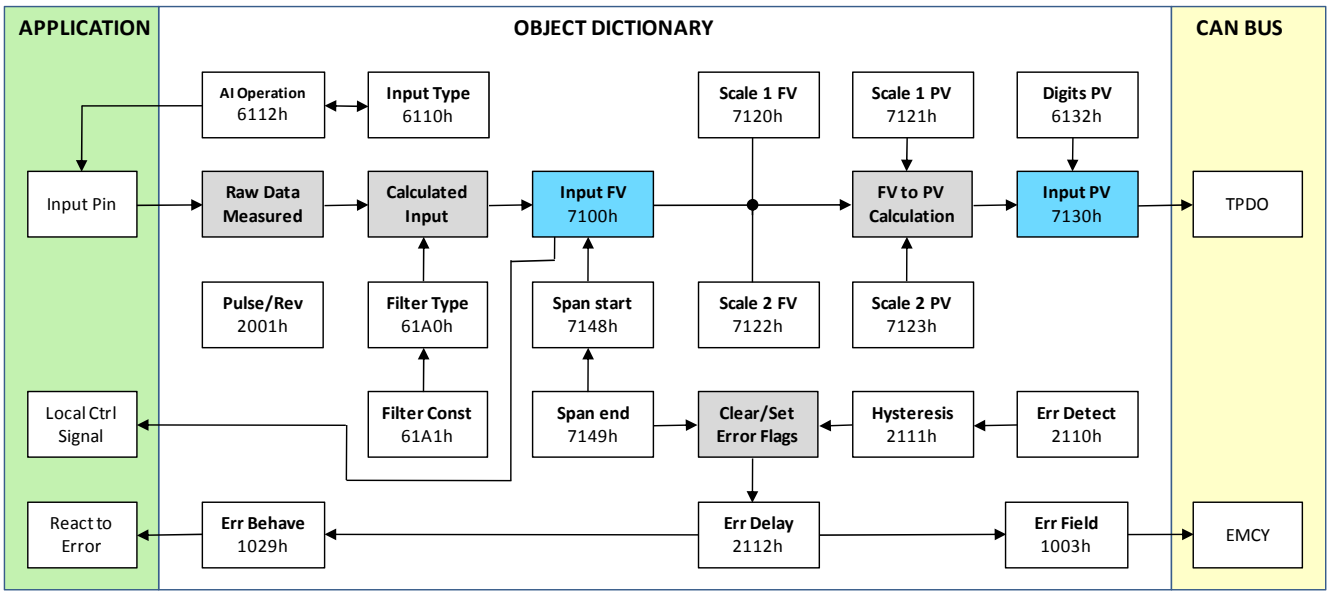


Figure 2 – Analog Input Objects

Object 6112h, **AI Operating Mode** determines whether the AI or DI function block is associated with input. The options for object 6112h are shown in Table 2. No values other than what are shown here will be accepted.

Value	Meaning
0	Channel Off
1	**Normal Operation (analog)**
10	Digital Input (on/off)

Table 2 – AI Operating Mode Options

The most important object associate with the AI function block is object 6110h **AI Sensor Type**. By changing this value, other objects will be automatically updated by the controller. The options for object 6110h are shown in Table 3, and no values other than what are shown here will be accepted. The input is setup to measure voltage (0…5V) by default.

Value	Meaning
0	Input not in use
1	**Voltage Input, 0…5V**
2	Voltage Input, 0…10V
3	Current Input, 0(4)…20mA
4	PWM Input
5	Frequency Input (or RPM)
6	16-bit Counter
7	Digital Input

Table 3 – AI Sensor Type Options

Independent of type, all analog inputs can be further filtered once the raw data has been measured (either from ADC or Timer.) Object 61A0h **AI Filter Type** determines what kind of filter is used per Table 4. By default, additional software filtering is disabled.

Value	Meaning
0	**No Filter**
1	Moving Average
2	Repeating Average

Table 4 – AI Filter Type Options

Object 61A1h **AI Filter Constant** is used with all three types of filters as per the formulas below:

Calculation with no filter:
Value = Input
The data is simply a 'snapshot' of the latest value measured by the ADC or timer.

Calculation with the moving average filter:

$$Value_N = Value_{N-1} + \frac{(Input - Value_{N-1})}{FilterConstant}$$

This filter is called every 1ms. The value FilterConstant stored in object 61A1h is 1 by default.

Calculation with the repeating average filter:

$$Value = \frac{\sum Input_N}{N}$$

At every reading of the input value, it is added to the sum. At every N^{th} read, the sum is divided by N, and the result is the new input value. The value and counter will be set to zero for the next read. The value of N is stored in object 61A1h, and is 1 by default. This filter is called every 1ms.

The **AI Input FV** (7100h) is used by the application for error detection, and as a control signal for other blocks (i.e. output control.) Object 7100h is mapped to TPDO2 (inputs 1…4) and TPDO3 (inputs 5…8) by default.

Read-only object 7130h **AI Input Process Value** is also mappable. However, the default values for objects 7121h **AI Scaling 1 PV** and 7123h **AI Scaling 2 PV** are set to equal 7120h and 7122h respectively. This means that the default relationship between the FV and PV is one-to-one, so object 7130h is not mapped to a TPDO by default.

Should a different linear relationship between what is measured versus what is sent to the CANopen bus be desired, objects 6132h, 7121h and 7123h can be changed. The linear relationship profile is shown in Figure 3 below.

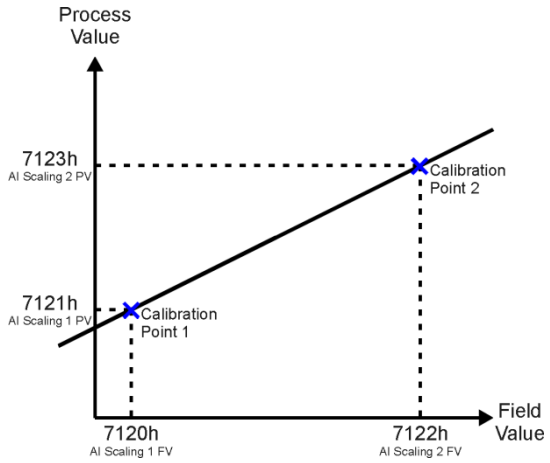


Figure 3 – Analog Input Linear Scaling FV to PV

If the input type is changed, various values are updated automatically by the 16AIO. These include **AI Input Minimum** (2020h), **AI Input Breakpoint Minimum** (2030h), **AI Input Deadband Minimum** (2040h), **AI Input Deadband Maximum** (2050h), **AI Input Breakpoint Maximum** (2060h), **AI Input Maximum** (2020h). Also included are the FV to PV scaling objects, 7120h and 7122h.

The **AI Span Start** (7148h) and **AI Span End** (7149h) objects are used for fault detection, so they too are automatically updated for sensible values as the input type changes. The Error Clear Hysteresis (2111h) object is also updated, as it too is measured in the same unit as the AI Input FV object.

Table 5 lists the default values that are loaded into objects 7120h, 7122h, 7148h, 7149h, and 2111h for Analog Sensor Types. In case input is disabled or selected as digital input, the 0…5V input values are used.

Sensor Type/ Input Range	7148h AI Span Start (i.e. Error Min)	7120h AI Scaling 1 FV (i.e. Input Min)	7122h AI Scaling 2 FV (i.e. Input Max)	7149h AI Span End (i.e. Error Max)	2111h Error Clear Hysteresis
Voltage: 0 to 5V	0 [mV]	0 [mV]	5000 [mV]	5000 [mV]	250 [mV]
Voltage: 0 to 10V	0 [mV]	0 [mV]	10000 [mV]	10000 [mV]	250 [mV]
Current: 0 to 20mA	0 [uA]	0 [uA]	20000 [uA]	20000 [uA]	250 [uA]
Frequency / RPM	0 [Hz]	0 [Hz]	10000 [Hz]	10000 [Hz]	10 [Hz]
PWM: 0 to 100%	10 [0.1%]	50 [0.1%]	950 [0.1%]	990 [0.1%]	100 [0.01%]

Table 5 – AI Object Defaults Based on Sensor Type and Input Range

The last objects associated with the analog input block left to discuss are those associated with fault detection. Should the calculated input (after measuring and filtering) fall outside of the

allowable range, as defined by the AI Span Start (7148h) and AI Span End (7149h) objects, an error flag will be set in the application if and only if object 2110h **AI Error Detect Enable** is set to TRUE (1).

When (7100h AI Input FV < 7148h AI Span Start), an “Out of Range Low” flag is set. If the flag stays active for the 2112h **AI Error Reaction Delay** time, an Input Overload Emergency (EMCY) message will be added to object 1003h **Pre-Defined Error Field**. Similarly, when (7100h AI Input FV > 7149h AI Span End), an “Out of Range High” flag is set, and will create an EMCY message should it stay active throughout the delay period. In either case, the application will react to the EMCY message as defined by object 1029h **Error Behaviour** at the sub-index corresponding to an Input Fault. Refer to section 3.2.4 and 3.2.13 for more information about objects 1003h and 1029h.

Once the fault has been detected, the associate flag will be cleared only once the input comes back into range. Object 2111h **AI Error Clear Hysteresis** is used here so that the error flag will not be set/cleared continuously while the AI Input FV hovers around the AI Span Start/End value.

To clear an “Out of Range Low” flag, AI Input FV >= (AI Span Start + AI Error Clear Hysteresis)
To clear an “Out of Range High” flag, AI Input FV <= (AI Span End - AI Error Clear Hysteresis)
Both flags cannot be active at once. Setting either one of these flags automatically clears the other.

1.4. Analog Output Function Block

Each analog output can be configured for one of the following options, and the properties and behavior of the output in each mode is described below.

0 to 5 Volt: The output is configured to drive a voltage output in the range of 0V to 5V.

-5 to 5 Volt: The output is configured to drive a voltage output in the range of –5V to 5V.

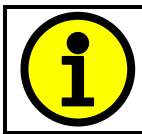
0 to 10 Volt: The output is configured to drive a voltage output in the range of 0V to 10V.

-10 to 10 Volt: The output is configured to drive a voltage output in the range of –10V to 10V.

0(4) to 20 Milliamp: The output is configured to source a current in the range of 0mA to 20mA.

For each output type, if the control signal is one of the inputs on the board, then there are up to six output profiles that can be selected to determine how the output will react to a change at the input. See the graphs below for a description of the profiles.

WARNING: If the control input is set to a Digital type, the output will simply jump to the maximum value when the input is ON, and jump to the minimum value when the output is OFF.



NOTE: For outputs that are controlled using a CANopen ® Process Value, only the "Single Profile" responses will be used (single or dual slope)

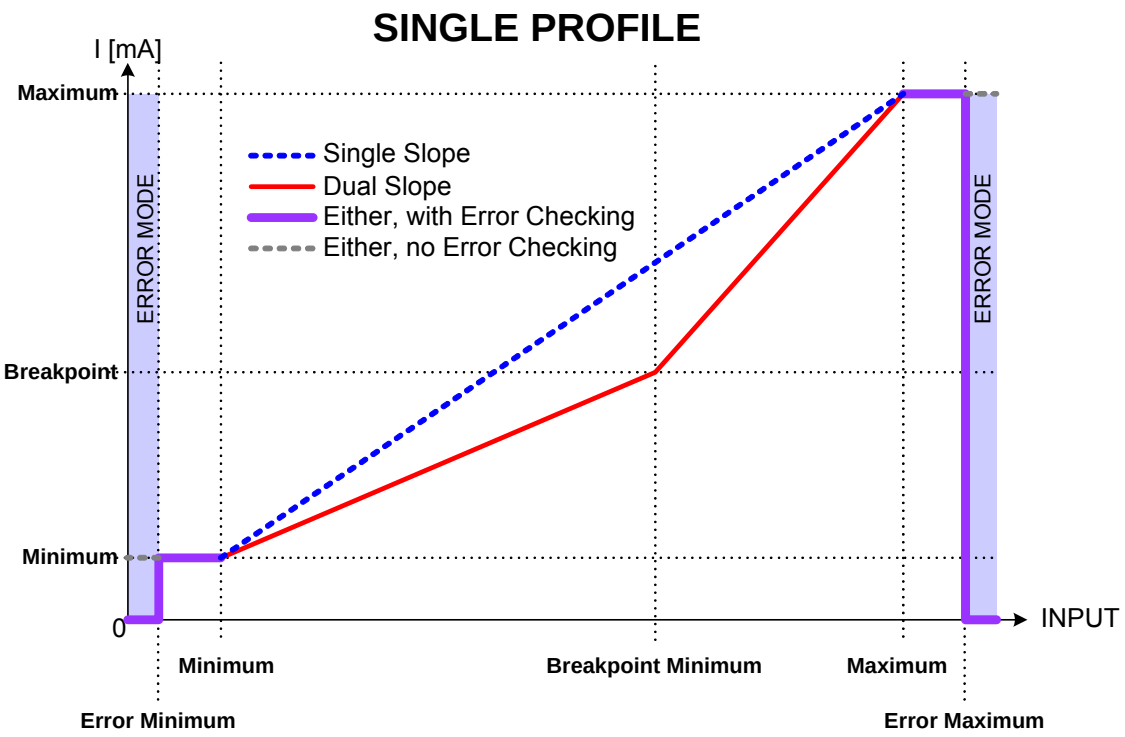


Figure 4 – Analog Output Single Profile

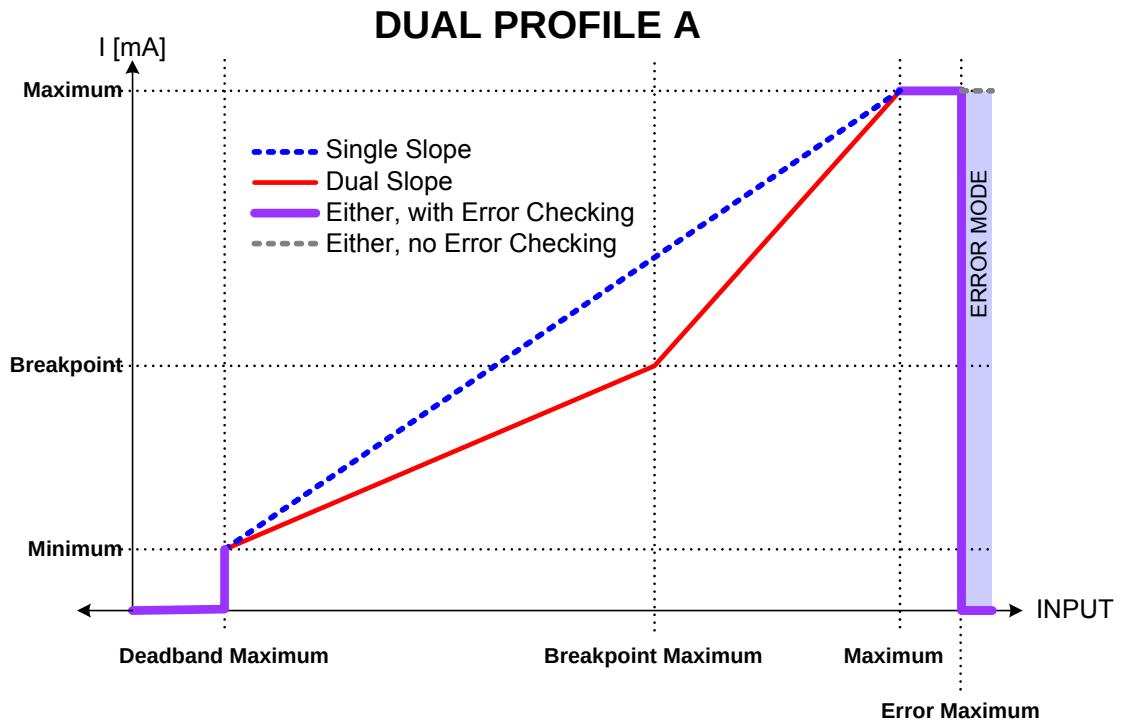


Figure 5 – Analog Output Dual Profile A

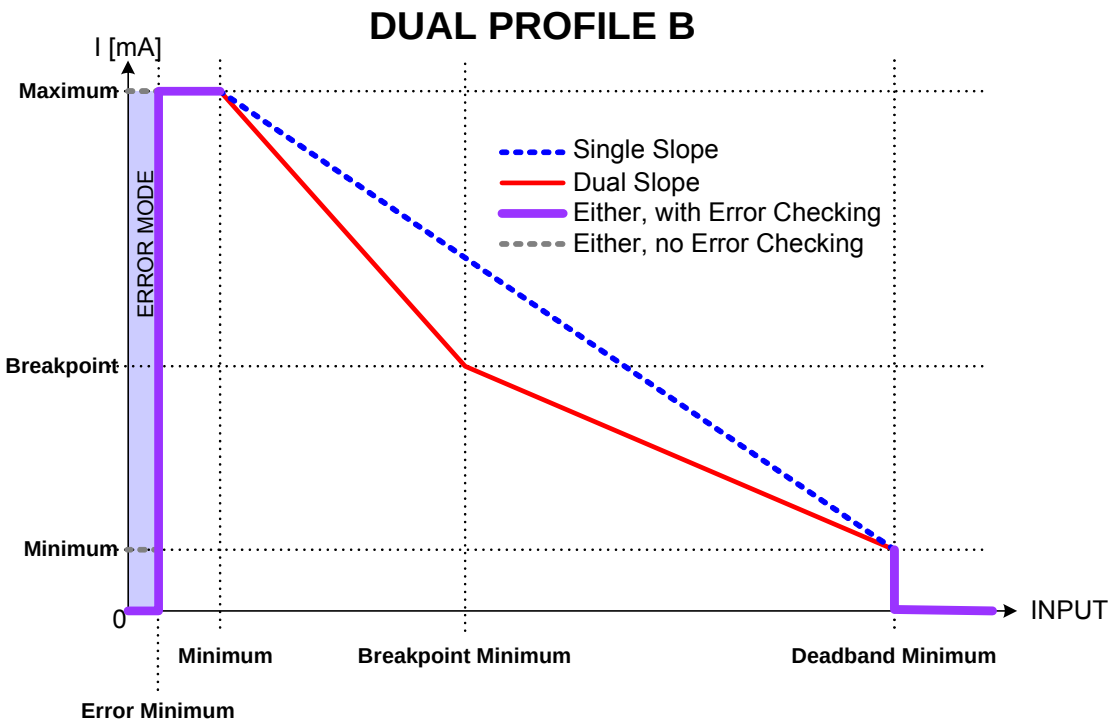


Figure 6 – Analog Output Dual Profile B

The different deadband, break point, minimum and maximum values associated with each profile can be changed using objects 2020h **AI Input Minimum**, 2030h **AI Input Breakpoint Minimum**, 2040h **AI Input Deadband Minimum**, 2050h **AI Input Deadband Maximum**, 2060h **AI Input Breakpoint Maximum** and 2070h **AI Input Maximum**. The minimum and maximum values are generally set by the selected input operating mode and its range. Please note, that the following must also hold, values falling outside these restrictions are rejected by the 16AIO.

Output Single Profile: **2020h** (AI min) **< 2030h** (AI breakpoint min) **< 2070h** (AI max)
Dual Profile A: **2050h** (AI deadband max) **< 2060h** (AI breakpoint max) **< 2070h** (AI max)
Dual Profile B: **2020h** (AI min) **< 2060h** (AI breakpoint min) **< 2070h** (AI deadband max)

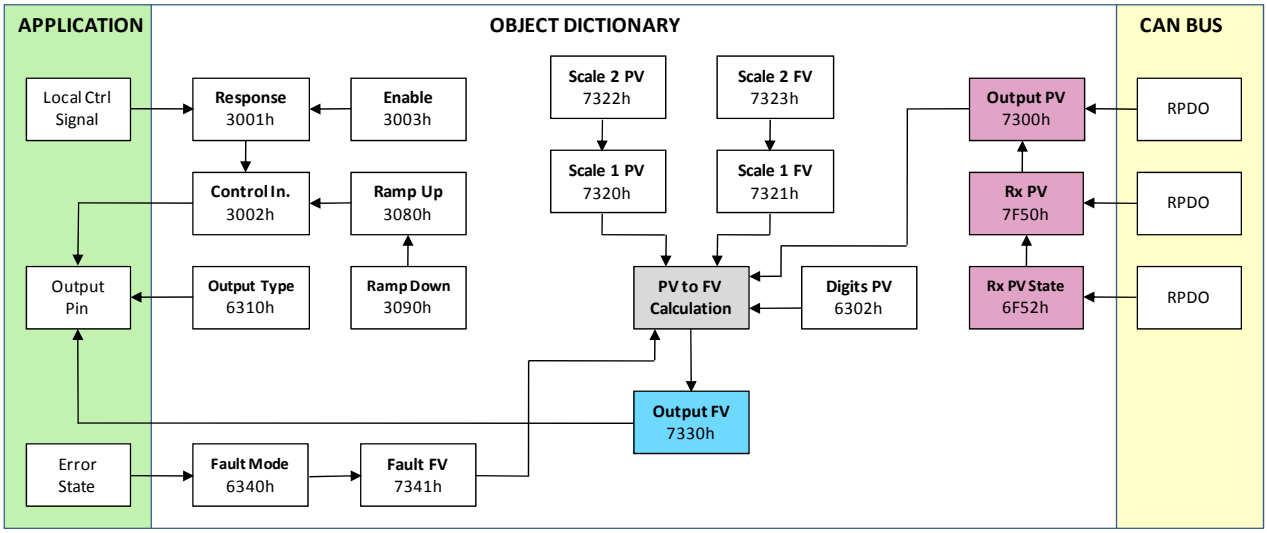


Figure 7 – Analog Output Objects

The object 6310h **AO Output Type** defines how the output drive circuitry will be configured as per Table 6. This table also shows the output unit and range for each type. By default, all outputs are configured as voltage types with a range of 0…5V.

Value	Meaning	Range [Unit]
0	**Voltage Output**	**0 to 5 [V]**
1	Voltage Output	-5 to 5 [V]
2	Voltage Output	0 to 10 [V]
3	Voltage Output	-10 to 10 [V]
4	Current Output	0 to 20 [mA]

Table 6 – AO Output Type Options

As with the analog input block, the relationship between the Process Value (input) and the Field Value (output) is a linear one, as shown in Figure 8. However, unlike with the AI, the output will actually use the AO Scaling FV objects as limits to the drive, such that the output will hold at the minimum and maximum FV points, as shown in the figure. Further, the AO uses a scaling of Process Values to the Output command range defined by objects 301Ah, 301Bh and 301Ch. In practice the received AO Process Values are scaled to a range of 0.0 … 100.0.

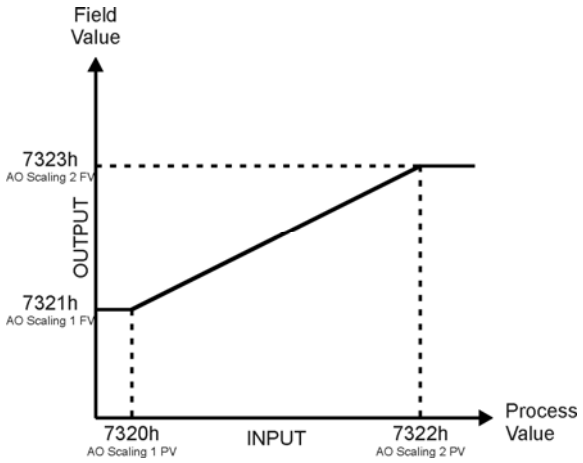


Figure 8 – Analog Output Linear Scaling PV to FV

The default configuration for the 16AIO controller is that all outputs are responding to changes from corresponding subindexes AO Process Value object. (Default value of 3002h is 9, CANopen control).

Value	Meaning
0	No control / disabled
1	Input 1
2	Input 2
3	Input 3
4	Input 4
5	Input 5
6	Input 6
7	Input 7
8	Input 8
9	**CAN message**

Table 7 – AO Control Sources (3002h)

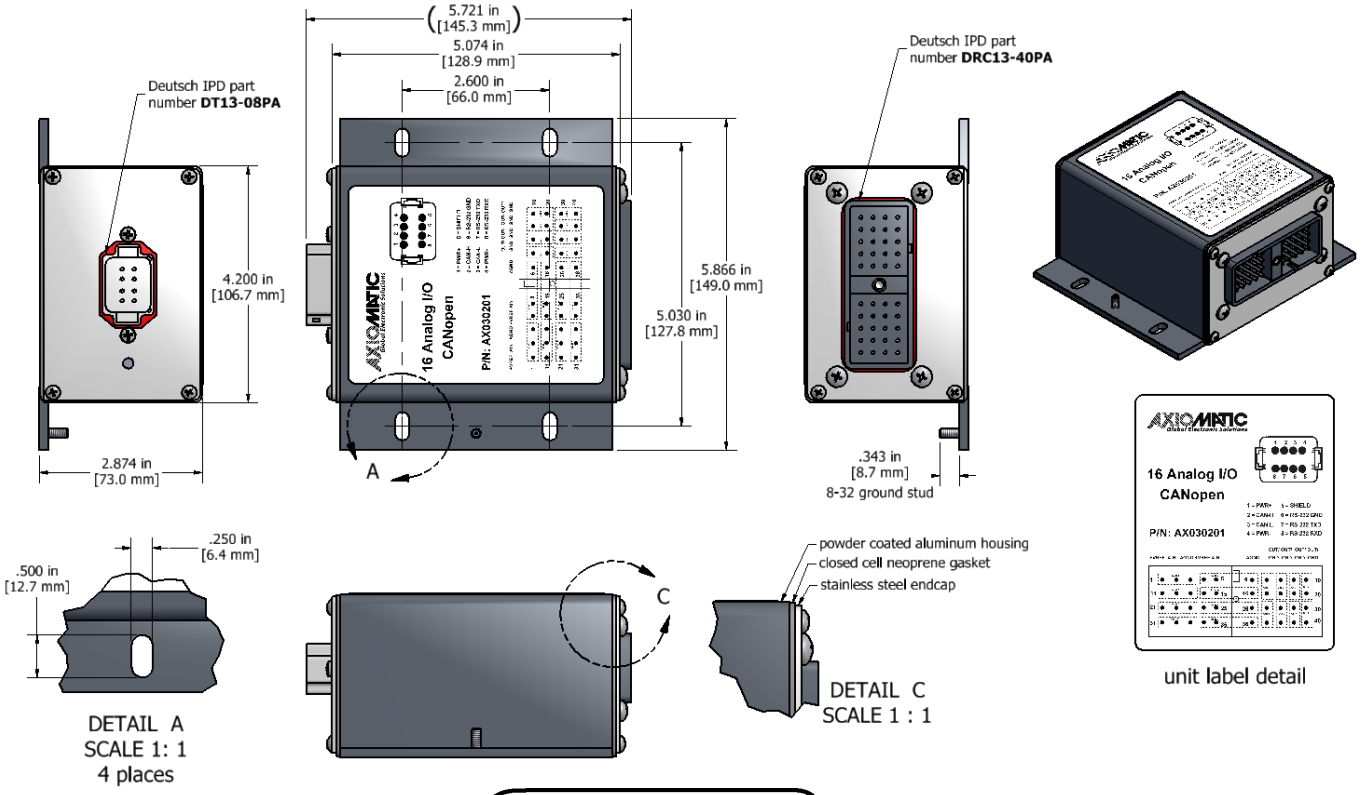
The output can be setup to react to a fault detected by the 16AIO. Should any one of the inputs be showing an error condition, object 6340 **AO Fault Mode** determines how the output will respond, per Table 8. By default, the output will be driven to the value defined in object 7341h **AO Fault FV**. Please note, that input error checking needs to be enabled in object 2110h for this to work.

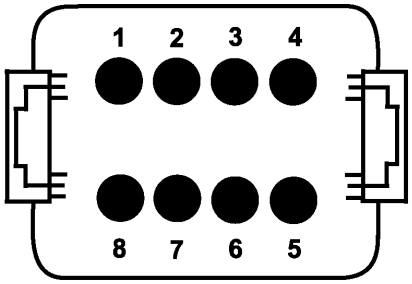
Value	Meaning
0	Maintain Last State
1	**Apply Pre-Defined FV**

Table 8 – AO Fault Mode Options

The controller applies the logic shown in Figure 7 when evaluating what output FV to apply. Under normal conditions, i.e. when the control input is driving the output as shown in the green box, there are ramping objects that can be applied to soften the output response. Object 3080h **AO Ramp Up** and object 3090 **AO Ramp Down** are both millisecond numbers that define how long it will take to ramp the current output value into new target value.

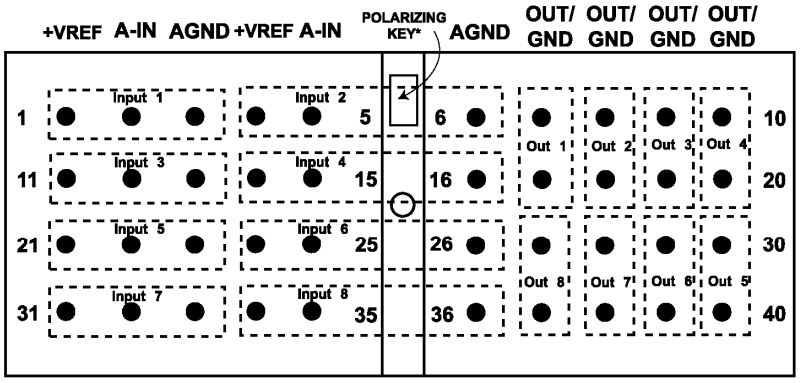
2. DIMENSIONS AND PINOUT





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)



FRONT VIEW OF
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DRC13-40PA
(Mating Plug is DRC16-40SA or DRC18-40SA with sockets 0462-201-16141)

Figure 9 – Housing Dimensions

NOISE – ELECTRICAL CONNECTIONS AND SHIELDING

To reduce noise, separate all power and output wires from those of the input and CAN. Shielded wires will protect against injected noise. Shield wires should be connected at the power or input source, or at the output load.

The CAN shield can be connected at the controller using the CAN Shield pin provide on the connector. However the other end should not be connected in this case.

All wires used must be 16 or 18 AWG.

CAN NETWORK CONSTRUCTION

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

CAN TERMINATION

It is necessary to terminate the network; therefore an external CAN termination is required. No more than two network terminators should be used on any one single network. A terminator is a 121Ω, 0.25 W, 1% metal film resistor placed between CAN_H and CAN_L terminals at the end two nodes on a network.

3. CANOPEN ® OBJECT DICTIONARY

The CANopen object dictionary of the 16AIO Controller is based on CiA device profile DS-404 V1.2 (device profile for Closed Loop Controllers). 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 16AIO Controller ships factory programmed with a Node ID = 127 (0x7F) and with Baudrate = 125 kbps.

3.1.1. LSS Protocol to Update

The preferred way 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. Note, that when using the LSS messages below, the 16AIO controller should be the only device connected to the bus.

The 16AIO will also respond to LSS selective mode commands. Please refer to the standard for more detailed information how to use LSS selective mode.

3.1.1.1. 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)

3.1.1.2. 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 32)

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 9 – 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):

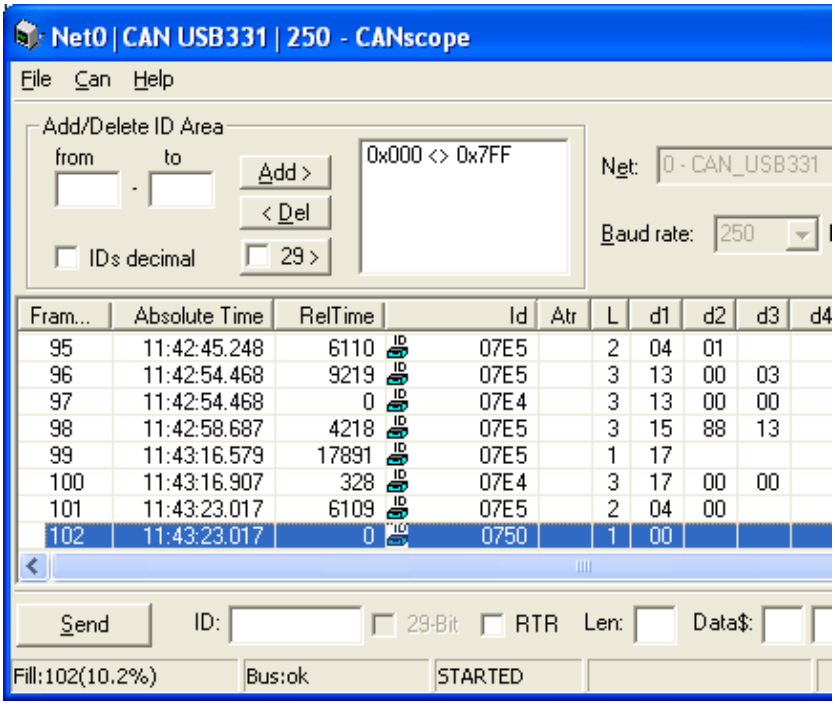
Item	***Value***
COB-ID	0x7E4
Length	3
Data 0	0x17 (cs=23 for store configuration)
Data 1	0x00
Data 2	0x00

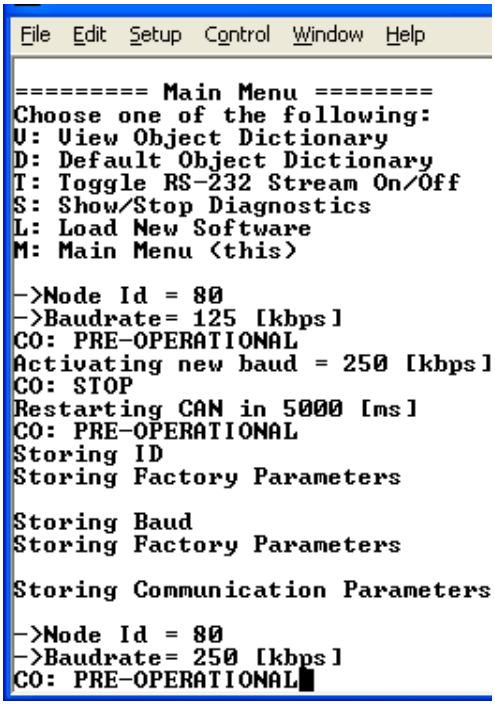
- Set the module state to LSS-operation by **sending** the following message:
  (Note, the module will reset itself back to the pre-operational state)

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 and DS-404)

The communication objects supported by the 16AIO 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	RW	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		RO	No
1601	RPDO2 Mapping Parameter	RECORD		RO	No
1602	RPDO3 Mapping Parameter	RECORD		RO	No
1603	RPDO4 Mapping Parameter	RECmarcel marceORD		RO	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-404. The 32-bit parameter is divided into two 16-bit values, showing General and Additional information as shown below.

MSB	LSB
Additional Information = 0x000B	**General Information** = 0x0194 (404)

DS-404 defines the Additional Information field in the following manner:
0000h = reserved
0001h = digital input block
0002h = analog input block
0004h = digital output block
0008h = analog output block
0010h = controller block (aka PID)
0020h = alarm block
0040h … 0800h = reserved
1000h = reserved
2000h = lookup table block (manufacturer-specific)
4000h = programmable logic block (manufacturer-specific)
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	0xB0194
Default Value	0xB0194

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 16AIO, the Generic Error Bit (bit 0) is set. Only if there is no errors in the module will this bit will be cleared. No other bits in this register are used by the 16AIO 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 or not they are still present. Clearing the list does NOT mean that the module will return to the error-free behaviour state if at least one error is still active.

The 16AIO Controller has a limitation of a maximum of 16 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 analog input fault is detect as described in Section 1.3, 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 32 outlines the resulting Error Field Codes and their meanings.

Error Field Code	Error Description	Meaning	ID	Meaning	EMCY Code	Meaning
00000000h	EMCY Error Reset (fault no longer active)					
2001F001h	20h	Positive Overload (Out of Range High)	01h	Analog Input 1	F001h	Input Overload
4001F001h	40h	Negative Overload (Out of Range Low)	01h	Analog Input 1	F001h	Input Overload
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
01FFF003h	01h	Contr. Temperature	FFh	Controller	F003h	High Temperature
02FFF004h	02h	Contr. Voltage	FFh	Controller	F004h	High Operating Voltage
02FFF005h	02h	Contr. Voltage	FFh	Controller	F005h	Low Operating Voltage

Table 10 – 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 16
Default Value	0

Sub-Index	1h to 10h
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 16AIO 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 16AIO 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 16AIO 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 16AIO 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 16AIO 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 16AIO 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 16AIO 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 16AIO 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	0, 10 to 65535
Default Value	0

3.2.11. Object 1018h: Identity Object

The identity object indicates the data of the 16AIO 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)	Hardware Revision	Software 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	0xAA030201
Default Value	0xAA030201

Sub-Index	3h
Description	Revision Number
Access	RO
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	0x00010601

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

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 0x03122010 would indicate that the software was compiled on December 3rd, 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 16AIO Controller will be set into in case of an error of the type associated with the sub-index.

Input faults are defined in Section 1.3. 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)

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 Behaviour
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	0 (Pre-operational on error)

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
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
Access	RW
PDO Mapping	No
Value Range	See above
Default Value	1 (No State Change)

Sub-Index	6h
Description	Controller Fault
Access	RW
PDO Mapping	No
Value Range	See above
Default Value	0 (Pre-operational on error)

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 16AIO Controller can support up to four RPDO messages. All RPDOs on the 16AIO 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. Three of the RPDOs have valid default mappings defined (see below), however only the first two are enabled by default (i.e. RPDO exists).

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

Sub-Index	***Value***	***Object***
0	4	Number of mapped application objects in PDO
1	0x73000110	Analog Output 1 Process Value
2	0x73000210	Analog Output 2 Process Value
3	0x73000310	Analog Output 3 Process Value
4	0x73000410	Analog Output 4 Process Value
5	0	Not used by default
6	0	Not used by default
7	0	Not used by default
8	0	Not used by default

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

Sub-Index	***Value***	***Object***
0	4	Number of mapped application objects in PDO
1	0x73000510	Analog Output 5 Process Value
2	0x73000610	Analog Output 6 Process Value
3	0x73000710	Analog Output 7 Process Value
4	0x73000810	Analog Output 8 Process Value
5	0	Not used by default
6	0	Not used by default
7	0	Not used by default
8	0	Not used by default

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

Sub-Index	***Value***	***Object***
0	8	Number of mapped application objects in PDO
1	0x6F520108	Analog Output 1 Received PV Status
2	0x6F520208	Analog Output 2 Received PV Status
3	0x6F520308	Analog Output 3 Received PV Status
4	0x6F520408	Analog Output 4 Received PV Status
5	0x6F520508	Analog Output 5 Received PV Status
6	0x6F520608	Analog Output 6 Received PV Status
7	0x6F520708	Analog Output 7 Received PV Status
8	0x6F520808	Analog Output 8 Received PV Status

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
5	0	Not used by default
6	0	Not used by default
7	0	Not used by default
8	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 16AIO Controller can support up to four TPDO messages. All TPDOs on the 16AIO Controller 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. The first three of them have valid default mappings defined (see below) and are enabled by default (i.e. TPDO exists).

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

Sub-Index	***Value***	***Object***
0	1	Number of mapped application objects in PDO
1	0x30C10220	Measured board operating voltage
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default
5	0	Not used by default
6	0	Not used by default
7	0	Not used by default
8	0	Not used by default

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

Sub-Index	***Value***	***Object***
0	4	Number of mapped application objects in PDO
1	0x71000110	Analog Input 1 Field Value
2	0x71000210	Analog Input 2 Field Value
3	0x71000310	Analog Input 3 Field Value
4	0x71000410	Analog Input 4 Field Value
5	0	Not used by default
6	0	Not used by default
7	0	Not used by default
8	0	Not used by default

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

Sub-Index	***Value***	***Object***
0	4	Number of mapped application objects in PDO
1	0x71000510	Analog Input 5 Field Value
2	0x71000610	Analog Input 6 Field Value
3	0x71000710	Analog Input 7 Field Value
4	0x71000810	Analog Input 8 Field Value
5	0	Not used by default
6	0	Not used by default
7	0	Not used by default
8	0	Not used by default

TPDO4 Mapping at Object 1A03h: Default ID 0x480 + 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
5	0	Not used by default
6	0	Not used by default
7	0	Not used by default
8	0	Not used by default

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-404)

Index (hex)	*Object*	*Object Type*	*Data Type*	*Access*	*PDO Mapping*
6000	DI Read State 8 Input Lines	ARRAY	UNSIGNED8	RO	Yes
6002	DI Polarity 8 Input Lines	ARRAY	UNSIGNED8	RW	No
7100	AI Input Field Value	ARRAY	INTEGER16	RO	Yes
6110	AI Sensor Type	ARRAY	UNSIGNED8	RW	No
6112	AI Operating Mode	ARRAY	UNSIGNED8	RW	No
7120	AI Input Scaling 1 FV	ARRAY	INTEGER16	RW	No
7121	AI Input Scaling 1 PV	ARRAY	INTEGER16	RW	No
7122	AI Input Scaling 2 FV	ARRAY	INTEGER16	RW	No
7123	AI Input Scaling 2 PV	ARRAY	INTEGER16	RW	No
7130	AI Input Process Value	ARRAY	INTEGER16	RO	Yes
6132	AI Decimal Digits PV	ARRAY	UNSIGNED8	RW	No
7148	AI Input Span Start	ARRAY	INTEGER16	RW	No
7149	AI Input Span End	ARRAY	INTEGER16	RW	No
61A0	AI Filter Type	ARRAY	UNSIGNED8	RW	No
61A1	AI Filter Constant	ARRAY	UNSIGNED8	RW	No
7300	AO Output Process Value	ARRAY	INTEGER16	RW	Yes
6302	AO Decimal Digits PV	ARRAY	UNSIGNED8	RW	No
6310	AO Output Type	ARRAY	UNSIGNED16	RW	No
7320	AO Output Scaling 1 PV	ARRAY	INTEGER16	RW	No
7321	AO Output Scaling 1 FV	ARRAY	INTEGER16	RW	No
7322	AO Output Scaling 2 PV	ARRAY	INTEGER16	RW	No
7323	AO Output Scaling 2 FV	ARRAY	INTEGER16	RW	No
7330	AO Output Field Value	ARRAY	INTEGER16	RO	Yes
6340	AO Fault Mode	ARRAY	UNSIGNED8	RW	No
7341	AO Fault Field Value	ARRAY	INTEGER16	RW	No
7F50	AO Received PV 16	ARRAY	INTEGER16	RW	Yes
6F52	AO Received PV Status	ARRAY	UNSIGNED8	RW	Yes

3.3.1. Object 6000h: DI Read State 8 Input Lines

This read-only object represents the digital inputs' state from the eight input lines. Refer to Section 1.x for more information

Object Description

Index	6000h
Name	DI Read State 8 Input Lines
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	Digital Inputs State
Access	RO
PDO Mapping	Yes
Value Range	0 (ALL OFF) to 0xFF (ALL ON)
Default Value	0

3.3.2. Object 6002h: DI Polarity 8 Input Lines

This object determines how the state read on the input pins corresponds to the logic state.

Object Description

Index	6002h
Name	DI Polarity 8 Input Lines
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	Digital Inputs Polarity
Access	RW
PDO Mapping	No
Value Range	0 (ALL NORMAL) to 0xFF (ALL INV.)
Default Value	0 (All normal)

3.3.3. Object 7100h: AI Input Field Value

This object represents the measured value of an analog input that has been scaled as per manufacturer object 2102h AI Decimal Digits PV. The base unit for each type of input is defined in Table 9, as well as the read-only resolution (decimal digits) associated with the FV.

Object Description

Index	7100h
Name	AI Input Field Value
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AIx FV
Access	RO
PDO Mapping	Yes
Value Range	Data Type Specific, see Table 5
Default Value	No

3.3.4. Object 6110h: AI Sensor Type

This object defines the type of sensor (input) which is connected to the analog input pin.

Object Description

Index	6110h
Name	AI Sensor Type
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 or 8)
Description	AIx Sensor Type
Access	RW
PDO Mapping	No
Value Range	See Table 3
Default Value	1 (voltage, 0…5V)

3.3.5. Object 6112h: AI Operating Mode

This object enables special operating modes for the input.

Object Description

Index	6112h
Name	AI Operating Mode
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 or 8)
Description	AIx Operating Mode
Access	RW
PDO Mapping	No
Value Range	See Table 2
Default Value	1 (normal operation)

3.3.6. Object 7120h: AI Input Scaling 1 FV

This object describes the field value of the first calibration point for the analog input channel, as shown in Figure 7. It also defines the “minimum” value of the analog input range when using this input as a control source for another function block, as described in Table 7 in Section 1.4. It is scaled in the physical unit of the FV, i.e. object 2102h applies to this object.

Object Description

Index	7120h
Name	AI Input Scaling 1 FV
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AIx Scaling 1 FV
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 [mV]

3.3.7. Object 7121h: AI Input Scaling 1 PV

This object defines the process value of the first calibration point for the analog input channel, as shown in Figure 7. It is scaled in the physical unit of the PV, i.e. object 6132h applies to this object.

Object Description

Index	7121h
Name	AI Input Scaling 1 PV
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AIx Scaling 1 PV
Access	RW
PDO Mapping	No
Value Range	Integer16
Default Value	0 [same as 7120h]

3.3.8. Object 7122h: AI Input Scaling 2 FV

This object describes the field value of the second calibration point for the analog input channel, as shown in Figure 7. It also defines the “maximum” value of the analog input range when using this input as a control source for another function block, as described in Table 7 in Section 1.4. It is scaled in the physical unit of the FV, i.e. object 2102h applies to this object.

Object Description

Index	7122h
Name	AI Input Scaling 2 FV
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AIx Scaling 2 FV
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	5000 [mV]

3.3.9. Object 7123h: AI Input Scaling 2 PV

This object defines the process value of the second calibration point for the analog input channel, as shown in Figure 7. It is scaled in the physical unit of the PV, i.e. object 6132h applies to this object.

Object Description

Index	7123h
Name	AI Input Scaling 2 PV
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AIx Scaling 2 PV
Access	RW
PDO Mapping	No
Value Range	Integer16
Default Value	5000 [same as 7122h]

3.3.10. Object 7130h: AI Input Process Value

This object represents the result of the input scaling applied per Figure 7, and gives the measured quantity scaled in the physical unit of the process value (i.e. °C, PSI, RPM, etc) with the resolution defined in object 6132h AI Decimal Digits PV.

Object Description

Index	7130h
Name	AI Input Process Value
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AIx Process Value
Access	RO
PDO Mapping	Yes
Value Range	Integer16
Default Value	No

3.3.11. Object 6132h: AI Decimal Digits PV

This object describes the number of digits following the decimal point (i.e. resolution) of the input data, which is interpreted with data type Integer16 in the process value object.

Example: A process value of 1.230 (Float) will be coded as 1230 in Integer16 format if the number of decimal digits is set to 3.

Object Description

Index	6123h
Name	AI Decimal Digits PV
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 or 8)
Description	AIx Decimal Digits PV
Access	RW
PDO Mapping	No
Value Range	0 to 9
Default Value	0

3.3.12. Object 7148h: AI Span Start

This value specifies the lower limit where field values are expected. Field values which are lower than this limit are marked as negative overload. It is scaled in the physical unit of the FV, i.e. object 2102h applies to this object.

Object Description

Index	7148h
Name	AI Span Start
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AIx Span Start (Error Min)
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 [mV]

3.3.13. Object 7149h: AI Span End

This value specifies the upper limit where field values are expected. Field values which are higher than this limit are marked as positive overload. It is scaled in the physical unit of the FV, i.e. object 2102h applies to this object.

Object Description

Index	7149h
Name	AI Span End
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AIx Span End (Error Max)
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	5000 [mV]

3.3.14. Object 61A0h: AI Filter Type

This object defines the type of data filter that will be applied to the raw input data, as read from the ADC or Timer, before it is passed to the field value object. The types of data filters are defined in Table 8, and how they are used is outlined in Section 1.3.

Object Description

Index	61A0h
Name	AI Filter Type
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 or 8)
Description	AIx Filter Type
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (no filter)

3.3.15. Object 61A1h: AI Filter Constant

This object defines the number of steps used in the various filters, as defined in Section 1.3

Object Description

Index	61A0h
Name	AI Filter Constant
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 or 8)
Description	AIx Filter Constant
Access	RW
PDO Mapping	No
Value Range	1 to 255
Default Value	1

3.3.16. Object 7300h: AO Output Process Value

This object represents the process value of the output. It can be used as an input to the analog output function block when the input has been selected as controlled by a CANopen Message (per Table 7 in Section 1.4).

Object Description

Index	7300h
Name	Analog Output Process Value
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AOx Process Value
Access	RW
PDO Mapping	Yes
Value Range	Integer16
Default Value	No

3.3.17. Object 6302h: AO Decimal Digits PV

This object describes the number of digits following the decimal point (i.e. resolution) of the output control data, which is interpreted with data type Integer16 in the process value object.

Object Description

Index	6302h
Name	AO Decimal Digits PV
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 or 8)
Description	AOx Decimal Digits PV
Access	RW
PDO Mapping	No
Value Range	0 to 9

Default Value	0

3.3.18. Object 6310h: AO Output Type

This object specifies the type of analog output, as defined in Table 6.

Object Description

Index	6310h
Name	AO Output Type
Object Type	ARRAY
Data Type	UNSIGNED16

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 or 8)
Description	AOx Type
Access	RW
PDO Mapping	No
Value Range	See Table 6
Default Value	1 (voltage, 0…5V)

3.3.19. Object 7320h: AO Output Scaling 1 PV

This object defines the minimum value of the input, and should be specified to equal the corresponding scaling object of the control source, as outlined in Table 7. It will be scaled in the physical unit of the control source. The resolution will ALWAYS be dependent on object 6302h AO Decimal Digits PV, even when the output is not being controlled directly by the AO Output PV object 7300h. This object must always be smaller than object 7322h AO Output Scaling 2 PV.

Object Description

Index	7320h
Name	AO Output Scaling 1 PV
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AOx Scaling 1 PV
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 [mV]

3.3.20. Object 7321h: AO Output Scaling 1 FV

This object defines the output field value when the input data is at or below the AO Output Scaling 1 PV value as shown in Figure 11. It will be scaled in the physical unit of the output, dependent on type, with the resolution defined in object 6332h AO Decimal Digits FV. The value can be set anywhere within the allowable output range as outlined in Table 6. This value can be set higher than object 7323h AO Output Scaling 2 FV for an inverse response (i.e. decreasing) to an increasing input.

Object Description

Index	7321h
Name	AO Output Scaling 1 FV
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AOx Scaling 1 FV
Access	RW
PDO Mapping	No
Value Range	Output Min Cmd (see 301Ah)
Default Value	0

3.3.21. Object 7322h: AO Output Scaling 2 PV

This object defines the maximum value of the input, and should be specified to equal the corresponding scaling object of the control source, as outlined in Table 7. It will be scaled in the physical unit of the control source. The resolution will ALWAYS be dependent on object 6302h AO Decimal Digits PV, even when the output is not being controlled directly by the AO Output PV object 7300h. This object must always be larger than object 7322h AO Output Scaling 2 PV.

Object Description

Index	7322h
Name	AO Output Scaling 2 PV
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AOx Scaling 2 PV
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	5000 [mV]

3.3.22. Object 7323h: AO Output Scaling 2 FV

This object defines the output field value when the input data is at or above the AO Output Scaling 2 PV value as shown in Figure 8. It will be scaled in the physical unit of the output, dependent on type.

Object Description

Index	7323h
Name	AO Output Scaling 2 FV
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AOx Scaling 2 FV
Access	RW
PDO Mapping	No
Value Range	Output Max Cmd (see 301Ch)
Default Value	100

3.3.23. Object 7330h: AO Output Field Value

This object represents the target output drive field value as a result of the output logic described in Section 1.4, and the scaling applied as shown in Figure 7. It is defined in the physical unit of the output dependent on type, as outlined in Table 6.

Object Description

Index	7330h
Name	Analog Output Field Value
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AOx Field Value
Access	RO
PDO Mapping	Yes
Value Range	Integer16
Default Value	No

3.3.24. Object 6340h: AO Fault Mode

This object defines how an analog output shall response when a fault condition is detected on any control input, as described in Table 22.

Object Description

Index	6340h
Name	AO Fault Mode
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 or 8)
Description	AOx Fault Mode
Access	RW
PDO Mapping	No
Value Range	0, 1
Default Value	1 (apply pre-defined FV)

3.3.25. Object 7341h: AO Fault FV

This object contains the pre-defined field value of an analog output when a fault condition is present, and the corresponding sub-index in object 7341h is enabled. It will be scaled in the physical unit of the output, dependent on type, with the resolution defined in object 6332h AO Decimal Digits FV.

Object Description

Index	7341h
Name	AO Fault FV
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AOx Fault FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 6)
Default Value	0 [mV]

3.3.26. Object 7F50h: AO Received PV 16

This object is a generic input process value that is used to write to the CAN input function block's process value, object 7300h. If and only if the value of object 6F52h at the same subindex is set to validate the PV will the data from 7F50h be copied to object 7300h. Note, that the device needs to be set to OPERATIONAL mode for writing successfully into this object.

Object Description

Index	7F50h
Name	AO Received PV 16
Object Type	ARRAY
Data Type	INTEGER16

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 or 8)
Description	AOx Received PV 16
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 6)
Default Value	0

3.3.27. Object 6F52h: AO Received PV Status

This object is used to validate the value in object 7F50h [Received PV 16] such that the value will be copied to object 7300h [AO output PV] and subsequently used as the output command. If this object is set to the non-validated value, the Received PV is not used. However, writes to object 7330h [AO Output FV] is allowed at any time, thus the field value can be used to control the CAN input blocks, even when the process values have not been validated.

The value of object 6F52h is invalidated after the value in object 7F50h is copied to 7300h. Therefore, if the object is not mapped into a PDO, the user must validate the Received PV by SDO writes before the Received PV will be used. Note, that the device needs to be set to OPERATIONAL mode for writing successfully into this object.

The following status values are allowed for object 6F52h.

- Value 0 = Received PV value not validated (writes to object 7F50h are ignored)
- Value 1 = Received PV value is validated (value in object 7F50h is copied to 7300h)

Object Description

Index	6F52h
Name	AO Received PV Status
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 or 8)
Description	AOx Received PV Status
Access	RW
PDO Mapping	No
Value Range	0, 1
Default Value	0

3.4. MANUFACTURER OBJECTS

Index (hex)	*Object*	*Object Type*	*Data Type*	*Access*	*PDO Mapping*
2001	AI Number of Pulses Per Revolution	ARRAY	UNSIGNED16	RW	No
2020	AI Input Minimum	ARRAY	UNSIGNED16	RW	No
2030	AI Input Breakpoint Minimum	ARRAY	UNSIGNED16	RW	No
2040	AI Input Deadband Minimum	ARRAY	UNSIGNED16	RW	No
2050	AI Input Deadband Maximum	ARRAY	UNSIGNED16	RW	No
2060	AI Input Breakpoint Maximum	ARRAY	UNSIGNED16	RW	No
2070	AI Input Maximum	ARRAY	UNSIGNED16	RW	No
2090	AI Input Measuring Window	ARRAY	UNSIGNED16	RW	No
2100	Overvoltage Fault Limits	ARRAY	FLOAT32	RW	No
2101	Under voltage Fault Limits	ARRAY	FLOAT32	RW	No
2102	Over temperature Fault Limits	ARRAY	FLOAT32	RW	No
2103	Fault Limit Flags	VARIABLE	UNSIGNED8	RW	No
2110	AI Input Error Detect Enable	ARRAY	UNSIGNED8	RW	No
2111	AI Input Error Clear Hysteresis	ARRAY	UNSIGNED16	RW	No
2112	AI Input Error Detect Reaction Delay	ARRAY	UNSIGNED16	RW	No
2113	Controller Error Detect Reaction Delay	VARIABLE	UNSIGNED16	RW	No
3001	AO Output Response	ARRAY	UNSIGNED8	RW	No
3002	AO Output Control Input	ARRAY	UNSIGNED8	RW	No
3003	AO Output Enable Input	ARRAY	UNSIGNED8	RW	No
301A	AO Output Command Minimum	ARRAY	FLOAT32	RW	No
301B	AO Output Command Breakpoint	ARRAY	FLOAT32	RW	No
301C	AO Output Command Maximum	ARRAY	FLOAT32	RW	No
3030	AO Output Minimum	ARRAY	UNSIGNED16	RW	No
3040	AO Output Breakpoint	ARRAY	UNSIGNED16	RW	No
3050	AO Output Maximum	ARRAY	UNSIGNED16	RW	No
3080	AO Ramp Up	ARRAY	UNSIGNED16	RW	No
3090	AO Ramp Down	ARRAY	UNSIGNED16	RW	No
30C1	Board Internal Measurements	ARRAY	FLOAT32	RO	Yes

3.4.1. Object 2001h: AI Number of Pulses Per Revolution

This object is only used when a “Frequency” input type has been selected by object 6110h. The controller will automatically convert frequency measurement from Hz to RPM when a non-zero value is specified. In this case, objects 2111h, 7120h, 7122h, 7148h and 7149h will be interpreted as RPM data.

Object Description

Index	2001h
Name	AI Number of Pulses Per Revolution
Object Type	ARRAY
Data Type	UNSIGNED16

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	AIx Pulses per Revolution
Access	RW
PDO Mapping	No
Value Range	0 to 1000
Default Value	1

3.4.2. Object 2020h: AI Input Minimum

This object defines the minimum input value for output control slope, see section 1.4.

Object Description

Index	2020h
Name	AI Input Minimum
Object Type	ARRAY
Data Type	UNSIGNED16

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	AIx Input Minimum

Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 5)
Default Value	500 [mV]

3.4.3. Object 2030h: AI Input Breakpoint Minimum

This object defines the input breakpoint value for output control slope, see section 1.4.

Object Description

Index	2030h
Name	AI Input Breakpoint Minimum
Object Type	ARRAY
Data Type	UNSIGNED16

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	AIx Input Breakpoint Minimum
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 5)
Default Value	1400 [mV]

3.4.4. Object 2040h: AI Input Deadband Minimum

This object defines the input deadband value for output control slope, see section 1.4.

Object Description

Index	2040h
Name	AI Input Deadband Minimum
Object Type	ARRAY
Data Type	UNSIGNED16

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	AIx Input Deadband Minimum
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 5)
Default Value	2300 [mV]

3.4.5. Object 2050h: AI Input Deadband Maximum

This object defines the input deadband value for output control slope, see section 1.4.

Object Description

Index	2050h
Name	AI Input Deadband Maximum
Object Type	ARRAY
Data Type	UNSIGNED16

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	AIx Input Deadband Maximum
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 5)
Default Value	2700 [mV]

3.4.6. Object 2060h: AI Input Breakpoint Maximum

This object defines the input breakpoint value for output control slope, see section 1.4.

Object Description

Index	2060h
Name	AI Input Breakpoint Maximum
Object Type	ARRAY
Data Type	UNSIGNED16

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	AIx Input Breakpoint Maximum
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 5)
Default Value	3600 [mV]

3.4.7. Object 2070h: AI Input Maximum

This object defines the maximum input value for output control slope, see section 1.4.

Object Description

Index	2070h
Name	AI Input Maximum
Object Type	ARRAY
Data Type	UNSIGNED16

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	AIx Input Maximum
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 5)
Default Value	4500 [mV]

3.4.8. Object 2090h: AI Input Measuring Window

This object defines the time window length during which the input value is detected.

Object Description

Index	2090h
Name	AI Input Measuring Window
Object Type	ARRAY
Data Type	UNSIGNED16

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	AIx Input Measuring Window
Access	RW
PDO Mapping	No
Value Range	1 to 10,000
Default Value	1000 [ms]

3.4.9. Object 2100h: Overvoltage Fault Limits

This object defines the fault limits for power supply overvoltage detection.

Object Description

Index	2100h
Name	Overvoltage Fault Limits
Object Type	ARRAY
Data Type	FLOAT32

Entry Description

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

Sub-Index	1h
Description	Overvoltage fault set limit
Access	RW
PDO Mapping	No
Value Range	5.0 to 36.0
Default Value	30.0 [V]

Sub-Index	2h
Description	Overvoltage fault clear limit
Access	RW
PDO Mapping	No
Value Range	5.0 to 36.0
Default Value	28.0 [V]

3.4.10. Object 2101h: Under voltage Fault Limits

This object defines the fault limits for power supply under voltage detection.

Object Description

Index	2101h
Name	Under voltage Fault Limits

Object Type	ARRAY
Data Type	FLOAT32

Entry Description

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

Sub-Index	1h
Description	Under voltage fault set limit
Access	RW
PDO Mapping	No
Value Range	5.0 to 36.0
Default Value	10.0 [V]

Sub-Index	2h
Description	Under voltage fault clear limit
Access	RW
PDO Mapping	No
Value Range	5.0 to 36.0
Default Value	12.0 [V]

3.4.11. Object 2102h: Over temperature Fault Limits

This object defines the fault limits for device internal temperature detection.

Object Description

Index	2102h
Name	Over temperature Fault Limits
Object Type	ARRAY
Data Type	FLOAT32

Entry Description

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

Sub-Index	1h
Description	Over temperature fault set limit
Access	RW
PDO Mapping	No
Value Range	10.0 to 127.0
Default Value	110.0 [°C]

Sub-Index	2h
Description	Over temperature fault clear limit
Access	RW
PDO Mapping	No
Value Range	10.0 to 127.0
Default Value	85.0 [°C]

3.4.12. Object 2103h: Fault Limit Flags

This object enables fault detection of different internal measurements with limits defined by objects 2100h, 2101h and 2102h.

Object Description

Index	2103h
Name	Fault Limit Flags
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Fault limit flags
Access	RW
PDO Mapping	No
Value Range	0x00 (All OFF) to 0x07 (All ON) 0x01 – Overvoltage 0x02 – Under voltage 0x04 – Over temperature
Default Value	0

3.4.13. Object 2110h: AI Error Detect Enable

This object enables error detection and reaction associated with the analog input function block. When disabled, the input will not generate an EMCY code in object 1003h Pre-Defined Error Field, nor will it disable any output controlled by the input should the input go out of range as defined by the objects 7148h AI Span Start and 7149h AI Span End.

Object Description

Index	2110h
Name	AI Error Detect Enable
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	AIx Error Detect Enable
Access	RW
PDO Mapping	No
Value Range	0 (FALSE) or 1 (TRUE)
Default Value	0 [FALSE]

3.4.14. Object 2111h: AI Error Clear Hysteresis

This object is used to prevent rapid activation/clearing of an input fault flag, and sending of object 1003h to the CANopen ® network. Once the input has gone above/below the thresholds that define the valid operating range, it must come back into range minus/plus this value to clear the fault.

Object Description

Index	2111h
Name	AI Error Clear Hysteresis
Object Type	ARRAY
Data Type	UNSIGNED16

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	AIx Error Clear Hysteresis
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 5)
Default Value	250 [mV]

3.4.15. Object 2112h: AI Error Reaction Delay

This object is used to filter out spurious signals and to prevent saturating the CANopen ® network with broadcasts of object 1003h as the fault is set/cleared. Before the fault is recognized (i.e. the EMCY code is added to the pre-defined error field list), it must remain active throughout the period of time defined in this object. The physical unit for this object is milliseconds.

Object Description

Index	2112h
Name	AI Error Reaction Delay
Object Type	ARRAY

Data Type	UNSIGNED16

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	AIx Error Reaction Delay
Access	RW
PDO Mapping	No
Value Range	0 to 10,000
Default Value	1000 [ms]

3.4.16. Object 2113h: Controller Error Reaction Delay

This object is used to filter out spurious signals and to prevent saturating the CANopen ® network with broadcasts of object 1003h as the fault is set/cleared. Before the fault is recognized (i.e. the EMCY code is added to the pre-defined error field list), it must remain active throughout the period of time defined in this object. The physical unit for this object is milliseconds.

Object Description

Index	2113h
Name	Controller Error Reaction Delay
Object Type	VARIABLE
Data Type	UNSIGNED16

Entry Description

Sub-Index	0h
Description	Controller Error Reaction Delay
Access	RW
PDO Mapping	No
Value Range	0 to 10,000
Default Value	1000 [ms]

3.4.17. Object 3001h: AO Output Response

This object defines the type of output response, deadband, breakpoint, etc. See section 1.4 for details.

Object Description

Index	3001h
Name	AO Output 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 or 8)
Description	AOx Output Response
Access	RW
PDO Mapping	No
Value Range	See Figures 4, 5 & 6.
Default Value	1 (Single profile – single slope)

3.4.18. Object 3002h: AO Output Control Input

This object defines the controlling source for output.

Object Description

Index	3002h
Name	AO Output Control Input
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 or 8)
Description	AOx Output Control Input
Access	RW
PDO Mapping	No
Value Range	0 – disabled 1…8 – Input 9 – CAN message
Default Value	9 (CAN message)

3.4.19. Object 3003h: AO Output Enable Input

This object defines whether an input should be used to enable / disable the output. In general, if the configured input drops below value defined by 2020h, the output will be disabled. Otherwise it can be driven with a control source defined by 3002h.

Object Description

Index	3003h
Name	AO Output Enable Input
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 or 8)
Description	AOx Output Enable Input
Access	RW
PDO Mapping	No
Value Range	See Table 7
Default Value	0 (Enable not used)

3.4.20. Object 301Ah: AO Output Command Minimum

This object defines the internal minimum value used to drive the output logic. The preferred approach is the use objects 7321h and 7323h, which by default correspond default values of 301Ah and 301Ch.

Object Description

Index	301Ah
Name	AO Output Command Minimum
Object Type	ARRAY
Data Type	FLOAT32

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 or 8)
Description	AOx Output Command Minimum
Access	RW
PDO Mapping	No
Value Range	0.0 to 100.0
Default Value	0.0

3.4.21. Object 301Bh: AO Output Command Breakpoint

This object defines the internal breakpoint value used to drive the output logic.

Object Description

Index	301Bh
Name	AO Output Command Breakpoint
Object Type	ARRAY
Data Type	FLOAT32

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 or 8)
Description	AOx Output Command Breakpoint
Access	RW
PDO Mapping	No
Value Range	0.0 to 100.0
Default Value	50.0

3.4.22. Object 301Ch: AO Output Command Maximum

This object defines the internal maximum value used to drive the output logic. The preferred approach is the use objects 7321h and 7323h, which by default correspond default values of 301Ah and 301Ch.

Object Description

Index	301Ch
Name	AO Output Command Maximum
Object Type	ARRAY
Data Type	FLOAT32

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 or 8)
Description	AOx Output Command Maximum
Access	RW
PDO Mapping	No
Value Range	0.0 to 100.0
Default Value	100.0

3.4.23. Object 3030h: AO Output Minimum

This object defines output minimum value. See section 1.4 for details.

Object Description

Index	3030h
Name	AO Output Minimum
Object Type	ARRAY
Data Type	UNSIGNED16

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 or 8)
Description	AOx Output Minimum
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 6)
Default Value	0 [mV]

3.4.24. Object 3040h: AO Output Breakpoint

This object defines output breakpoint value. See section 1.4 for details.

Object Description

Index	3040h
Name	AO Output Breakpoint
Object Type	ARRAY
Data Type	UNSIGNED16

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 or 8)
Description	AOx Output Breakpoint
Access	RW
PDO Mapping	No

Value Range	Dependent on type (see Table 6)
Default Value	2500 [mV]

3.4.25. Object 3050h: AO Output Maximum

This object defines output maximum value. See section 1.4 for details.

Object Description

Index	3050h
Name	AO Output Maximum
Object Type	ARRAY
Data Type	UNSIGNED16

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 or 8)
Description	AOx Output Maximum
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 6)
Default Value	5000 [mV]

3.4.26. Object 3080h: AO Ramp Up

This object defines the time it will take to ramp from the minimum output PV to the maximum as defined by objects 7321h and 7323h. It can be used to soften the response to a step change at the input. The physical unit for this object is milliseconds.

Object Description

Index	3080h
Name	AO Ramp Up
Object Type	ARRAY
Data Type	UNSIGNED16

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	AOx Ramp Up
Access	RW
PDO Mapping	No
Value Range	0 to 10,000
Default Value	1000 [ms]

3.4.27. Object 3090h: AO Ramp Down

This object defines the time it will take to ramp from the maximum output PV to the minimum as defined by objects 7321h and 7323h. It can be used to soften the response to a step change at the input. The physical unit for this object is milliseconds.

Object Description

Index	2330h
Name	AO Ramp Down
Object Type	ARRAY
Data Type	UNSIGNED16

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 or 8)
Description	AOx Ramp Down
Access	RW
PDO Mapping	No
Value Range	0 to 10,000
Default Value	1000 [ms]

3.4.28. Object 30C1h: Board Internal Measurements

This object lists the results of the internal measurements of controller's state.

Object Description

Index	30C1h
Name	Board Internal Measurements
Object Type	ARRAY
Data Type	FLOAT32

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	Board temperature
Access	RO
PDO Mapping	Yes
Value Range	Float32
Default Value	[°C]

Sub-Index	2h
Description	Board operating voltage
Access	RO
PDO Mapping	Yes
Value Range	Float32
Default Value	[V]

Sub-Index	3h
Description	Negative 14V reference voltage
Access	RO
PDO Mapping	Yes
Value Range	Float32
Default Value	[V]

Sub-Index	4h
Description	Positive 14V reference voltage
Access	RO
PDO Mapping	Yes
Value Range	Float32
Default Value	[V]

Sub-Index	5h
Description	Positive 24V reference voltage
Access	RO
PDO Mapping	Yes
Value Range	Float32
Default Value	[V]

APPENDIX A – Technical Specifications

Input Power

Power Supply Input - Nominal	12, 24VDC nominal (9…32 VDC power supply range) Surge protection is provided. 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 module by means of a series connection of properly rated fuses or circuit breakers. Input power switches must be arranged external to the 16 Analog I/O Module. Power input wiring should be limited to 10 meters.
Reverse Polarity Protection	Provided

Input Signals

All Inputs	Up to 8 inputs are selectable by the user. All inputs, except for frequency, are sampled every 1ms. The user can select the type of filter that is applied to the measured data, before it is transmitted to the bus. The available filters are: • Filter Type 0 = No Filter • Filter Type 1 = Moving Average • Filter Type 2 = Repeating Average With the CAN model, AX030201, all input channels are completely independent of each other as well as can simultaneously control an on-board output and send a message to the CAN bus.
Input Configuration	Up to 8 inputs are available. *Refer to Table 10.0.* Each input can be configured for any one of the following options. • Disable input • 0…5VDC or 0…10VDC • 4…20mA or 0…20mA • Digital input • PWM signal • Pulse (Hz or RPM) • 16-bit Counter
Threshold Levels	For digital, PWM, pulse or counter inputs the voltage threshold levels are: Input positive threshold (signal goes from low to high): Min. 2.2V, typical 2.9V, max. 3.6V Input negative threshold (signal goes from high to low): Min. 1.2V, typical 1.7V, max. 2.3V
Analog GND	8 Analog GND connections are provided.
Voltage References	8 +5V references (sourcing up to 10 mA) +/- 0.1% or 8 +20 mA constant (voltage up to power supply) +/-0.2%
Input Accuracy	0-5V: +/- 0.3% 0-10V: +/- 0.2% 0-20mA: +/- 0.35% PWM, single channel: +/- 0.05% to +/- 1.25% (over the 500 Hz to 10 kHz range) (NOTE: When selecting all input types as “PWM Duty Cycle” the inputs will be accurate at frequencies above 3 kHz.) Frequency/RPM, single channel: +/- 1% 16-bit counter, single channel: +/- 3 mSec (@50 Hz)
Input Resolution	0-5V: 1 mV resolution 0-10V: 1 mV resolution 0-20mA: 1 µA resolution PWM, single channel: +/- 0.05% to +/- 1.25%, 2 decimal place resolution NOTE: If the Input Maximum setpoint is set for a low frequency (<=50Hz), the controller will use a different technique to measure the frequency. Instead of measuring the pulses in the Measuring Window (this parameter is ignored) it will measure the time between rising edges of the signal. If more than 10 seconds pass without a transition, the input will be read as zero. The frequency range in this mode is 0.5-50Hz, with up to 2 decimal places of resolution. Frequency/RPM (single channel) 0.5 Hz to 50 Hz: +/- 0.01Hz, 2 decimal place resolution 50 Hz to 10kHz: +/- 1Hz, 0 decimal place resolution 16-bit counter, single channel: 1 pulse resolution
Input Scan Rate	1 mSec.
Input Impedance	Voltage 1 MOhm Current 250 Ohms PWM, frequency, 16-bit counter 1 MOhm

Table 10.0 Description of Inputs to AX030201	
Input Type	Description
Disable Inputs	Each input can be configured as a disable input command. When disable is selected, no CAN messages associated with that channel are sent to the network.
Universal Analog Inputs	Up to 8 analog inputs are available. 0…5VDC or 0…10VDC The offset is in volts and the resolution setpoint is V/bit, when sending a CAN message. Error detection setpoints are interpreted in volts. 4…20mA or 0…20mA The offset is in milliamps and the resolution setpoint is mA/bit, when sending a message. Error detection setpoints are interpreted in milliamps.
Digital Inputs	Up to 8 digital inputs are available. The input accepted is active high (switch is connected to a +V signal when ON). The controller interprets the offset as a state (OFF=0 or ON=1) and the resolution setpoint as state/bit, when sending the message. Error detection setpoints are not used, since error detection is not possible in this mode.
PWM Signal Inputs	Up to 8 PWM inputs are available to interface to a PWM signal from an ECM, PLC, etc. PWM Signal Frequency: 50 – 10,000 Hz Amplitude: 5-12V PWM Duty Cycle: 0 to 100% The offset is interpreted as percent duty cycle (%dc) and the resolution setpoint as %dc/bit, when sending the CAN message. Error detection setpoints will be interpreted in %dc. NOTE: If the Input Maximum setpoint is set for a low frequency (<=50Hz), the controller will use a different technique to measure the frequency. Instead of measuring the pulses in the Measuring Window (this parameter is ignored) it will measure the time between rising edges of the signal. If more than 10 seconds pass without a transition, the input will be read as zero. The frequency range in this mode is 0.5-50Hz, with up to 2 decimal places of resolution.
Pulse Inputs	Up to 8 pulse inputs are available. This input counts the number of pulses over the period of the measuring window setpoint and calculates the frequency of the pulses. Hz = With a pulse per revolution of 0, the controller calculates the offset in Hz and the resolution setpoint as Hz/bit, when sending the CAN message. Error detection setpoints are in Hertz. RPM = With a non-zero pulse per revolution, the frequency is interpreted as a RPM input. The offset is in revolutions per minute (RPM) and the resolution setpoint is RPM/bit. Error detection setpoints are interpreted in RPM. NOTE: The difference between Frequency and Counter mode is that the Frequency mode measures the number of pulses that occur in the Measuring Window period and calculates frequency, while the counter gives the period of time (in milliseconds) it takes for the number of pulses in the Measuring Window to be read at the input.
16-bit Counter Inputs	Up to eight 16-bit counter inputs are available. A counter input cannot be used to control an output. The input is configured to count pulses on the input until the value in the measuring window setpoint is reached. While the counter is active, a timer with a 1ms resolution is running in the background. When the count has been reached, the value in the 1ms timer is captured and updated to the input feedback variable. The timer is reset until the count value once again reaches the measuring window. Input and error detection setpoints are not used, since error detection is not possible in this mode. NOTE: If set to be a 16-bit counter, the input can no longer be used as either a control signal or an enable input to any of the outputs on the ECU.

Outputs

<table>
<tr><td>Analog Outputs</td><td>8 Analog outputs
User selectable (0-5V, 0-10V, +/-5V, +/-10V, 0-20 mA, 4-20 mA)
Each analog output can be configured for one of the following options, and the properties and behavior of the output in each mode is described below in Table 11.0.
<table>
<tr><td colspan="2">Table 11.0 Analog Outputs</td></tr>
<tr><td>0 to 5 Volts</td><td>The output is configured to drive a voltage output in the range of 0V to 5V. If feedback messages are used to send the output value to the bus, then the message will be sent with a resolution of 1mV/bit, and a 0mV offset.</td></tr>
<tr><td>-5 to 5 Volts</td><td>The output is configured to drive a voltage output in the range of –5V to 5V. If feedback messages are used to send the output value to the bus, then the message will be sent with a resolution of 1mV/bit, and a -5000mV offset.</td></tr>
<tr><td>0 to 10 Volts</td><td>The output is configured to drive a voltage output in the range of 0V to 10V. If feedback messages are used to send the output value to the bus, then the message will be sent with a resolution of 1mV/bit, and a 0mV offset.</td></tr>
<tr><td>-10 to 10 Volts</td><td>The output is configured to drive a voltage output in the range of –10V to 10V. If feedback messages are used to send the output value to the bus, then the message will be sent with a resolution of 1mV/bit, and a -10000mV offset.</td></tr>
<tr><td>0(4) to 20 Milliamps</td><td>The output is configured to source a current in the range of 0mA to 20mA. If feedback messages are used to send the output value to the bus, then the message will be sent with a resolution of 1uA/bit, and a 0uA offset.</td></tr>
</table></td></tr>
<tr><td>Output Accuracy</td><td>Voltage Output: +/- 0.4%
Current Output: +/- 0.4%</td></tr>
<tr><td>Output Resolution</td><td>15-bit PWM</td></tr>
<tr><td>Output Adjust Rate</td><td>1 mSec.</td></tr>
<tr><td>Output Response</td><td>For each output type, if the control signal is one of the inputs on the board, then there are up to six output profiles that can be selected to determine how the output will react to a change at the input. Refer to Figures 4, 5 and 6.
Note 1. If the control input is set to a digital type, the output will jump to the maximum setpoint when the input is ON and jump to the minimum setpoint when the input is OFF.
Note 2: For outputs that are controlled using a CAN Message, only the “Single Profile” responses will be used (single or dual slope).</td></tr>
<tr><td>Output Objects</td><td>There are objects that will determine how an input controls the output’s behavior.</td></tr>
<tr><td>Short Circuit Protection</td><td>Individual short circuit protection is provided.</td></tr>
<tr><td>Other Protection</td><td>Each output is protected against miswiring.</td></tr>
<tr><td>Accuracy</td><td>0.5%</td></tr>
<tr><td>Response Time</td><td>1 mSec.</td></tr>
<tr><td>Output Short Circuit Protection</td><td>Fully protected (all physical pins, all inputs, outputs and power)</td></tr>
</table>

General Specifications

<table>
<tr><td>Microprocessor</td><td>DSP56F8346</td></tr>
<tr><td>Control Logic</td><td>Standard embedded software is provided.</td></tr>
<tr><td>Quiescent Current Draw</td><td>
<table>
<tr><th>BATT+ Voltage (V)</th><th>Quiescent Current (ma)</th><th>Power - Watts (W)</th></tr>
<tr><td>9</td><td>269.8</td><td>2.43</td></tr>
<tr><td>10</td><td>241.8</td><td>2.42</td></tr>
<tr><td>11</td><td>220.3</td><td>2.42</td></tr>
<tr><td>12</td><td>200.5</td><td>2.41</td></tr>
<tr><td>15</td><td>159.3</td><td>2.39</td></tr>
<tr><td>20</td><td>115.1</td><td>2.30</td></tr>
<tr><td>24</td><td>95.9</td><td>2.30</td></tr>
<tr><td>28</td><td>82.4</td><td>2.31</td></tr>
<tr><td>32</td><td>72.4</td><td>2.32</td></tr>
</table>
</td></tr>
<tr><td>Communications</td><td>1 CAN port (CANopen®)
– N.B. Default baud rate is 125kBit/s (user configurable).
1 RS-232</td></tr>
<tr><td>User Interface</td><td>EDS file is provided.
To configure the unit, use standard commercially available tools that can interact with a CANopen ® Object Dictionary via an .EDS file.</td></tr>
<tr><td>Operating Conditions</td><td>-40 to 85°C (-40 to 185°F)</td></tr>
<tr><td>Protection</td><td>IP65, Unit is conformally coated in the housing.</td></tr>
<tr><td>Weight</td><td>2.30 lbs. (1.04 kg)</td></tr>
</table>

OUR PRODUCTS

Actuator Controls

Battery Chargers

CAN bus Controls, Gateways

CAN/Wifi, CAN/Bluetooth

Current Converters

DC/DC Power Converters

DC Voltage/Current Signal Converters

Engine Temperature Scanners

Ethernet/CAN Converters

Fan Drive Controllers

Hydraulic Valve Controllers

I/O Controls

LVDT Simulators

Machine Control Systems

Motor Controls

PID Controls

Position Sensors, Angle Measurement Inclinometers

Power Supplies

PWM Signal Converters/Isolators

Resolver Signal Conditioners

Service Tools

Signal Conditioners

Strain Gauge CAN Controls

Surge Suppressors

OUR COMPANY

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 provide efficient, innovative solutions that focus on adding value for our customers.

We emphasize service and partnership with our customers, suppliers, and employees to build long term relationships and mutual trust.

QUALITY DESIGN AND MANUFACTURING

Axiomatic is an ISO 9001:2008 registered facility.

SERVICE

All products to be returned to Axiomatic require a Return Materials Authorization Number (RMA#).

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

When preparing the return shipping paperwork, please note the following. The commercial invoice for customs (and packing slip) should state the harmonized international HS (tariff code), valuation and return goods terminology, as shown in italics below. The value of the units on the commercial invoice should be identical to their purchase price.

Goods Made In Canada (or Finland)
Returned Goods for Warranty Evaluation, HS: 9813.00
Valuation Identical Goods
Axiomatic RMA#

WARRANTY, APPLICATION APPROVALS/LIMITATIONS

Axiomatic Technologies Corporation reserves the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. Users should satisfy themselves that the product is suitable for use in the intended application. All our products carry a limited warranty against defects in material and workmanship. Please refer to our Warranty, Application Approvals/Limitations and Return Materials Process as described on www.axiomatic.com/service.html.

CONTACTS

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