USER MANUAL UMAX023241
Version 1.2

QUADRATURE ENCODER INPUT DUAL PROPORTIONAL VALVE HIGH TEMPERATURE CONTROLLER

With CANopen®

USER MANUAL

P/N: AX023241

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ACCRONYMS

CAN-ID	CAN 11-bit Identifier
COB	Communication Object
DIN	Digital Input used to measure active high or low signals.
EA	Axiomatic Electronic Assistant (A Service Tool for Axiomatic ECUs)
ECU	Electronic Control Unit
EMCY	Diagnostic Message (from CANopen® standard)
GND	Ground reference (a.k.a. BATT-)
I/O	Inputs and Outputs
LUT	Look Up Table
PID	Proportional-Integral-Derivative Control
PWM	Pulse Width Modulation
QD	Quadrature Encoder
RO	Read Only Object
RPDO	Received Process Data Object
RPM	Rotations per Minute
RW	Read/Write Object
SDO	Service Data Object
TPDO	Transmitted Process Data Object
WO	Write Only Object
Vps	Voltage Power Supply (a.k.a. BATT+)
%dc	Percent Duty Cycle (Measured from a PWM input)

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 High Temperature Quadrature Encoder Input Dual Output Valve Controller

This User Manual describes the architecture and functionality of the High Temperature Quadrature Encoder Input Dual Valve controller.

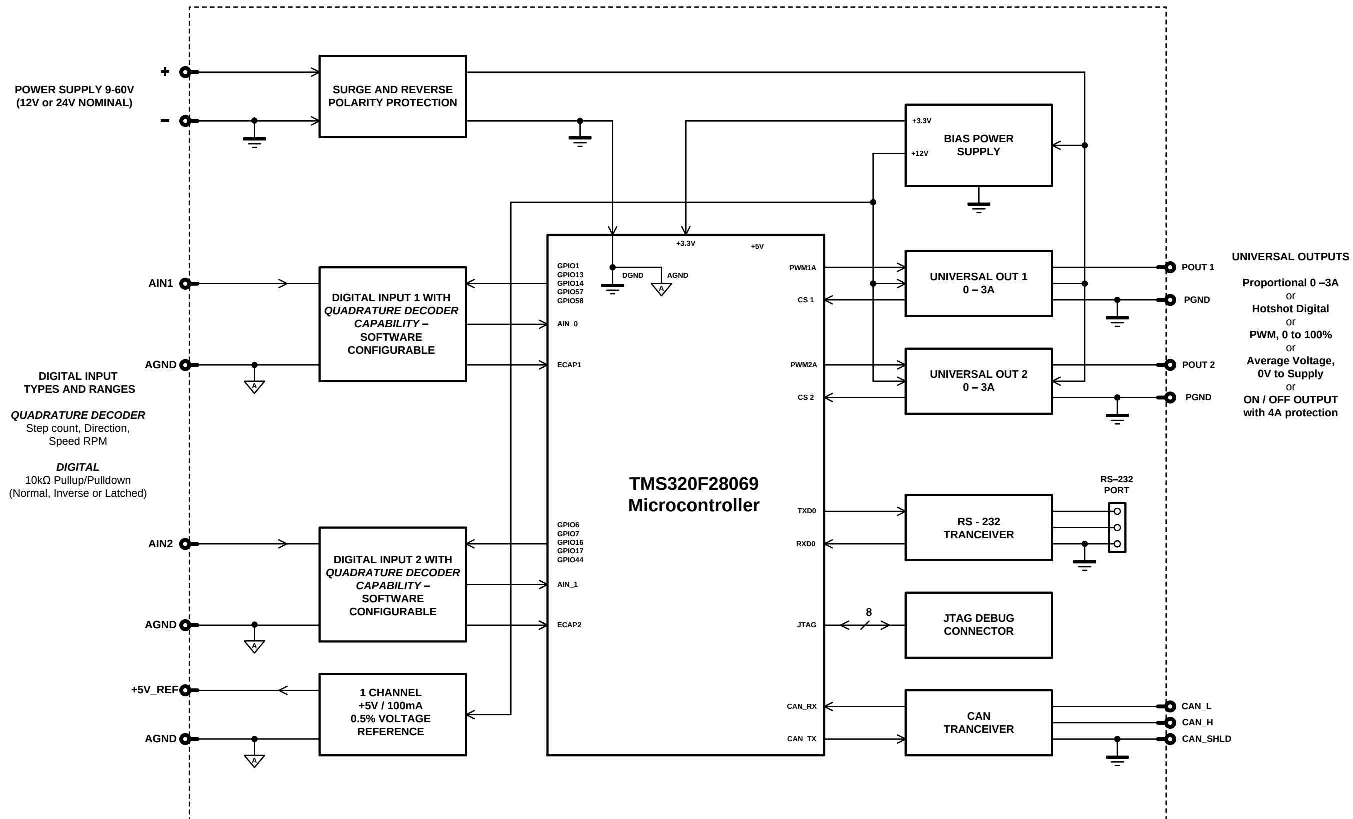


Figure 1: Hardware Functional Block Diagram

The High Temperature Quadrature Encoder Input 2 Output controller, later referred to as AX023241, is a highly configurable controller with versatile control of two digital inputs targeted for quadrature Encoder interfacing and two universal outputs. Its flexible hardware design allows the controller to have a wide range of output types. The sophisticated control algorithms/logical function blocks allow the user to configure the controller for a wide range of applications without the need for custom firmware.

The two digital inputs can be configured to read signals generated by a quadrature Encoder unit. The inputs are described in more detail in section 1.2.

The two universal outputs can be configured to different types: *Proportional Current, Voltage, PWM, Hotshot Digital Current and Digital (ON/OFF).* Each output consists of a high side half-bridge driver able to source up to 2.5Amps with hardware shutdown at 4Amps. The outputs are described in more detail in section 1.4.

The controller also offers a variety of logical/mathematical functions blocks that can be used to perform application-specific logic or calculations. These functional blocks are explained in more detailed in section 1.6 through section 1.8.

Both outputs and the various logical function blocks on the unit are inherently independent from one another but can be configured to interact in a large number of ways with each other.

The different blocks listed above are configured using any CANopen® configuration software.

1.2. Quadrature Encoder Input Function Block

The controller consists of two digital inputs. The two inputs can be configured to measure digital signals generated by a quadrature Encoder unit.

The AX023241 controller has configuration options for specifying various Quadrature Encoder unit parameters, such as step count scaler, direction/polarity of rotation, static step count offset and number of quadrature Encoder pulses per revolution (for speed measurements).

The controller has two inputs for detecting the pulses generated by a quadrature Encoder unit. The three measurements (step count, direction and speed) are determined using these two input signals.

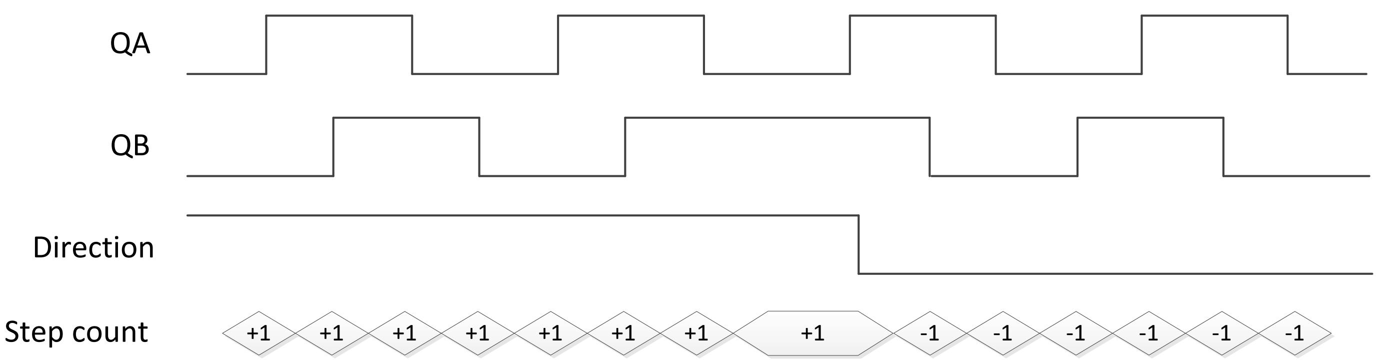


Figure 2: Quadrature Encoder Signals (QA&QB) and resulting Direction and Step count.

The quadrature Encoder functionality can be configured using objects 3410h **Quadrature Encoder Scaler**, 3411h **Quadrature Encoder Direction**, 3412h **Quadrature Encoder Offset** and 3413h **Quadrature Encoder Pulses Per Revolution**.

The quadrature Encoder results are available in object 7100h **Input FV** and are processed depending on the Input FV to PV scaling settings.

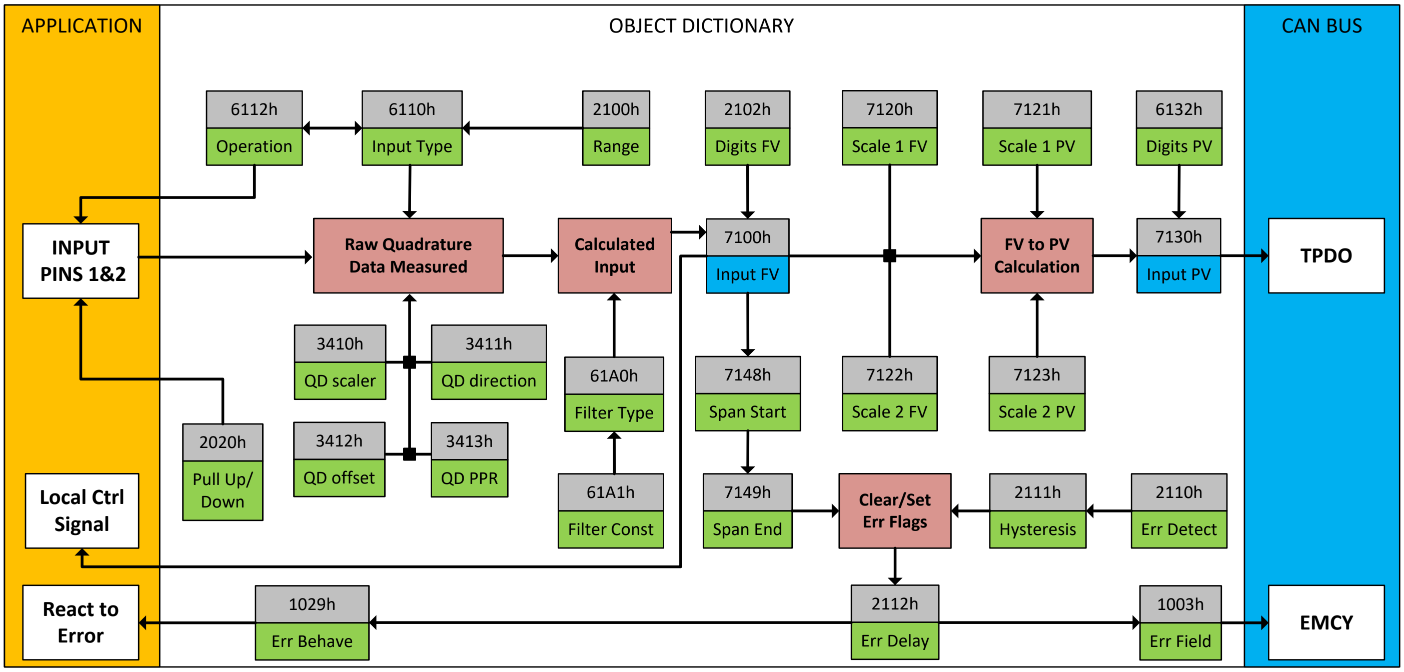


Figure 3: Quadrature Encoder objects

1.2.1. Input Sensor Types

The most important object associate with the AI function block is object 6110h **AI Sensor Type**, which accepts the input types described in Table 1. By changing this value, and associated with its object 2100h **AI Input Range**, other objects will be automatically updated by the controller. The list of affected objects includes **Input Scaling FV** & **PV** objects (7120h, 7121h, 7122h & 7123h) and also **Span Start** and **End** objects (7148h and 7149h). The options for object 6110h are shown in Table 1, and no values other than what are shown here will be accepted. The inputs are setup to read quadrature Encoder signals by default.

Table 1: Object 6110h - AI Sensor Type Options

Value	Meaning
60	Frequency Input (or RPM)
10000	PWM Input
10002	**Quadrature Encoder**

Table 2: Object 6112h - AI Operating Mode Options

Value	Meaning
0	Channel Off
10	**Digital Input (on/off/QD)**

The allowable ranges will depend on the input sensor type selected. Table 3 shows the relationship between the sensor type, and the associated range options. The default value for each range is bolded, and object 2100h **AI Range** will automatically be updated with this value when 6110h is changed. The grayed cells mean that the associate value is not allowed for the range object when that sensor type has been selected.

Table 3: Object 2100h - AI Input Range Options Depending on Sensor Type

Value	Frequency	PWM	Digital	Quad.Dec
0	**0.5Hz to 50Hz**	**Low Freq (<1kHz)**	**Normal**	**Edge count**
1	10Hz to 1kHz	High Freq (>100Hz)	Inverse	Direction
2	100Hz to 10kHz		Latched	Speed

Digital **Input Sensor Types** offers three modes: Normal, Inverse, and Latched. The measurements taken with digital input types are 1 (ON) or 0 (OFF).

When a quadrature Encoder unit is read using the AX023241 controller, both digital inputs should be connected to read the signals generated by the quadrature Encoder unit. Both inputs need to be configured as one of the Quadrature Encoder input types, Step Count (2100h – '0'), Direction (2100h – '1') or Speed (2100h – '2'), measured as RPM).

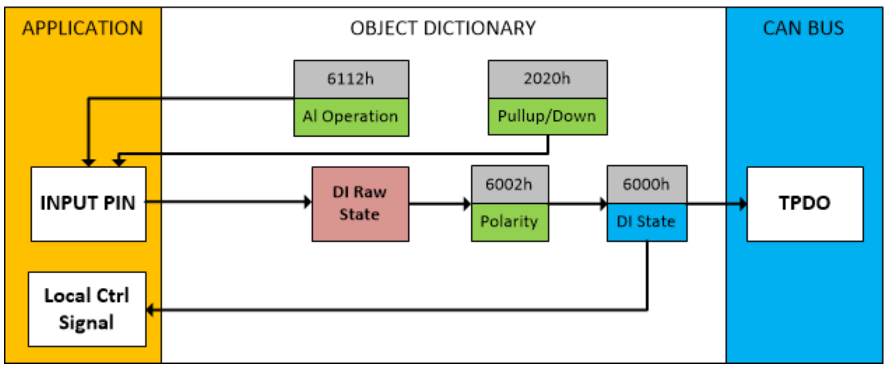


Figure 4: Digital Input objects

1.2.2. Pullup / Pulldown Resistor Options

In all **Input Sensor Types:** Digital and Quadrature Encoder types, the user has the option of three (3) different pull up/pull down options as listed in Table 4.

Table 4: Pullup/Pulldown Resistor Options

0	*Pullup/Pulldown Off*
1	*1kΩ Pullup*
2	*10kΩ Pulldown*

In order to create 'Active High'/'Active Low' configurations – a proper combination of Digital Input modes: *Normal, Inverse, Latched* and **Pullup/Pulldown Resistor**: *1kΩ Pullup, 10kΩ Pulldown* needs selected. For example, when using a 'floating' input, in order to create an 'Active Low' configuration use **Pullup/Pulldown Resistor:** *1kΩ Pullup* and **Input Sensor Type***: Digital (Inverse)*. The pullup resistor will create a 1 (ON) value when the input is floating. Since it is placed in *Digital (Inverse),* this value will be considered as OFF. Once the input is grounded this will create a 0 (OFF) but since the input is *Digital (Inverse)* this be considered as ON.

1.2.3. Input Software Filter Types

All input types can be filtered using **Filter Type** and **Filter Constant** objects 61A0h and 61A1h. There are three (3) filter types available as listed in Table 5.

Table 5: Input Filtering Types

0	*No Filtering*
1	*Moving Average*
2	*Repeating Average*

The first filter option, *No Filtering*, provides no filtering to the measured data. Thus, the measured data will be directly used to the any function block which uses this data.

The second option, *Moving Average*, applies 'Equation 1' below to measured input data, where $Value_N$ represents the current input measured data, while $Value_{N-1}$ represents the previous filtered data. The Filter Constant is the **Filter Constant** object 61A1h.

Equation 1 - Moving Average Filter Function:

$$\text{Value}_\text{N} = \text{Value}_{\text{N}-1} + \frac{(\text{Input} - \text{Value}_{\text{N}-1})}{\text{Filter Constant}}$$

The third option, Repeating Average, applies the 'Equation 2' below to measured input data, where N is the value of **Filter Constant** object. The filtered input, Value, is the average of all input measurements taken in N (**Filter Constant)** number of reads. When the average is taken, the filtered input will remain until the next average is ready.

Equation 2 - Repeating Average Transfer Function:

$$\text{Value} = \frac{\sum_0^N \text{Input}_N}{N}$$

1.3. Internal Function Block Control Sources

The AX023241 controller allows for internal function block sources to be selected from the other function blocks supported by the controller. As a result, any output from one function block can be selected as the control source for another. Keep in mind that not all options make sense in all cases, but the complete list of control sources is shown in Table 6.

Table 6: Control Source Options

Value	Meaning
0	Control Not Used
1	Received CAN Message
2	Quadrature Encoder Input Measured
3	Output Target Value
4	Output Current Feedback
5	Lookup Table
6	Math Function Block
7	Programmable Logic Block
8	PID Function Block
9	Control Constant Data
10	Set/Reset Block
11	Diagnostic Trouble Code
12	Power Supply Measured
13	Processor Temperature Measured

In addition to a source, each control also has a number which corresponds to the sub-index of the function block in question. Table 7 outlines the ranges supported for the number objects, depending on the source that had been selected.

Table 7: Control Source Number Options

Control Source	Control Source Number Range
Control Not Used	[0]
Received CAN Message	[1…5]
Quadrature Encoder Input Measured	[1…2]
Output Target Value	[1…2]
Output Current Feedback	[1…2]
Lookup Table	[1…3]
Math Function Block	[1...2]
Programmable Logic Block	[1…1]
PID Function Block	[1…1]
Control Constant Data	[1…10]
Set/Reset Block	[1…2]
Diagnostic Trouble Code	[1…3]
Power Supply Measured	[1…1]
Processor Temperature Measured	[1…1]

1.4. Output Drive Function Blocks

The controller consists of two proportional fully independent outputs. Each output consists of a high side half-bridge driver able to source up to 2.5Amps. The outputs are connected to independent microcontroller timer peripherals and thus can be configured independently from 1Hz to 25kHz.

The **Output Type** object 6310h determines what kind of signal the output produces. Changing this object causes other output type related objects to match the selected type. For this reason, the first object that should be changed prior to configuring other output objects is the **Output Type** object. The supported output types by the controller are listed in Table 8 below:

Table 8: Output Type Options

Value	Meaning	Range [Unit]
0	Output Disabled	N/A
10	Output Voltage	0 to 60 [V]
20	**Output Current**	**0 to 2500 [mA]**
40	Output PWM	0 to 100 [%]
1000	Output Digital On/Off	0 (OFF) or 1 (ON)
1020	Output Digital Hotshot	0 (OFF) or 1 (ON)

There are two objects that are associated to *Proportional Current* and *Digital Hotshot* **Output Type**s that are not with others - these are *Dither Frequency* and *Dither Amplitude.* The dither signal is used in *Proportional Current* mode and is a low frequency signal superimposed on top of the high frequency (25kHz) signal controlling the output current. The two outputs have independent dither frequencies which can be adjusted at any time. The combination of *Dither Amplitude* and *Dither Frequency* must be appropriately selected to ensure fast response to the coil to small changes in the control inputs but not so large as to affect the accuracy or stability of the output.

In *Proportional Voltage* type, the controller measures the Vps applied to the unit and based on this information, the controller will adjust the PWM duty cycle of the signal (0-Vps amplitude) so that the average signal is the commanded target value. Thus, the output signal is not an analog one. In order to create an analog signal, a simple low pass filter can be connected externally to the controller.

In *PWM Duty Cycle* **Output Type**, the controller outputs a signal (0-Vps amplitude) on a fixed output frequency set by object 2380h **Output Frequency** with varying PWM Duty Cycle based on commanded input. Since both outputs are connected to independent timers, the **Output Frequency** object can be changed at any time for each output without affecting the other.

Digital **Output Type** offers the user with four different output responses as listed in Table 9. The controller will source any current required in any of the options listed in Table 9 up to 2.5Amps.

Table 9: Digital Output Responses

0	Normal On/Off
1	Inverse Logic
2	Latched Logic
3	Blinking Logic

In a *'Normal'* response, when the Control input commands the output ON, then the output will be turned ON. However, in an *'Inverse'* response, the output will be ON unless the input commands the output ON, in which case it turns OFF.

If a *'Latched'* response is selected, when the input commands the state from OFF to ON, the output will change state.

If a *'Blinking'* response is selected, then while the input command the output ON, it will blink at the rate defined in the **Digital Blink Rate** object. When commanded OFF, the output will stay off. A blinking response is only available with a *'Digital On/Off'* type of output (not a Hotshot type).

The *'Hotshot Digital'* type is different from *'Digital On/Off'* in that it still controls the current through the load. This type of output is used to turn on a coil then reduce the current so that the valve will remain open, as shown in Figure 5. Since less energy is used to keep the output engaged, this type of response is very useful to improve overall system efficiency. With this output type there are associated three objects: **Hold Current**, **Hotshot Current** and **Hotshot Time** which are used to configure form of the output signal as shown in Figure 5.

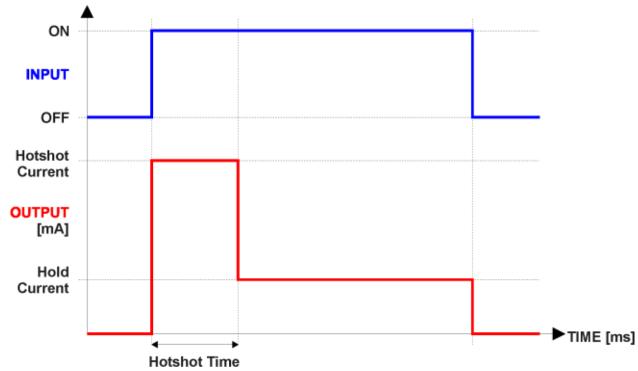


Figure 5: Hotshot Digital Profile

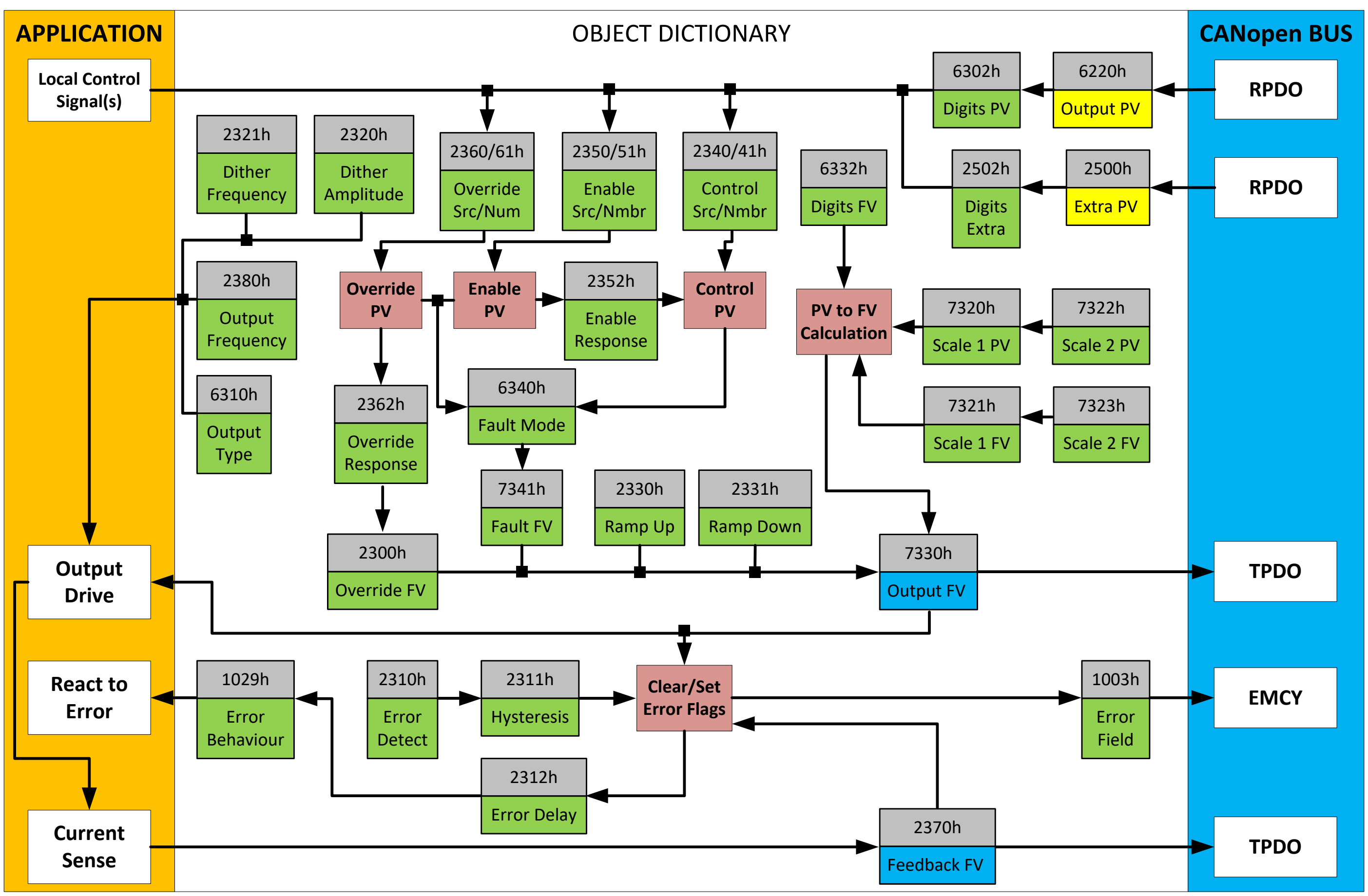


Figure 6: Universal Output objects

In order to prevent abrupt changes at the output due to sudden changes in the command input, the user can choose to use the independent up or down ramps to smooth out the coil's response. The

2330h **Ramp Up** and 2331h **Ramp Down** setpoints are in milliseconds, and the step size of the output change will be determined by taking the absolute value of the output range and dividing it by the ramp time.

Object 7300h (AO Output PV) can be used to control the proportional outputs.

The relationship between the Process Value (input) and the Field Value (output) is a linear one, as shown in Figure 5. However, 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.

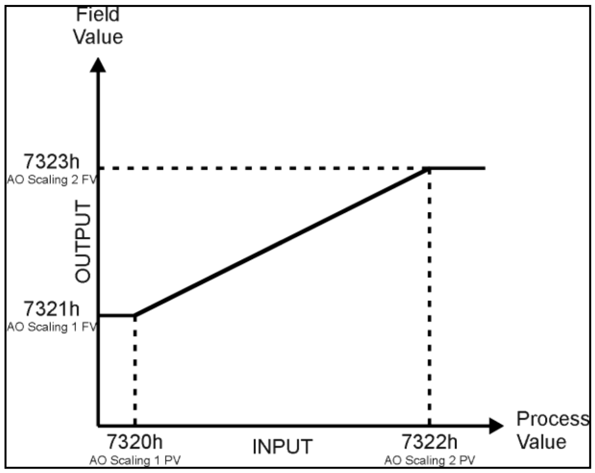


Figure 7: Analog Output Linear Scaling PV to FV

The **Control Source** object 2340h together with **Control Number** object 2341h determine which signal is used to drive the output. For example, setting **Control Source** to *Quadrature Encoder Input Measured* and **Control Number** to (*1)* will connect signal measured from Quadrature Encoder Input 1 to the output in question. The input signal is scaled per input type range between 0 and 1 to form control signal. Outputs respond in a linear fashion to changes in control signal.

In addition to the **Control Source** object, the controller offers two more options that help increase its versatility – **Enable Source/Number/Response** and **Override Source/Number/Response** set of objects (2350h/51h and 2360h/61h/62h).

The **Enable Source** object together with **Enable Number** object to determine the enable signal for the output in question. The **Enable Response** object is used to select how output will respond to the selected Enable signal. **Enable Response** object options are listed in Table 10.

Table 10: Enable Response Options

0	Enable When On, Else Shutoff
1	Enable When On, Else Rampoff
2	Enable When On, Else Ramp To Max
3	Enable When On, Else Ramp To Min
4	Enable When On, Else Keep Last Value
5	Enable When Off, Else Shutoff
6	Enable When Off, Else Rampoff
7	Enable When Off, Else Ramp To Max
8	Enable When Off, Else Ramp To Min
9	Enable When Off, Else Keep Last Value

Override input allows the output drive to be configured to go to a default value in the case of the override input being engaged or disengaged, depending on the logic selected in **Override Response**, presented on Table 11. When active, the output will be driven to the value in **Output at Override Command** regardless of the value of the Control input. The **Override Source** and **Override Number** together determine the Override input signal.

Table 11: Override Response Options

0	Override When On
1	Override When Off

If a fault is detected in any of the active inputs (Control/Enable/Override) the output will respond per **Control Fault Response** object as outlined in Table 12. Fault Value is defined by **Output in Fault Mode** object value, which is interpreted in selected output units.

Table 12: Fault Response Options

0	Shutoff Output
1	Apply Fault Value
2	Hold Last Value

1.5. Miscellaneous Function Block

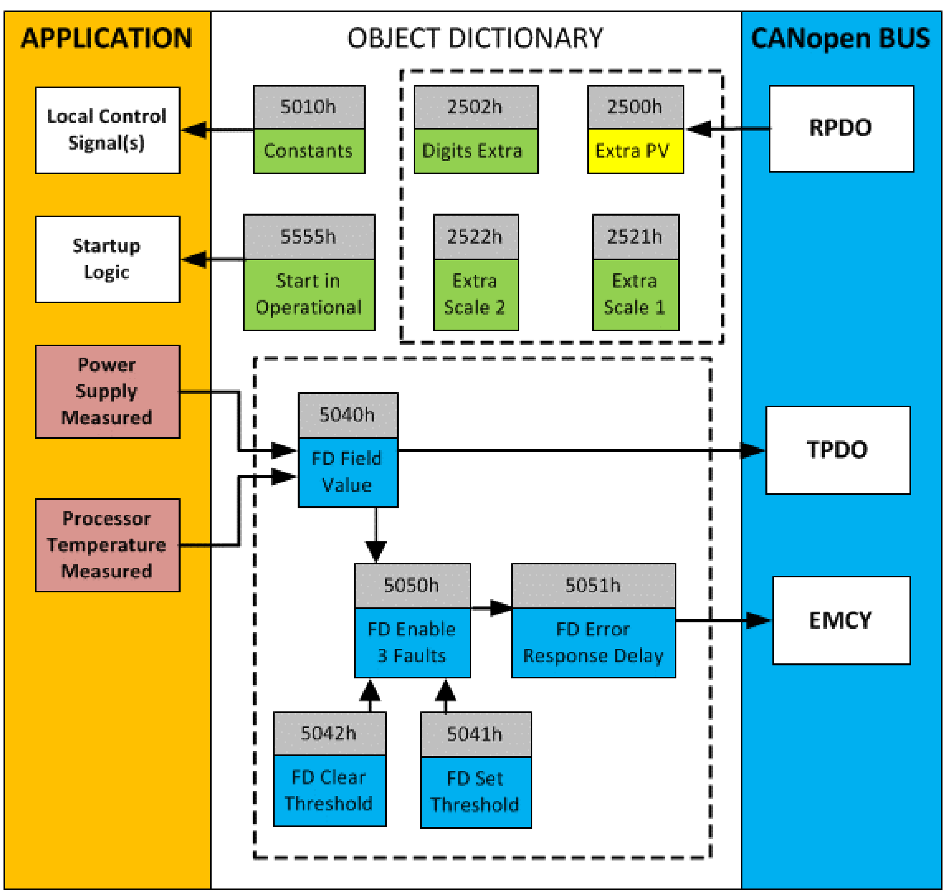


Figure 8: Miscellaneous objects

Extra RPDO Messages

Objects 2500h **Extra Control Received PV**, 2502h **EC Decimal Digits PV**, 2502h **EC Scaling 1 PV** and **EC Scaling 2 PV** allow for additional data received on a CANopen® RPDO to be mapped independently to various function blocks as a control source. The scaling objects are provided to define the limits of the data when it is used by another function block, as shown in Figure 7.

Constant Values

Object 5010h **Constant Field Value** is provided to give the user the option for a fixed value that can be used by other function blocks. Sub-index 1 is fixed as FALSE (0) and sub-index 2 is always TRUE (1). There are 13 other sub-indexes provided for user selectable values.

The constants are read as 32-bit real (float) data, so no decimal digit object is provided. When setting up the constant, make sure to do it with the resolution of the object that will be compared with it.

The False/True constants are provided primarily to be used with the logic block. The variable constants are also useful with logic or math blocks.

Fault Detection Objects

Object 5040h **FD Field Value** is a read only object containing the field values of the over temperature, over and under voltage. Object 5041h **FD Set Threshold** sets the limit values for which the faults occur when reached. When any of these thresholds are reached, the faults will clear when the values have lowered to values set in object 5042h **FD Clear Threshold.**

For the AX023241 controller to begin monitoring fault detections, object 5050h **Error Check Detection** determines which Fault Detection is enabled through 1 byte data as bits. Once a fault is detected, object 5051h **Error Response Delay** will determine how long (in 100ms steps) the fault needs to be present to flag and error.

Startup

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

When using the AX023241 as a stand-alone controller where 5555h is set to TRUE, it is recommended to disable all TPDOs (set the Event Timer to zero) so that it does not run with a continuous CAN error when not connected to a bus.

Besides Enable and Override signals controlling a particular output; another fault mode than can occur is that of a Power Supply. Power Supply fault can be enabled to detect over voltage or under voltage which will automatically disable ALL outputs. This setpoint is associated with the **Power Supply Diag** function block. Also, if the **Over Temperature Diag** function block is enabled, then a microcontroller over-temperature reading disables all the outputs until it has cooled back to the operating range.

Fault detection is available for current output types. A current feedback signal is measured and compared to desired output current value.

The outputs are inherently protected against a short to GND or Vps by hardware. In case of a dead short, the hardware will automatically disable the output drive, regardless of what the processor is commanding for the output. When this happens, the processor detects output hardware shutdown and commands off the output in question. It will continue to drive non-shorted outputs normally and periodically try to re-engage the short load, if still commanded to do so. If the fault has gone away since the last time the output was engaged while shorted, the controller will automatically resume normal operation.

In the case of an open circuit, there will be no interruption of the control for any of the outputs. The processor will continue to attempt to drive the open load.

The measured current through the load is available to be broadcasted on a CAN message if desired. It is also used as the input to the diagnostic function block for each output, and an open or shorted output can be broadcasted in a DM1 message on the CAN network.

1.6. Lookup Table Function Block

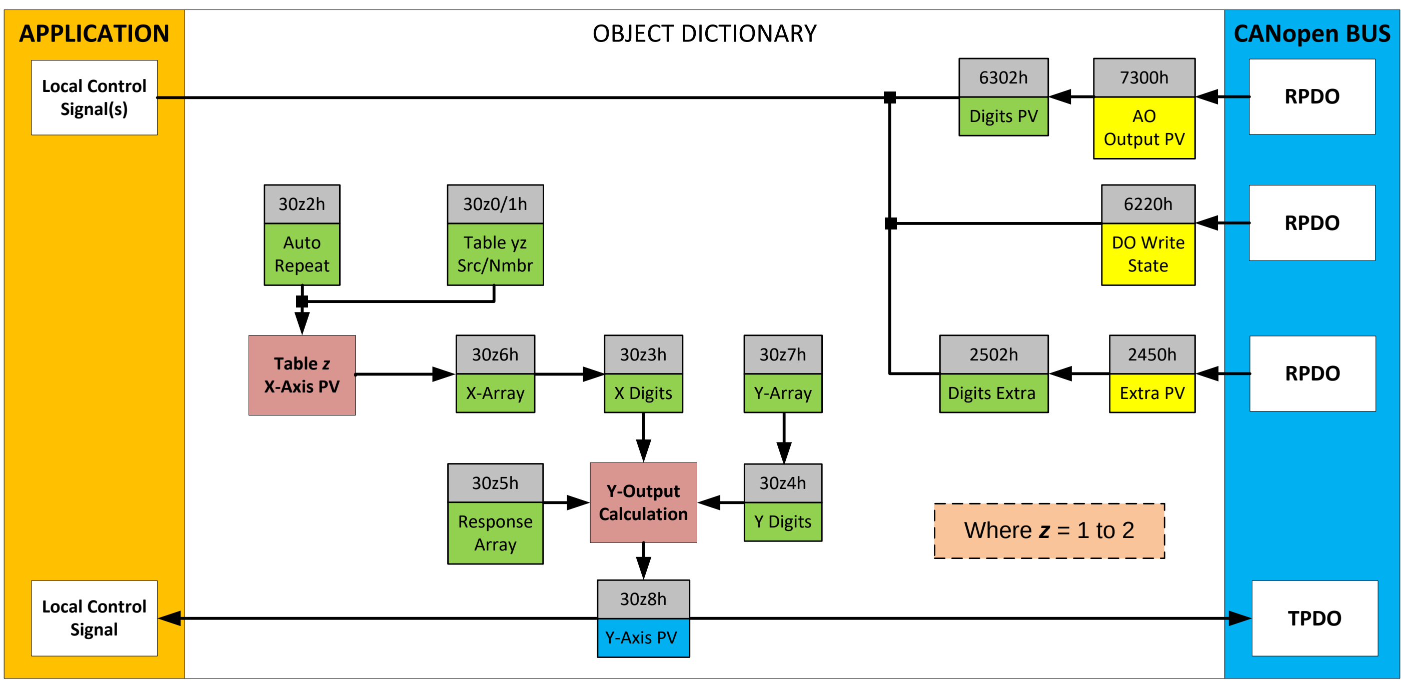


Figure 9: Lookup Table Block objects

Lookup Tables are used to give an output response of up to 10 slopes per Lookup Table. There are two types of Lookup Table response based on **X-Axis Type**: *Data Response* and *Time Response* Sections 1.6.1 through 1.6.5 will describe these two **X-Axis Types** in more detail.

There are two key setpoints that will affect this function block. The first is the **X-Axis Source** and **X-Axis Number** which together define the Control Source for the function block.

1.6.1. X-Axis, Input Data Response

In the case where the **X-Axis Type** = *Data Response,* the points on the X-Axis represent the data of the control source. These values must be selected within the range of the control source.

When selecting X-Axis data values, there are no constraints on the value that can be entered into any of the X-Axis points. The user should enter values in increasing order to be able to utilize the entire table. Therefore, when adjusting the X-Axis data, it is recommended that X_{10} is changed first, then lower indexes in descending order as to maintain the below:

$$Xmin <= X_0 <= X_1 <= X_2 <= X_3 <= X_4 <= X_5 <= X_6 <= X_7 <= X_8 <= X_9 <= X_{10} <= Xmax$$

As stated earlier, *Xmin* and *Xmax* will be determined by the X-Axis Source that has been selected.

If some of the data points are *'Ignored'* as described in Section 1.6.3, they will not be used in the X-Axis calculation shown above. For example, if points X_4 and higher are ignored, the formula becomes $Xmin <= X_0 <= X_1 <= X_2 <= X_3 <= Xmax$ instead.

1.6.2. Y-Axis, Lookup Table Output

The Y-Axis has no constraints on the data that it represents. This means that inverse or increasing/decreasing or other responses can be easily established.

In all cases, the controller looks at the **entire range** of the data in the Y-Axis objects and selects the lowest value as the *Ymin* and the highest value as the *Ymax*. They are passed directly to other function blocks as the limits on the Lookup Table output. (i.e used as Xmin and Xmax values in linear calculations.)

However, if some of the data points are *'Ignored'* as described in Section 1.6.3, they will not be used in the Y-Axis range determination.

1.6.3. Default Configuration, Data Response

By default, all Lookup Tables in the ECU are disabled (**X-Axis Source** equals *Control Not Used).* Lookup Tables can be used to create the desired response profiles. If a Universal Input is used as the X-Axis, the output of the Lookup Table will be what the user enters in **Y-Values** setpoints.

Recall, any controlled function block which uses the Lookup Table as an input source will also apply a linearization to the data. **Therefore, for a 1:1 control response, ensure that the minimum and maximum values of the output correspond to the minimum and maximum values of the table's Y-Axis.**

All tables (1 to 2) are disabled by default (no control source selected). However, should an **X-Axis Source** be selected, the **Y-Values** defaults will be in the range of 0 to 100% as described in the "Y-Axis, Lookup Table Output" section above. X-Axis minimum and maximum defaults will be set as described in the "X-Axis, Data Response" section above.

By default, the X and Y axes data is set up for an equal value between each point from the minimum to maximum in each case.

1.6.4. Point To Point Response

By default, the X and Y axes are setup for a linear response from point (0,0) to (10,10), where the output will use linearization between each point, as shown in Figure 4. To get the linearization, each "**Point N – Response**", where N = 1 to 10, is setup for a *'Ramp To'* output response.

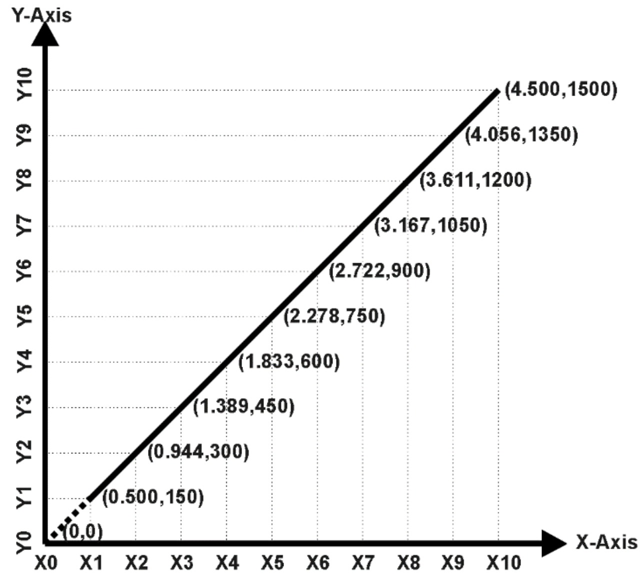


Figure 10: Lookup Table with "Ramp To" Data Response

Alternatively, the user could select a *'Jump To'* response for "**Point N – Response**", where N = 1 to 10. In this case, any input value between X_{N-1} to X_N will result in an output from the Lookup Table function block of Y_N.

An example of a Math function block (0 to 100) used to control a default table (0 to 100) but with a *'Jump To'* response instead of the default *'Ramp To'* is shown in Figure 5.

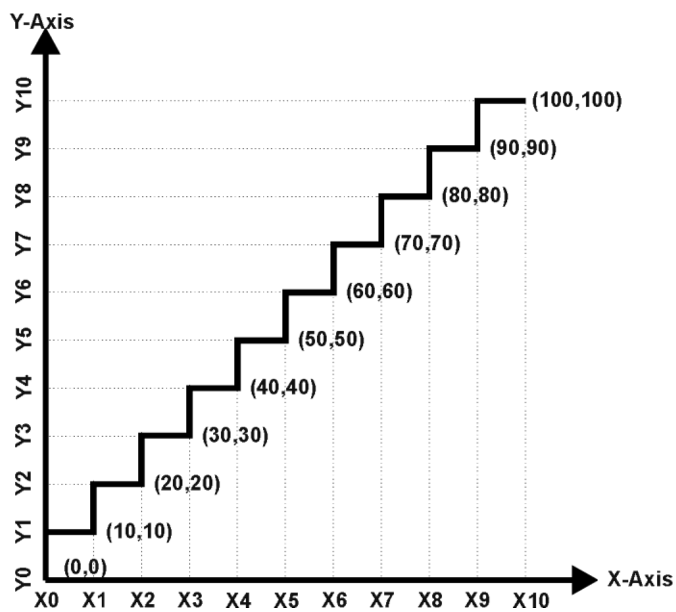


Figure 11: Lookup Table with "Jump To" Data Response

Lastly, any point except (0,0) can be selected for an *'Ignore'* response. If "**Point N – Response**" is set to ignore, then all points from (X_N, Y_N) to (X_{10}, Y_{10}) will also be ignored. For all data greater than X_{N-1}, the output from the Lookup Table function block will be Y_{N-1}.

A combination of *Ramp To*, *Jump To* and *Ignore* responses can be used to create an application specific output profile.

1.6.5. X-Axis, Time Response

As mentioned in Section 1.6, a Lookup Table can also be used to get a custom output response where the **X-Axis Type** is a *'Time Response.'* When this is selected, the X-Axis now represents time, in units of milliseconds, while the Y-Axis still represents the output of the function block. There is also another setpoint associated to the Lookup Table when configured to *Time Response* which is the **Table Auto-Cycle** setpoint.

In this case, the **X-Axis Source** is treated as a digital input. When the control input is ON, the output will be changed over a period of time based on the profile in the Lookup Table. There are two different scenarios on how the Lookup Table will react once the profile is finished. The first option is when 30z2h **Table Auto-Cycle** is set to *FALSE* in which case, once the profile has finished (i.e. index 10, or *Ignored* response), the output will remain at the last output at the end of the profile until the control input turns OFF. The second option is when 30z2h **Table Auto-Cycle** is set to *TRUE* in which case, once the profile has finished (i.e. index 10, or *Ignored* response), the Lookup Table will automatically return to the 1st response and will continually be auto-cycling for as long as the input remains in the ON state.

When the control input is OFF, the output is always at zero. When the input comes ON, the profile ALWAYS starts at position (X_0, Y_0) which is 0 output for 0ms.

In a time response, the interval time between each point on the X-axis can be set anywhere from 1ms to 1min. [60,000 ms]

1.7. Math Function Block

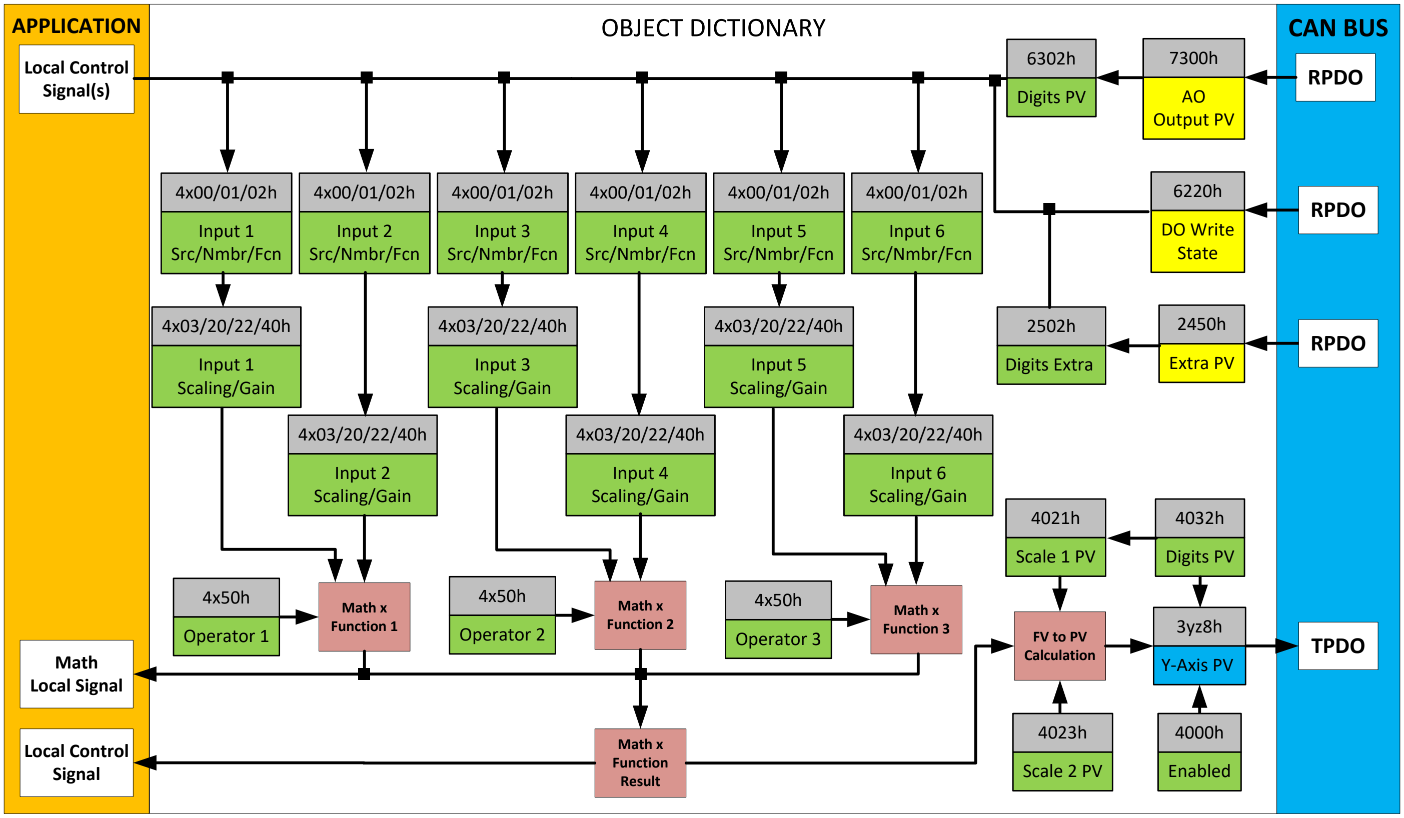


Figure 12: Math Function Block objects

There are two mathematical function blocks that allow the user to define basic algorithms. A math function block can take up to five input signals. Each input is then scaled according to the associated limit and scaling setpoints.

Inputs are converted into percentage value based on the “Function X Input Y Minimum” and “Function X Input Y Maximum” values selected. For additional control the user can also adjust the “Function X Input Y Scaler”. By default, each input has a scaling ‘weight’ of 1.0 However, each input can be scaled from -1.0 to 1.0 as necessary before it is applied in the function.

For example, in the case where the user may want to combine two inputs such that a quadrature Encoder speed (Input 1) is the primary control of an output, but the speed can be incremented or decremented based on the quadrature Encoder step count (Input 2), it may be desired that 75% of the scale is controlled by the Encoder speed, while the current step count can increase or decrease the min/max output by up to 25%. In this case, Input 1 would be scaled with 0.75, while Input 2 uses 0.25. The resulting addition will give a command from 0 to 100% based on the combined positions of both inputs.

A mathematical function block includes four selectable functions, which each implements equation *A operator B*, where A and B are function inputs and operator is function selected with setpoint **Math function X Operator**. Setpoint options are presented in the table below. The functions are connected together, so that result of the preceding function goes into Input A of the next function. Thus Function 1 has both Input A and Input B selectable with setpoints, where Functions 2 to 3 have only Input B selectable. Input is selected by setting “**Function X Input Y Source**” and **Function X**

Input Y Number. If **Function X Input B Source** is set to 0 '*Control not used'* signal goes through function unchanged.

$$Math\ Block\ Output = \left(\left((\mathrm{InA}\ Op1\ \mathrm{InB1})\ op2\ \mathrm{InB2}\right)\ op3\ \mathrm{InB3}\ \right)$$

Table 13: Math Function Operators

0	=	True when InA Equals InB
1	!=	True when InA Not Equal InB
2	>	True when InA Greater Than InB
3	>=	True when InA Greater Than or Equal InB
4	<	True when InA Less Than InB
5	<=	True when InA Less Than or Equal InB
6	OR	True when InA or InB is True
7	AND	True when InA and InB are True
8	XOR	True when InA/InB is True, but not both
9	+	Result = InA plus InB
10	-	Result = InA minus InB
11	x	Result = InA times InB
12	/	Result = InA divided by InB
13	MIN	Result = Smallest of InA and InB
14	MAX	Result = Largest of InA and InB
15	MAX-MIN	Result = Largest minus Smallest of InA and InB

For logic operations (6, 7, 8) scaled input greater or equal to 1 is treated as TRUE. For logic operations (0 to 8), the result of the function will always be 0 (FALSE) of 1 (TRUE). For the arithmetic functions (9 to 15), it is recommended to scale the data such that the resulting operation will not exceed full scale (0 to 100%) and saturate the output result.

When dividing, a zero divider will always result in a 100% output value for the associated function.

Lastly the resulting mathematical calculation, presented as a percentage value, can be scaled into the appropriate physical units using the 4021h **Math Output Scaling 1 PV** and 4023h **Math Output Scaling 2 PV** objects setpoints. These values are also used as the limits when the Math Function is selected as the input source for another function block.

1.8. PID Control Function Block

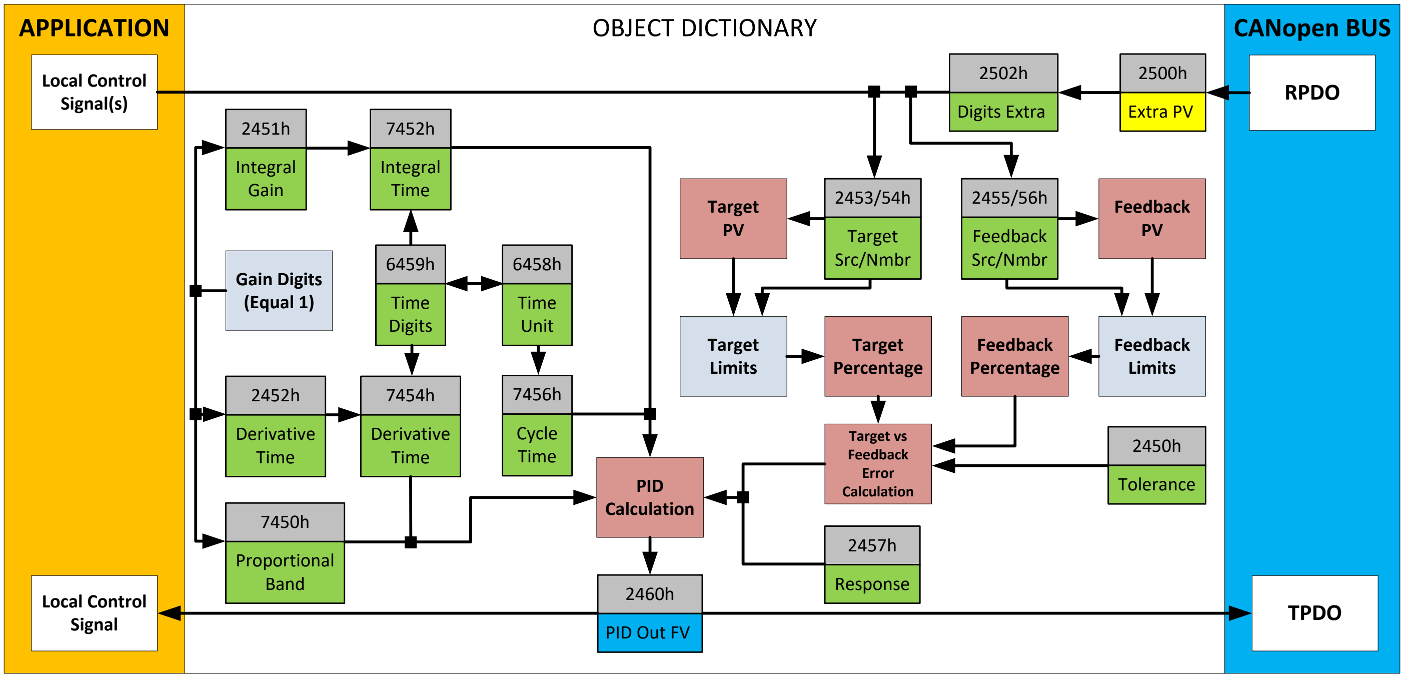


Figure 13: PID Block objects

The PID Control function block is an independent logic block, but it is normally intended to be associated with proportional output control blocks described earlier. When the **Control Source** for an output has been setup as a 'PID Function Block', the command from the selected PID block drives the physical output on the AX023241 Controller.

The 2453h **PID Target Command Source** and 2454h **PID Target Command Number** objects determine control input and the 2455h **PID Feedback Input Source** and 2456h **PID Feedback Input Number** setpoints determine the established the feedback signal to the PID function block. The 2457h **PID Control Response** will use the selected inputs as per the options listed in Table 14.

Table 14: PID Response Options

0	Single Output
1	Setpoint Control
2	On When Over Target
3	On When Below Target

When a '*Single Output*' response is selected, the Target and Feedback inputs do not have to share the same units. In both cases, the signals are converted to a percentage value based on the minimum and maximum values associated with the source function block.

When a *Setpoint Control* response is selected, the 2453h **PID Target Command Source** automatically gets updated to *Control Constant Data* and cannot be changed. The value set in the associated constant in the Constant Data List function block becomes the desired target value. In this case, both the target and the feedback values are assumed to be in the same units and range. The minimum and maximum values for the feedback automatically become the constraints on the constant target. In this mode, the output of the block would be a value from 0% to 100%.

The last two response options, '*On When Over Target'* and '*On When Under Target'*, are designed to allow the user to combine the two proportional outputs as a push-pull drive for a system. Both outputs must be set up to use the same control input (linear response) and feedback signal in order to get the expected output response. In this mode, the output would be between 0% to 100%.

In Order to allow the output to stabilize, the user can select a non-zero value for 2450h **PID Tolerance**. If the absolute value of $Error_K$ is less than this value, $Error_K$ in the formula below will be set to zero.

The PID algorithm used is shown below, where G, Ki, Ti, Kd, and Td are configurable parameters.

$$PIDOutput_k = P_k + I_k + D_k$$

$$P_k = P\_Gain * Error_k$$
$$I_k = I\_Gain * ErrorSum_k$$
$$D_k = D\_Gain * (Error_k - Error_{k-1})$$

$$Error_k = Target - Feedback$$
$$ErrorSum_k = ErrorSum_{k-1} + Error_k$$

$$P\_Gain = G$$
$$I\_Gain = Ki * \ T/Ti \ \ (\text{Note: If Ti is zero, I\_Gain} = 0)$$
$$D\_Gain = Kd * Td/T$$

$$T = 0.001$$

Each system will have to be tuned for the optimum output response. Response times, overshoots and other variables will have to be decided by the customer using an appropriate PID tuning strategy. Axiomatic is not responsible for tuning the control system.

2. Installation Instructions

2.1. Dimensions and Pinout

The High Temperature Quadrature Encoder Input 2 Output Valve Controller AX023241 is packaged in a plastic enclosure from TE Deutsch equivalent. The assembly carries an IP67 rating.

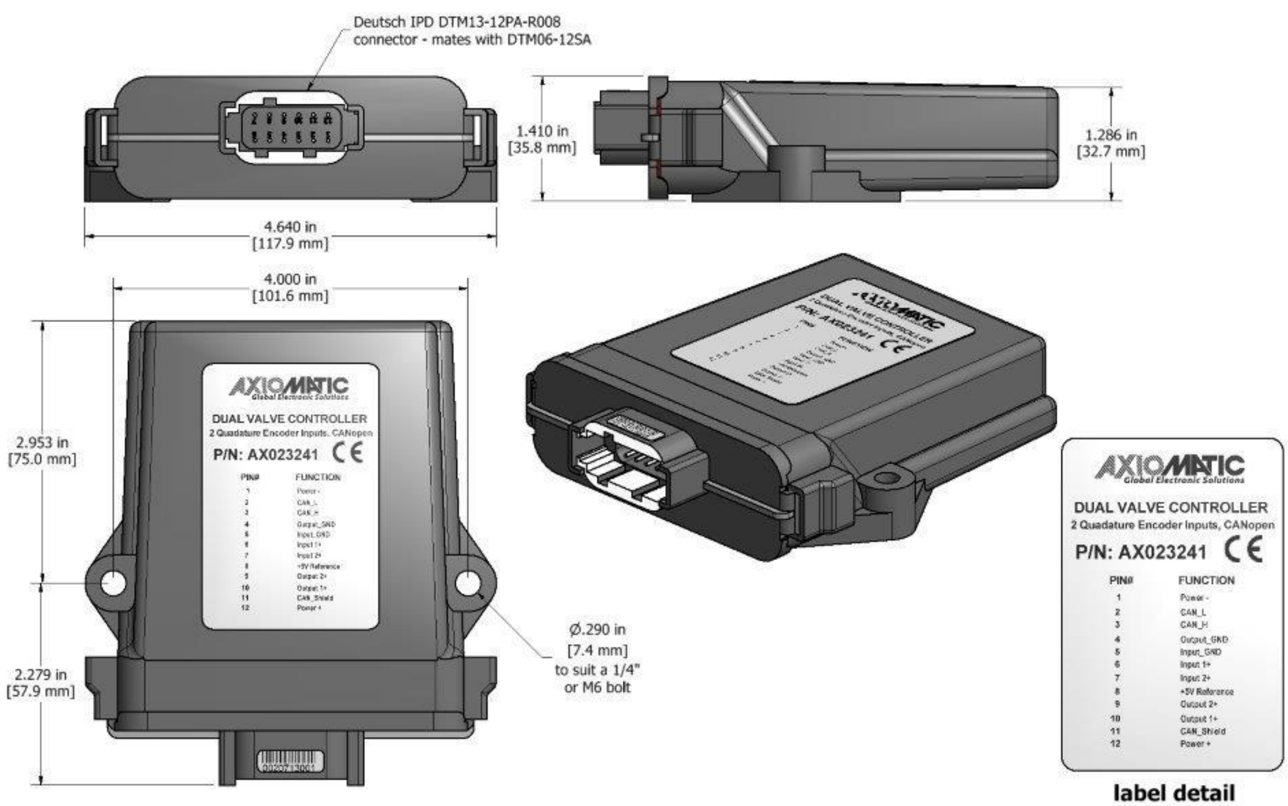


Figure 14: Enclosure Dimensions

Table 15: Connector Pinout

CAN and I/O Connector	
Pin #	**Description (Notes)**
1	BATT -
2	CAN_L
3	CAN_H
4	P_GND (Out 1 and Out 2)
5	Analog _GND (Input 1 and Input 2)
6	Input 1+
7	Input 2+
8	+5V Ref
9	Output 2+ (Default: Not Used)
10	Output 1+
11	CAN_Shield
12	BATT +

2.2. Mounting Instructions

NOTES & WARNINGS

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

MOUNTING

The module is designed for mounting on the valve block. If it is mounted without an enclosure, the controller should be mounted horizontally with connectors facing left or right, or with the connectors facing down, to reduce likelihood of moisture entry.

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

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

If the module is mounted away from the valve block, no wire or cable in the harness should exceed 30 meters in length. The power input wiring should be limited to 10 meters.

CONNECTIONS

Use the following TE Deutsch equivalent mating plugs to connect to the integral receptacles. Wiring to these mating plugs must be in accordance with all applicable local codes. Suitable field wiring for the rated voltage and current must be used. The rating of the connecting cables must be at least 85°C. For ambient temperatures below –10°C and above +70°C, use field wiring suitable for both minimum and maximum ambient temperature.

Refer to the respective TE Deutsch equivalent datasheets for usable insulation diameter ranges and other instructions.

Receptacle Contacts	Mating Sockets as appropriate (Refer to www.laddinc.com for more information on the contacts available for this mating plug.)
Mating Connector	DTM06-12SA, DTM06-12SB, 2 wedges WM12S, 24 contacts (0462-201-20141)

3. CANopen Interface and Object Dictionary

The CANopen® object dictionary of the AX023241 Controller is based on CiA device profile DS-404. The object dictionary includes Communication Objects beyond the minimum requirements in the profile, as well as several manufacturer-specific objects for extended functionality.

1.1. Node ID and Baud rate

By default, the AX023241 controller ships factory programmed with a

Node ID = 127 (0x7F)

and with

Baud rate = 125 kbps.

1.1.1. LSS Protocol to Update

The only means by which the Node-ID and Baud rate 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.

1.1.1.1. 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)

1.1.1.2. Setting Baud rate

- 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 baud rate 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)

Table 16: LSS baud rate indices

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

- 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 baud rate):

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

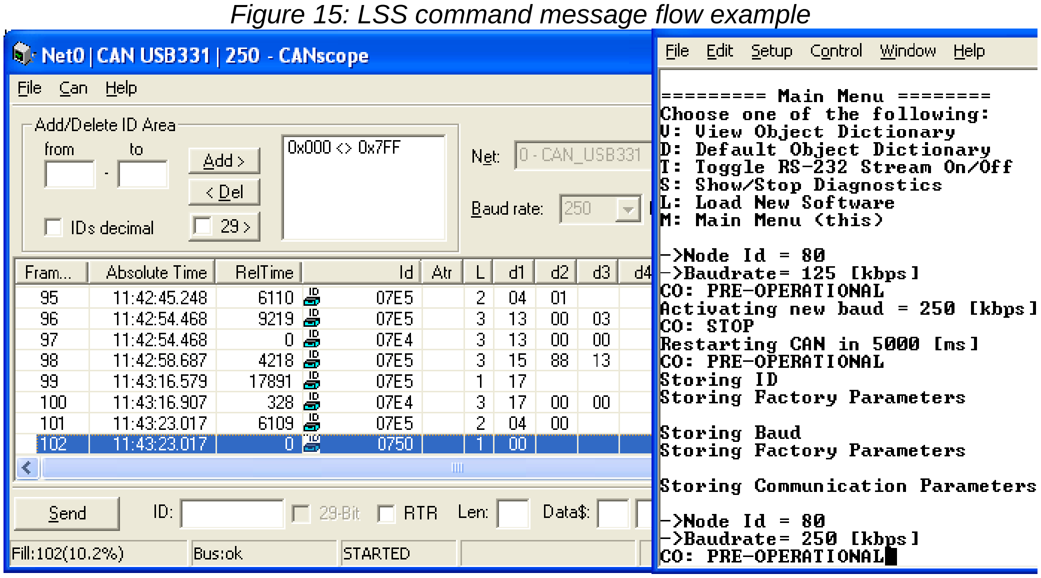
- Set the module state to LSS-operation by sending the following message: (Note, the module will reset itself back to the pre-operational state)

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 baud rate 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 baud rate on the CAN Scope tool was changed from 125 to 250 kbps.

Figure 15: LSS command message flow example



1.2. Communication Objects (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
1010	Store Parameters	ARRAY	UNSIGNED32	RW	No
1011	Restore Default Parameters	ARRAY	UNSIGNED32	RW	No
1016	Consumer Heartbeat Time	ARRAY	UNSIGNED32	RW	No
1017	Producer Heartbeat Time	VAR	UNSIGNED16	RW	No
1018	Identity Object	RECORD		RO	No
1020	Verify Configuration	ARRAY	UNSIGNED32	RO	No
1029	Error Behavior	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	RECORD		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

1.2.1. 1000h Device Type

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1000	0	UINT32	RO	No	0x192	0x192	DS-402

1.2.2. 1001h Error Register

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1001	0	UINT8	RO	No	0, 1	0	Error register

1.2.3. 1002h Manufacturer Status Object

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1002	0	UINT32	RO	No	UINT32	0	Manufacturer debug information

1.2.4. 1003h Pre-Defined Error Field

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1003	0	UINT8	RW	No	15	15	Number of subindexes / reset error codes
	1	UINT32	RO		UINT32	0	EMCY error code #1
	2						EMCY error code #2
	3						EMCY error code #3
	4						EMCY error code #4
	5						EMCY error code #5
	6						EMCY error code #6
	7						EMCY error code #7
	8						EMCY error code #8
	9						EMCY error code #9
	10						EMCY error code #10
	11						EMCY error code #11
	12						EMCY error code #12
	13						EMCY error code #13
	14						EMCY error code #14
	15						EMCY error code #15

1.2.5. 1010h Store Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1010	0	UINT8	RO	No	4	4	Number of subindexes
	1	UINT32	RW		save	1	Write 0x65766173 (‘e’, ‘v’, ‘a’, ‘s’) for storing ALL parameters
	2						Write 0x65766173 (‘e’, ‘v’, ‘a’, ‘s’) for storing Communication parameters
	3						Write 0x65766173 (‘e’, ‘v’, ‘a’, ‘s’) for storing Application parameters
	4						Write 0x65766173 (‘e’, ‘v’, ‘a’, ‘s’) for storing Manufacturer parameters

1.2.6. 1011h Restore Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1011	0	UINT8	RO	No	4	4	Number of subindexes
	1	UINT32	RW		load	1	Write 0x4616F6C (‘d’, ‘a’, ‘o’, ‘l’) for restoring ALL parameters
	2						Write 0x4616F6C (‘d’, ‘a’, ‘o’, ‘l’) for restoring Communication parameters
	3						Write 0x4616F6C (‘d’, ‘a’, ‘o’, ‘l’) for restoring Application parameters
	4						Write 0x4616F6C (‘d’, ‘a’, ‘o’, ‘l’) for restoring Manufacturer parameters

1.2.7. 1016h Consumer Heartbeat Time

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1016	0	UINT8	RO	No	4	4	Number of subindexes
	1	UINT32	RW		UINT32	0	Consumer heartbeat time bits 31-24: reserved bits 23-16: Node ID bits 15-0: heartbeat time in milliseconds
	2						
	3						
	4						

1.2.8. 1017h Producer Heartbeat Time

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1017	0	UINT16	RW	No	10-65000	0	Producer heartbeat time in milliseconds

1.2.9. 1018h Identity Object

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1018	0	UINT8	RO	No	4	4	Number of subindexes
	1	UINT32			UINT32	0x55	Vendor ID (Axiomatic Technologies)
	2					0xAA023241	Product Code
	3						Revision Number
	4						Serial Number

1.2.10. 1020h Verify Configuration

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1020	0	UINT8	RO	No	4	4	Number of subindexes
	1	UINT32			UINT32		Configuration date: DD-MM-YYYY
	2						Configuration time: HH-MM

1.2.11. 1029h Error Behavior

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1029	0	UINT8	RO	No	6	4	Number of subindexes
	1		RW		0-2	1 (no change)	State transition on Comm. fault
	2						State transition on DI fault
	3						State transition on AI fault
	4						State transition on DO fault
	5						State transition on AO fault
	6						State transition on other faults

1.2.12. 1400h RPDO 1 Communication Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1400	0	UINT8	RO	No	5	5	Number of subindexes
	1	UINT32	RW		UINT32	0x4000027F	COB-ID
	2	UINT8			UINT8	0xFF	Transmission type
	3	UINT16			UINT16	0	Inhibit time
	4	UINT8			UINT8	0	Compatibility entry
	5	UINT16			UINT16	0	Event timer

1.2.13. 1401h RPDO 2 Communication Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1401	0	UINT8	RO	No	5	5	Number of subindexes
	1	UINT32	RW		UINT32	0xC000037F	COB-ID
	2	UINT8			UINT8	0xFF	Transmission type
	3	UINT16			UINT16	0	Inhibit time
	4	UINT8			UINT8	0	Compatibility entry
	5	UINT16			UINT16	0	Event timer

1.2.14. 1402h RPDO 3 Communication Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1402	0	UINT8	RO	No	5	5	Number of subindexes
	1	UINT32	RW		UINT32	0xC000047F	COB-ID
	2	UINT8			UINT8	0xFF	Transmission type
	3	UINT16			UINT16	0	Inhibit time
	4	UINT8			UINT8	0	Compatibility entry
	5	UINT16			UINT16	0	Event timer

1.2.15. 1403h RPDO 4 Communication Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1403	0	UINT8	RO	No	5	5	Number of subindexes
	1	UINT32	RW		UINT32	0xC000057F	COB-ID
	2	UINT8			UINT8	0xFF	Transmission type
	3	UINT16			UINT16	0	Inhibit time
	4	UINT8			UINT8	0	Compatibility entry
	5	UINT16			UINT16	0	Event timer

1.2.16. 1600h RPDO 1 Mapping Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1600	0	UINT8	RW	No	0-4	2	Number of subindexes
	1	UINT32			UINT32	0x73000110	Output #1 FV
	2					0x73000210	Output #2 FV
	3					0	Not used by default
	4					0	Not used by default

1.2.17. 1601h RPDO 2 Mapping Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1601	0	UINT8	RW	No	0-4	4	Number of subindexes
	1	UINT32			UINT32	0x25000110	EC Extra Received PV Value 1
	2					0x25000210	EC Extra Received PV Value 2
	3					0x25000310	EC Extra Received PV Value 3
	4					0x25000410	EC Extra Received PV Value 4

1.2.18. 1602h RPDO 3 Mapping Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1602	0	UINT8	RW	No	0-4	0	Number of subindexes
	1	UINT32			UINT32	0x25000510	EC Extra Received PV Value 5
	2					0x25000610	EC Extra Received PV Value 6
	3					0	Not used by default
	4					0	Not used by default

1.2.19. 1603h RPDO 4 Mapping Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1603	0	UINT8	RW	No	0-4	0	Number of subindexes
	1	UINT32			UINT32	0	Not used by default
	2					0	Not used by default
	3					0	Not used by default
	4					0	Not used by default

1.2.20. 1800h TPDO 1 Communication Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1800	0	UINT8	RO	No	5	5	Number of subindexes
	1	UINT32	RW		UINT32	0x400001FF	COB-ID
	2	UINT8			UINT8	0xFE	Transmission type
	3	UINT16			UINT16	0	Inhibit time
	4	UINT8			UINT8	0	Compatibility entry
	5	UINT16			UINT16	0x64	Event timer

1.2.21. 1801h TPDO 2 Communication Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1801	0	UINT8	RO	No	5	5	Number of subindexes
	1	UINT32	RW		UINT32	0xC00002FF	COB-ID
	2	UINT8			UINT8	0xFE	Transmission type
	3	UINT16			UINT16	0	Inhibit time
	4	UINT8			UINT8	0	Compatibility entry
	5	UINT16			UINT16	0	Event timer

1.2.22. 1802h TPDO 3 Communication Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1802	0	UINT8	RO	No	5	5	Number of subindexes
	1	UINT32	RW		UINT32	0xC00003FF	COB-ID
	2	UINT8			UINT8	0xFE	Transmission type
	3	UINT16			UINT16	0	Inhibit time
	4	UINT8			UINT8	0	Compatibility entry
	5	UINT16			UINT16	0	Event timer

1.2.23. 1803h TPDO 4 Communication Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1803	0	UINT8	RO	No	5	5	Number of subindexes
	1	UINT32	RW		UINT32	0xC00004FF	COB-ID
	2	UINT8			UINT8	0xFE	Transmission type
	3	UINT16			UINT16	0	Inhibit time
	4	UINT8			UINT8	0	Compatibility entry
	5	UINT16			UINT16	0	Event timer

1.2.24. 1A00h TPDO 1 Mapping Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1A00	0	UINT8	RW	No	0-4	2	Number of subindexes
	1	UINT32			UINT32	0x71000110	Universal Input #1 FV
	2					0x71000210	Universal Input #2 FV
	3					0	Not used by default
	4					0	Not used by default

1.2.25. 1A01h TPDO 2 Mapping Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1A01	0	UINT8	RW	No	0-4	0	Number of subindexes
	1	UINT32			UINT32	0	Not used by default
	2					0	Not used by default
	3					0	Not used by default
	4					0	Not used by default

1.2.26. 1A02h TPDO 3 Mapping Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1A02	0	UINT8	RW	No	0-4	2	Number of subindexes
	1	UINT32			UINT32	0x50200020	Processor Temperature Field Value
	2					0x50300020	Power Supply Field Value
	3					0	Not used by default
	4					0	Not used by default

1.2.27. 1A03h TPDO 4 Mapping Parameters

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
1A03	0	UINT8	RW	No	0-4	0	Number of subindexes
	1	UINT32			UINT32	0	Not used by default
	2					0	Not used by default
	3					0	Not used by default
	4					0	Not used by default

1.3. Application Objects (DS-404)

Index (hex)	***Object***	***Object Type***	***Data Type***	***Access***	***PDO Mapping***
6000	DI Read State 8 Input Lines	VAR	UNSIGNED8	RO	Yes
6002	DI Polarity 8 Input Lines	VAR	UNSIGNED8	RW	No
7100	AI Input Field Value	ARRAY	INTEGER16	RO	Yes
6110	AI Sensor Type	ARRAY	UNSIGNED16	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	UNSIGNED16	RW	No
6200	DO Write State 8 Input Lines	ARRAY	UNSIGNED8	RW	Yes
6202	DO Polarity 8 Input Lines	ARRAY	UNSIGNED8	RW	No
6250	DO Fault Mode 1 Output Line	ARRAY	BOOLEAN	RW	No
6260	DO Fault State 1 Output Line	ARRAY	BOOLEAN	RW	No
6302	AO Decimal Digits PV	ARRAY	UNSIGNED16	RW	No
6310	AO Output Type	ARRAY	UNSIGNED16	RW	No
6332	AO Decimal Digits FV	ARRAY	UNSIGNED16	RW	No
6340	AO Fault Mode	ARRAY	UNSIGNED8	RW	No
7300	AO Output Process Value	ARRAY	INTEGER16	RW	Yes
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	RW	Yes
7341	AO Fault Field Value	ARRAY	INTEGER16	RW	No
7450	PID Proportional Band	ARRAY	INTEGER16	RW	No
7452	PID Integral Action Time	ARRAY	INTEGER16	RW	No
7454	PID Derivative Action Time	ARRAY	INTEGER16	RW	No
7456	PID Cycle Time	ARRAY	INTEGER16	RW	No
6458	PID Physical Unit Timing	ARRAY	UNSIGNED32	RO	No
6459	PID Decimal Digits Timing	ARRAY	INTEGER8	RW	No

1.3.1. 6000h DI Read State 8 Input Lines

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6000	0	UINT8	RO	No	1	1	Number of subindexes
	1			Yes	0x0 … 0x3	0	Digital Input state bitmap, one bit per input.

1.3.2. 6002h DI Polarity 8 Input Lines

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6002	0	UINT8	RO	No	1	1	Number of subindexes
	1		RW		0x0 … 0x3	0	Digital Input state polarity bitmap, one bit per input.

1.3.3. 7100h AI Input Field Value

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7100	0	UINT8	RO	No	6	6	Number of subindexes
	1	INT16	RW		INT16	0	Input #1 field value
	2						Input #2 field value

1.3.4. 6110h AI Sensor Type

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6110	0	UINT8	RO	No	4	4	Number of subindexes
	1	UINT16	RW		60, 10000, 10002	40	Input #1 sensor type
	2						Input #2 sensor type

1.3.5. 6112h AI Operating Mode

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6112	0	UINT8	RO	No	4	4	Number of subindexes
	1		RW		0,1,10	1	Input #1 operating mode
	2						Input #2 operating mode

1.3.6. 7100h AI Input Field Value

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7100	0	UINT8	RO	No	6	6	Number of subindexes
	1	INT16		Yes	INT16	0	Input #1 field value
	2						Input #2 field value

1.3.7. 7120h AI Input Scaling 1 FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7120	0	UINT8	RO	No	6	6	Number of subindexes
	1	INT16	RW		INT16	0	Input #1 field value scaler 1
	2						Input #2 field value scaler 1

1.3.8. 7121h AI Input Scaling 2 FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7121	0	UINT8	RO	No	6	6	Number of subindexes
	1	INT16	RW		INT16	0	Input #1 field value scaler 2
	2						Input #2 field value scaler 2

1.3.9. 7122h AI Input Scaling 1 PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7122	0	UINT8	RO	No	6	6	Number of subindexes
	1	INT16	RW		INT16	0	Input #1 process value scaler 1
	2						Input #2 process value scaler 1

1.3.10. 7123h AI Input Scaling 2 PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7123	0	UINT8	RO	No	6	6	Number of subindexes
	1	INT16	RW		INT16	0	Input #1 process value scaler 2
	2						Input #2 process value scaler 2

1.3.11. 7130h AI Input Process Value

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7130	0	UINT8	RO	No	6	6	Number of subindexes
	1	INT16	RW	Yes	INT16	0	Input #1 process value
	2						Input #2 process value

1.3.12. 6132h AI Decimal Digits PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6132	0	UINT8	RO	No	6	6	Number of subindexes
	1		RW		0-3	3	Input #1 PV decimal digits
	2						Input #2 PV decimal digits

1.3.13. 7148h AI Input Span Start

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7148	0	UINT8	RO	No	4	4	Number of subindexes
	1	INT16	RW		Input type dependent	200	Input #1 span start
	2						Input #2 span start

1.3.14. 7149h AI Input Span End

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7149	0	UINT8	RO	No	4	4	Number of subindexes
	1	INT16	RW		Input type dependent	4800	Input #1 span end
	2						Input #2 span end

1.3.15. 61A0h AI Filter Type

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
61A0	0	UINT8	RO	No	4	4	Number of subindexes
	1		RW		0-2	0	Input #1 software filter type
	2						Input #2 software filter type

1.3.16. 61A1h AI Filter Constant

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
61A1	0	UINT8	RO	No	4	4	Number of subindexes
	1	UINT16	RW		1-1000	1	Input #1 software filter constant
	2						Input #2 software filter constant

1.3.17. 6200h DO Write State 8 Output Lines

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6200	0	UINT8	RO	No	1	1	Number of subindexes
	1		RW		UINT8	0	Output write state bit 0 = input #1, bit 1 = input #2

1.3.18. 6202h DO Polarity 8 Output Lines

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6202	0	UINT8	RO	No	1	1	Number of subindexes
	1		RW		UINT8	0	Output polarity bit 0 = input #1, bit 1 = input #2

1.3.19. 6250h DO Fault Mode 1 Output Line

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6250	0	UINT8	RO	No	2	2	Number of subindexes
	1	BOOL	RW		BOOL	1	Output #1 fault mode
	2						Output #2 fault mode

1.3.20. 6260h DO Fault State 1 Output Line

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6260	0	UINT8	RO	No	2	2	Number of subindexes
	1	BOOL	RW		BOOL	0	Output #1 fault state
	2						Output #2 fault state

1.3.21. 6302h AO Decimal Digits PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7300	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW	Yes	INT16	0	Number of decimal digits in output process value
	2						

1.3.22. 6310h AO Output Type

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6310	0	UINT8	RO	No	2	2	Number of subindexes
	1	UINT16	RW		0, 10, 20, 40, 1000, 1020	20	Proportional current output, see Table 8
	2						

1.3.23. 6332h AO Decimal Digits FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6332	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0-3	0	Number of decimal digits in output field value
	2						

1.3.24. 6340h AO Fault Mode

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6340	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0-1	0	0 = Shut down output 1 = Hold last value
	2						

1.3.25. 7300h AO Output Process Value

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7300	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW	Yes	INT16	0	Output Process Value
	2						

1.3.26. 7320h AO Output Scaling 1 PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7320	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW		INT16	0	Output PV to FV scaling value 1
	2						

1.3.27. 7321h AO Output Scaling 1 FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7321	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW		INT16	0	Output PV to FV scaling value 1
	2						

1.3.28. 7322h AO Output Scaling 2 PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7322	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW		INT16	5000	Output PV to FV scaling value 2
	2						

1.3.29. 7323h AO Output Scaling 2 FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7323	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW		INT16	5000	Output PV to FV scaling value 2
	2						

1.3.30. 7330h AO Output Field Value

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7330	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW	Yes	INT16	0	Output Field Value
	2						

1.3.31. 7341h AO Fault Field Value

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7341	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW		INT16	500	Output Field Value during active fault.
	2						

1.3.32. 7450h PID Proportional Band

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7450	0	INT16	RW	No	0-100	5	Additional PID controller P gain

1.3.33. 7452h PID Integral Action Time

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7452	0	INT16	RW	No	0-1000	5	Additional PID controller integral action time

1.3.34. 7454h PID Derivative Action Time

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7454	0	INT16	RW	No	0-1000	1	Additional PID controller derivative action time

1.3.35. 7456h PID Cycle Time

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
7456	0	INT16	RW	No	0-1000	10	Additional PID controller cycle time

1.3.36. 6458h PID Physical Unit Timing

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6458	0	UINT32	RO	No	12288	12288	Additional PID controller physical unit timing

1.3.37. 6459h PID Decimal Digits Timing

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
6459	0	UINT8	RW	No	0-4	3	Additional PID controller decimal digits timing

1.4. Manufacturer Objects

Index (hex)	***Object***	***Object Type***	***Data Type***	***Access***	***PDO Mapping***
2100	AI Input Range	ARRAY	UNSIGNED8	RW	No
2102	AI Decimal Digits FV	ARRAY	UNSIGNED8	RW	No
2110	AI Error Detect Enable	ARRAY	BOOLEAN	RW	No
2111	AI Error Clear Hysteresis	ARRAY	INTEGER16	RW	No
2112	AI Error Reaction Delay	ARRAY	UNSIGNED16	RW	No
2020	DI Pull Up Down Mode 1 Input Line	ARRAY	UNSIGNED8	RW	No
2224	DO Delay Time 1 Output Line	ARRAY	UNSIGNED16	RW	No
2225	DO Delay Polarity 1 Output Line	ARRAY	UNSIGNED8	RW	No
2300	AO Override Value	ARRAY	INTEGER16	RW	No
2310	AO Error Detect Enable	ARRAY	BOOLEAN	RW	No
2311	AO Error Clear Hysteresis	ARRAY	INTEGER16	RW	No
2312	AO Error Reaction Delay	ARRAY	UNSIGNED16	RW	No
2330	AO Ramp Up	ARRAY	UNSIGNED16	RW	No
2331	AO Ramp Down	ARRAY	UNSIGNED16	RW	No
2340	AO Control Input Source	ARRAY	UNSIGNED8	RW	No
2341	AO Control Input Number	ARRAY	UNSIGNED8	RW	No
2350	AO Enable Input Source	ARRAY	UNSIGNED8	RW	No
2351	AO Enable Input Number	ARRAY	UNSIGNED8	RW	No
2360	AO Override Input Source	ARRAY	UNSIGNED8	RW	No
2361	AO Override Input Number	ARRAY	UNSIGNED8	RW	No
2362	AO Override Response	ARRAY	UNSIGNED8	RW	No
2370	AO Feedback Field Value	ARRAY	INTEGER16	RO	Yes
2380	AO Output Frequency	ARRAY	UNSIGNED16	RW	No
2450	PID Tolerance	VAR	INTEGER16	RW	No
2451	PID Integral Gain	VAR	INTEGER16	RW	No
2452	PID Derivative Gain	VAR	INTEGER16	RW	No
2453	PID Target Source	VAR	UNSIGNED8	RW	No
2454	PID Target Number	VAR	UNSIGNED8	RW	No
2455	PID Feedback Source	VAR	UNSIGNED8	RW	No
2456	PID Feedback Number	VAR	UNSIGNED8	RW	No
2457	PID Control Response	VAR	UNSIGNED8	RW	No
2460	PID Output Field Value	VAR	INTEGER16	RO	Yes

2500	EC Extra Received Process Value	ARRAY	INTEGER16	RW	Yes
2502	EC Decimal Digits PV	ARRAY	UNSIGNED8	RW	No
2520	EC Scaling 1 PV	ARRAY	INTEGER16	RW	No
2522	EC Scaling 2 PV	ARRAY	INTEGER16	RW	No
30x0	LT0x Input X Axis Source	VAR	UNSIGNED8	RW	No
30x1	LT0x Input X Axis Number	VAR	UNSIGNED8	RW	No
30x2	LT0x Auto Repeat	VAR	UNSIGNED8	RW	No
30x3	LT0x X Axis Decimal Digits PV	VAR	UNSIGNED8	RW	No
30x4	LT0x Y Axis Decimal Digits PV	VAR	UNSIGNED8	RW	No
30x5	LT0x Point Response	ARRAY	UNSIGNED8	RW	No
30x6	LT0x X Axis PV	ARRAY	INTEGER32	RW	No
30x7	LT0x Y Axis PV	ARRAY	INTEGER16	RW	No
30x8	LT0x Output PV	VAR	INTEGER16	RO	Yes
3410	Quadrature Encoder Scaler	VAR	FLOAT32	RW	No
3411	Quadrature Encoder Direction	VAR	UNSIGNED8	RW	No
3412	Quadrature Encoder Offset	VAR	INTEGER32	RW	No
3413	Quadrature Encoder Pulses per Rev	VAR	INTEGER32	RW	No
4000	Math Function Enable	ARRAY	BOOLEAN	RW	No
4021	Math Output Scaling 1 PV	ARRAY	INTEGER16	RW	No
4023	Math Output Scaling 2 PV	ARRAY	INTEGER16	RW	No
4030	Math Output Process Value	ARRAY	INTEGER16	RO	Yes
4032	Math Output Decimal Digits PV	ARRAY	UNSIGNED8	RW	No
4x00	Math x Input Source	ARRAY	UNSIGNED8	RW	No
4x01	Math x Input Number	ARRAY	UNSIGNED8	RW	No
4x03	Math x Input Decimal Digits FV	VAR	INTEGER8	RW	No
4x20	Math x Input Scaling 1 FV	VAR	UNSIGNED8	RW	No
4x22	Math x Input Scaling 2 FV	ARRAY	UNSIGNED8	RW	No
4x40	Math x Input Input Gain	ARRAY	UNSIGNED8	RW	No
4x50	Math x Operator	ARRAY	UNSIGNED8	RW	No
5010	Constant Field Value	ARRAY	FLOAT32	RW	No
5020	Power Supply FV	VAR	FLOAT32	RO	Yes
5030	CPU Temperature FV	VAR	FLOAT32	RO	Yes
5040	Fault Detection Field Value	ARRAY	UNSIGNED16	RO	Yes
5041	Fault Detection Set Threshold	ARRAY	UNSIGNED16	RW	No
5042	Fault Detection Clear Threshold	ARRAY	UNSIGNED16	RW	No
5050	Fault Detection Enable Err Check 3 Faults	ARRAY	UNSIGNED8	RW	No
5051	Fault Detection Error Response Delay	ARRAY	UNSIGNED16	RW	No
5555	Start in Operational Mode	VAR	BOOLEAN	RW	No
5556	Start in Operational NMT Delay	VAR	UNSIGNED16	RW	No

1.4.1. 2100h AI Input Range

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2100	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		Input type dependent	0	Input #1 range selection
	2						Input #2 range selection

1.4.2. 2102h AI Decimal Digits FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2102	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0-4	3	Input #1 decimal digits FV
	2						Input #2 decimal digits FV

1.4.3. 2110h AI Error Detect Enable

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2110	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0, 1	0	Input #1 error detect enable
	2						Input #2 error detect enable

1.4.4. 2111h AI Error Clear Hysteresis

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2111	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW		0-32767	100	Input #1 error clear hysteresis
	2						Input #2 error clear hysteresis

1.4.5. 2112h AI Error Reaction Delay

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2112	0	UINT8	RO	No	2	2	Number of subindexes
	1	UINT16	RW		0-60000	1000	Input #1 error reaction delay
	2						Input #2 error reaction delay

1.4.6. 2020h DI Pull Up Down Mode 1 Input Line

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2020	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0–no pull 1 – PU 2 – PD	0	Input #1 pull up / down selection
	2						Input #2 pull up / down selection

1.4.7. 2224h DO Delay Time 1 Output Line

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2224	0	UINT8	RO	No	2	2	Number of subindexes
	1	UINT16	RW		UINT16	0	Output #1 delay time
	2						Output #2 delay time

1.4.8. 2225h DO Delay Polarity 1 Output Line

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2225	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0, 1	0	Output #1 delay polarity
	2						Output #2 delay polarity

1.4.9. 2300h AO Override Field Value

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2300	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW		INT16	0	Output #1 override field value
	2						Output #2 override field value

1.4.10. 2310h AO Error Detect Enable

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2310	0	UINT8	RO	No	2	2	Number of subindexes
	1	BOOL	RW		BOOL	1	Output #1 error detect enable
	2						Output #2 error detect enable

1.4.11. 2311h AO Error Clear Hysteresis

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2311	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW		INT16	100	Output #1 error clear hysteresis
	2						Output #2 error clear hysteresis

1.4.12. 2312h AO Error Reaction Delay

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2312	0	UINT8	RO	No	2	2	Number of subindexes
	1	UINT16	RW		0 … 60000	1000	Output #1 error reaction delay
	2						Output #2 error reaction delay

1.4.13. 2330h AO Ramp Up

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2330	0	UINT8	RO	No	2	2	Number of subindexes
	1	UINT16	RW		0 … 60000	1000	Output #1 ramp up time in ms
	2						Output #2 ramp up time in ms

1.4.14. 2331h AO Ramp Down

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2331	0	UINT8	RO	No	2	2	Number of subindexes
	1	UINT16	RW		0 … 60000	1000	Output #1 ramp down time in ms
	2						Output #2 ramp down time in ms

1.4.15. 2340h AO Control Input Source

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2340	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0 … 13	1	Output #1 control source, see Table 6
	2						Output #2 control source, see Table 6

1.4.16. 2341h AO Control Input Number

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2341	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0 - 12	1	Output #1 control number, see Table 7
	2					2	Output #2 control number, see Table 7

1.4.17. 2350h AO Enable Input Source

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2350	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0 … 13	1	Output #1 enable source, see Table 6
	2						Output #2 enable source, see Table 6

1.4.18. 2351h AO Enable Input Number

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2351	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0 - 12	1	Output #1 enable number, see Table 7
	2					2	Output #2 enable number, see Table 7

1.4.19. 2360h AO Override Input Source

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2360	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0 … 13	1	Output #1 override source, see Table 6
	2						Output #2 override source, see Table 6

1.4.20. 2361h AO Override Input Number

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2361	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0 - 12	1	Output #1 override number, see Table 7
	2					2	Output #2 override number, see Table 7

1.4.21. 2362h AO Override Response

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2362	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0, 1	0	Output #1 override response, see Table 11
	2						Output #2 override response, see Table 11

1.4.22. 2370h AO Feedback Field Value

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2370	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16		Yes	INT16	0	Output #1 feedback field value in mA
	2						Output #2 feedback field value in mA

1.4.23. 2380h AO Output Frequency

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2380	0	UINT8	RO	No	2	2	Number of subindexes
	1	UINT16	RW		0 - 50	25	Output #1 frequency in kHz
	2						Output #2 frequency in kHz

1.4.24. 2450h PID Tolerance

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2450	0	INT16	RW	No	0-100	10	Additional PID controller tolerance

1.4.25. 2451h PID Integral Gain

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2451	0	INT16	RW	No	0-100	10	Additional PID controller integral gain

1.4.26. 2452h PID Derivative Gain

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2452	0	INT16	RW	No	0-100	10	Additional PID controller derivative gain

1.4.27. 2453h PID Target Source

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2453	0	UINT8	RW	No	0-10	0	By default disabled, see Table 6

1.4.28. 2454h PID Target Number

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4254	0	UINT8	RW	No	0-16	1	By default disabled, see Table 7

1.4.29. 2455h PID Feedback Source

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2455	0	UINT8	RW	No	0-10	0	By default disabled, see Table 6

1.4.30. 2456h PID Feedback Number

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4256	0	UINT8	RW	No	0-16	1	By default disabled, see Table 7

1.4.31. 2457h PID Control Response

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4257	0	UINT8	RW	No	0-3	0	Additional PID controller response selection

1.4.32. 2460h PID Output FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4260	0	INT16	RO	Yes	0-1000	0	Additional PID controller output FV

1.4.33. 2500h EC Extra Received PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2500	0	UINT8	RO	Yes	6	6	Number of subindexes
	1	INT16	RW		INT16	0	Extra received PV 1
	2						Extra received PV 2
	3						Extra received PV 3
	4						Extra received PV 4
	5						Extra received PV 5
	6						Extra received PV 6

1.4.34. 2502h EC Decimal Digits PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2502	0	UINT8	RO	No	6	6	Number of subindexes
	1		RW		0-3	1	Extra received PV 1 decimal digits
	2						Extra received PV 2 decimal digits
	3						Extra received PV 3 decimal digits
	4						Extra received PV 4 decimal digits
	5						Extra received PV 5 decimal digits
	6						Extra received PV 6 decimal digits

1.4.35. 2520h EC Scaling 1 PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2520	0	UINT8	RO	No	6	6	Number of subindexes
	1	INT16	RW		INT16	0	EC 1 process value scaler 1
	2						EC 2 process value scaler 1
	3						EC 3 process value scaler 1
	4						EC 4 process value scaler 1
	5						EC 5 process value scaler 1
	6						EC 6 process value scaler 1

1.4.36. 2522h EC Scaling 2 PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
2522	0	UINT8	RO	No	6	6	Number of subindexes
	1	INT16	RW		INT16	0	EC 1 process value scaler 2
	2						EC 2 process value scaler 2
	3						EC 3 process value scaler 2
	4						EC 4 process value scaler 2
	5						EC 5 process value scaler 2
	6						EC 6 process value scaler 2

1.4.37. 30x0h LT0x Input X Axis Source

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
30x0	0	UINT8	RW	No	0-13	0	LT0x X Axis data source, see Table 6

1.4.38. 30x1h LT0x Input X Axis Number

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
30x1	0	UINT8	RW	No	0-12	0	LT0x X Axis data source, see Table 7

1.4.39. 30x2h LT0x Auto Repeat

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
30x2	0	UINT8	RW	No	0, 1	0	LT0x auto repeat functionality enable

1.4.40. 30x3h LT0x X Axis Decimal Digits PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
30x3	0	UINT8	RW	No	0-3	0	LT0x X Axis number of decimal digits in PV

1.4.41. 30x4h LT0x Y Axis Decimal Digits PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
30x4	0	UINT8	RW	No	0-3	0	LT0x Y Axis number of decimal digits in PV

1.4.42. 30x5h LT0x Point Response

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
30x5	0	UINT8	RO	No	12	12	Number of subindexes
	1		RW		0,1	0 (ramp)	LT0x transition 0-1 response
	2						LT0x transition 1-2 response
	3						LT0x transition 2-3 response
	4						LT0x transition 3-4 response
	5						LT0x transition 4-5 response
	6						LT0x transition 5-6 response
	7						LT0x transition 6-7 response
	8						LT0x transition 7-8 response
	9						LT0x transition 8-9 response
	10						LT0x transition 9-10 response
	11						LT0x transition 10-11 response
	12						LT0x transition 11-12 response

1.4.43. 30x6h LT0x Point X Axis PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
30x6	0	UINT8	RO	No	11	11	Number of subindexes
	1	INT32	RW		INT32	0	LT0x X Axis PV 1
	2					10	LT0x X Axis PV 2
	3					20	LT0x X Axis PV 3
	4					30	LT0x X Axis PV 4
	5					40	LT0x X Axis PV 5
	6					50	LT0x X Axis PV 6
	7					60	LT0x X Axis PV 7
	8					70	LT0x X Axis PV 8
	9					80	LT0x X Axis PV 9
	10					90	LT0x X Axis PV 10
	11					100	LT0x X Axis PV 11

1.4.44. 30x7h LT0x Point Y Axis PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
30x7	0	UINT8	RO	No	11	11	Number of subindexes
	1	INT16	RW		INT16	0	LT0x Y Axis PV 1
	2					10	LT0x Y Axis PV 2
	3					20	LT0x Y Axis PV 3
	4					30	LT0x Y Axis PV 4
	5					40	LT0x Y Axis PV 5
	6					50	LT0x Y Axis PV 6
	7					60	LT0x Y Axis PV 7
	8					70	LT0x Y Axis PV 8
	9					80	LT0x Y Axis PV 9
	10					90	LT0x Y Axis PV 10
	11					100	LT0x Y Axis PV 11

1.4.45. 30x8h LT0x Output PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
30x8	0	INT16	RO	Yes	INT16	0	LT0x Output PV

1.4.46. 3410h Input QD Scaler

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
3410	0	REAL32	RW	No	REAL32	1.0	Quadrature Encoder scaler coefficient

1.4.47. 3411h Input QD Dir

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
3411	0	UINT16	RW	No	0, 1	0	Quadrature Encoder direction

1.4.48. 3412h Input QD Offset

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
3412	0	INT32	RW	No	INT32	0	Quadrature Encoder step offset

1.4.49. 3413h Input QD Pulses Per Rev

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
3413	0	INT32	RW	No	INT32	4	Quadrature Encoder number of pulses per rev

1.4.50. 4000h Math Function Enable

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4000	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0, 1	0	Math block #1 enable
	2						Math block #2 enable

1.4.51. 4021h Math Output Scaling 1 PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4021	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW		INT16	0	Math block #1 output scaling 1 PV
	2						Math block #2 output scaling 1 PV

1.4.52. 4023h Math Output Scaling 2 PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4023	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16	RW		INT16	10000	Math block #1 output scaling 2 PV
	2						Math block #2 output scaling 2 PV

1.4.53. 4030h Math Output Process Value

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4030	0	UINT8	RO	No	2	2	Number of subindexes
	1	INT16			INT16	0	Math block #1 output PV
	2						Math block #2 output PV

1.4.54. 4032h Math Output Decimal Digits PV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4032	0	UINT8	RO	No	2	2	Number of subindexes
	1		RW		0-3	2	Math block #1 output PV decimal digits
	2						Math block #2 output PV decimal digits

1.4.55. 4x00h Math x Input Source

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4x00	0	UINT8	RO	No	5	5	Number of subindexes
	1		RW		0-13	0	Math block #x Input 1 source. See Table 6
	2						Math block #x Input 2 source. See Table 6
	3						Math block #x Input 3 source. See Table 6
	4						Math block #x Input 4 source. See Table 6
	5						Math block #x Input 5 source. See Table 6

1.4.56. 4x01h Math x Input Number

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4x01	0	UINT8	RO	No	5	5	Number of subindexes
	1		RW		0-12	1	Math block #x Input 1 number. See Table 7
	2						Math block #x Input 2 number. See Table 7
	3						Math block #x Input 3 number. See Table 7
	4						Math block #x Input 4 number. See Table 7
	5						Math block #x Input 5 number. See Table 7

1.4.57. 4x03h Math x Input Decimal Digits FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4x03	0	UINT8	RO	No	5	5	Number of subindexes
	1		RW		0-3	2	Math block #x Input 1 decimal digits in FV
	2						Math block #x Input 2 decimal digits in FV
	3						Math block #x Input 3 decimal digits in FV
	4						Math block #x Input 4 decimal digits in FV
	5						Math block #x Input 5 decimal digits in FV

1.4.58. 4x20h Math x Input Scaling 1 FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4x20	0	UINT8	RO	No	5	5	Number of subindexes
	1	INT16	RW		INT16	0	Math block #x Input 1 scaling 1 FV
	2						Math block #x Input 2 scaling 1 FV
	3						Math block #x Input 3 scaling 1 FV
	4						Math block #x Input 4 scaling 1 FV
	5						Math block #x Input 5 scaling 1 FV

1.4.59. 4x22h Math x Input Scaling 2 FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4x22	0	UINT8	RO	No	5	5	Number of subindexes
	1	INT16	RW		INT16	10000	Math block #x Input 1 scaling 2 FV
	2						Math block #x Input 2 scaling 2 FV
	3						Math block #x Input 3 scaling 2 FV
	4						Math block #x Input 4 scaling 2 FV
	5						Math block #x Input 5 scaling 2 FV

1.4.60. 4x40h Math x Input Input Gain

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4x40	0	UINT8	RO	No	5	5	Number of subindexes
	1	INT8	RW		INT8	100	Math block #x Input 1 gain
	2						Math block #x Input 2 gain
	3						Math block #x Input 3 gain
	4						Math block #x Input 4 gain
	5						Math block #x Input 5 gain

1.4.61. 4x50h Math x Operator

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
4x50	0	UINT8	RO	No	4	4	Number of subindexes
	1		RW		0-15	9	Math block #x operator 1, see Table 13
	2						Math block #x operator 1, see Table 13
	3						Math block #x operator 1, see Table 13
	4						Math block #x operator 1, see Table 13

1.4.62. 5010h Constant Field Value

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
5010	0	UINT8	RO	No	12	12	Number of subindexes
	1	FLOAT32	RW		FLOAT32	0.0	User modifiable constant values to be used in custom control application.
	2					1.0	
	3					10.0	
	4					20.0	
	5					30.0	
	6					40.0	
	7					50.0	
	8					60.0	
	9					70.0	
	10					80.0	
	11					90.0	
	12					100.0	

1.4.63. 5020h Power Supply FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
5020	0	FLOAT32	RO	Yes	FLOAT32	0	Measured power supply voltage

1.4.64. 5030h CPU Temperature FV

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
5030	0	FLOAT32	RO	Yes	FLOAT32	0	Measured CPU internal temperature

1.4.65. 5040h FD Field Value

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
5040	0	UINT8	RO	No	3	3	Number of subindexes
	1	FLOAT32			FLOAT32	0	FD Field Value 1
	2						FD Field Value 2
	3						FD Field Value 3

1.4.66. 5041h FD Set Threshold

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
5041	0	UINT8	RO	No	3	3	Number of subindexes
	1	UINT16	RW		UINT16	1100	FD Set Threshold 1 (Temperature SET)
	2					500	FD Set Threshold 2 (VPS SET High)
	3					90	FD Set Threshold 3 (VPS SET Low)

1.4.67. 5042h FD Clear Threshold

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
5042	0	UINT8	RO	No	3	3	Number of subindexes
	1	UINT16	RW		UINT16	850	FD Set Threshold 1 (Temperature CLR)
	2					480	FD Set Threshold 2 (VPS CLR High)
	3					120	FD Set Threshold 3 (VPS CLR Low)

1.4.68. 5050h FD Enable 3 Faults

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
5050	0	UINT8	RW	No	0-7	7	Enable diagnostics: bit 0 – VPS bit 1 – CPU temperature

1.4.69. 5051h FD Error Response Delay

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
5051	0	UINT8	RO	No	3	3	Number of subindexes
	1	INT16	RW		0-600	10	FD Error response delay 1 (Temperature)
	2					10	FD Error response delay 2 (VPS)
	3					10	FD Error response delay 3

1.4.70. 5555h Start In Operational Mode

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
5555	0	UINT8	RW	No	0-3	0	0 – No action, wait NMT commands 1 – Start directly in operational mode 2 – Start in operational mode and send NMT for starting also other devices

1.4.71. 5556h Start In Operational NMT Delay

Index	Subindex	Data Type	Access	PDO Mapping	Value Range	Default Value	Description
5556	0	UINT16	RW	No	0-65000	1000	Delay in milliseconds before sending the NMT message in case object 5555h is set to ‘2’.

4. TECHNICAL SPECIFICATIONS

Specifications are indicative and subject to change. Actual performance will vary depending on the application and operating conditions. 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 https://www.axiomatic.com/service/.

Inputs

Power Supply Input - Nominal	12 or 24VDC nominal (9…60 VDC power supply range)
Protection	Reverse polarity protection is provided. Surge protection up to 65V is provided. Overvoltage shutdown of the output load is provided. Undervoltage protection (hardware and software shutdown at 7.5V) is provided.
CAN	CANopen®
Voltage Reference	One provided 5V +/- 0.2% error Can source up to 50mA without derating
Analog GND Reference	One provided
Universal Signal Inputs	2 fully independent digital inputs are provided. Refer to Table 1.0 All inputs are user selectable as Quadrature Encoder or Digital input types. Inputs are sampled multiple times per millisecond. Protected against shorts to GND or +Vps (up to 60 Vdc) All input channels can handle negative voltage inputs down to -2VDC due to voltage spikes or noise. Response time to change at the input 2 mSec +/- 1 mSec (without software filtering) unless otherwise noted.

Table 1.0 – **Input – User Selectable Options**	
Digital Input Functions	Discrete Input, Quadrature Encoder Input (Steps, Direction, Speed in RPM) 12-bit Analog to Digital
Digital Input Level	12V
Quadrature Encoder Input	Configurable 1kΩ pullup or 10kΩ pulldown resistor (to GND) which can also be disabled (floating input) Rising/Falling edge threshold 2.0V +/- 0.1V Number or pulses per revolution are configurable. Custom scaler for encoder steps counter value. There is a configurable polarity of direction of rotation.
Digital Input	Normal, Inverse or Latched (pushbutton) Configurable 1kΩ pullup or 10kΩ pulldown resistor (to GND) which can also be disabled (floating input) Rising/Falling edge threshold 2.0V +/- 0.1V Input debouncing time is selectable.

Outputs

CAN	CANopen®
Response Time	1 mSec.
Protection	Fully protected against short circuit to ground or +Vps Grounded short circuit protection will engage at 4.5A +/- 0.5A. Unit will fail safe in the case of a short-circuit condition, and is self-recovering when the short is removed.
Power GND Reference	One Provided
Universal Outputs	Two independent software controlled outputs selectable as: Proportional Current; Hotshot Digital; PWM Duty Cycle; Proportional Voltage; or On/Off Digital types Half-bridge outputs, current sensing, grounded load. High side sourcing up to 3A All output types have configurable minimum and maximum output levels within the range for the type selected.

Configurable Output Options	Current Outputs: 1mA resolution, accuracy +/- 2% error Software controlled PID current Range 0 to 3000 mA Fully configurable dither superimposed on top of output current Configurable from 50 to 400Hz amplitude High frequency output drive at 25kHz Voltage Outputs: 0.1V resolution, accuracy +/- 3% error Average voltage output based on unit power supply High frequency drive at 25kHz Additional external filtering is required to create a DC voltage PWM Outputs: 0.1% resolution, accuracy +/- 1% error Range 0 to 100% Output Frequency: 1 Hz to 25 kHz Configurable frequency ONLY if no current output types are used, otherwise default 25kHz is used Digital On/Off: Load at supply voltage must not draw more than 3A.

General Specifications

Quiescent Current	109 mA @ 12Vdc Typical; 66 mA @ 24Vdc Typical
Microcontroller	TI TMS320F2806x, 32-bit, 256 KB flash program memory, 100 KB RAM
EMC Compliance	CE marking
Vibration	Random Vibration: 7.7 Grms peak Sinusoidal Component: 10 g peak Based on MIL-STD-202G, Methods 204G and 214A
Diagnostics	Each input and output channel can be configured to send diagnostic messages to the J1939 CAN network if the I/O goes out of range. Diagnostic data is stored in a non-volatile log. Refer to the User Manual for details.
Additional Fault Feedback	There are several types of faults that the controller will detect and provide a response: unit power supply undervoltage and overvoltage, microprocessor over temperature and lost communication. They can be sent to the J1939 CAN bus.
Control Logic	User configurable functionality using standard CANopen® tools Refer to the User Manual for details.
Communications	1 CAN port (CANopen®) SAE J1939 models are available.
CAN User Interface	EDS File is downloadable from www.axiomatic.com. Standard CANopen® tools (not supplied)
CAN Response Time	Per the CANopen® standard, the maximum recommended transmit rate for any message is 10ms. Response time of feedback on the CAN to changes at the I/O will be a combination of the I/O type's response time and the configurable software filtering, ramps, delays, etc. that were selected in the application.
Reflashing Software over CAN	Reflash software over the CAN bus using the Axiomatic Electronic Assistant.
Enclosure	High Temperature Nylon PCB Enclosure – (equivalent TE Deutsch P/N: EEC-325X4B) 4.64 x 5.23 x 1.41 inches 117.90 x 132.90 x 35.80 mm (W x L x H excluding mating plugs) Refer to the dimensional drawing.
Protection	IP67 rating for the product assembly
Weight	0.50 lbs. (0.23 kg)
Temperature Rating	-40°C to +125°C (-40°F to 257°F)
Network Termination	It is necessary to terminate the network with external termination resistors. The resistors are 120 Ohm, 0.25W minimum, metal film or similar type. They should be placed between CAN_H and CAN_L terminals at both ends of the network.
Installation	Mounting holes sized for ¼ inch or M6 bolts. The bolt length will be determined by the end-user's mounting plate thickness. The mounting flange of the controller is 0.63 inches (16 mm) thick. All field wiring should be suitable for the operating temperature range, rated voltage and current. Wiring to the product must be in accordance with all applicable local codes. Install the unit with appropriate space available for servicing and for adequate wire harness access (6 inches or 15 cm) and strain relief (12 inches or 30 cm).
Mating Plug Kit	Axiomatic P/N: **PL-DTM06-12SA**. It is comprised of the following TE Deutsch part equivalents: plug (DTM06-12SA); wedgelock (WM12S); and 12 contacts (0462-201-20141) as well as 6 sealing plugs (0413-204-2005).

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5. Version History

Version	Date	Author	Modifications
1.0	March 5, 2019	Antti Keränen	Initial Draft, largely based on the AX023240 user manual.
1.1	March 29, 2019	Amanda Wilkins	Marketing Review – updated to CANopen® in Tech Spec Updated dimensions per drawing
1.2	December 31, 2023	M Ejaz Sue Thomas	Changed Decoder to Encoder

OUR PRODUCTS

AC/DC Power Supplies

Actuator Controls/Interfaces

Automotive Ethernet Interfaces

Battery Chargers

CAN Controls, Routers, Repeaters

CAN/WiFi, CAN/Bluetooth, Routers

Current/Voltage/PWM Converters

DC/DC Power Converters

Engine Temperature Scanners

Ethernet/CAN Converters, Gateways, Switches

Fan Drive Controllers

Gateways, CAN/Modbus, RS-232

Gyroscopes, Inclinometers

Hydraulic Valve Controllers

Inclinometers, Triaxial

I/O Controls

LVDT Signal Converters

Machine Controls

Modbus, RS-422, RS-485 Controls

Motor Controls, Inverters

Power Supplies, DC/DC, AC/DC

PWM Signal Converters/Isolators

Resolver Signal Conditioners

Service Tools

Signal Conditioners, Converters

Strain Gauge CAN Controls

Surge Suppressors

OUR COMPANY

Axiomatic provides electronic machine control components to the off-highway, commercial vehicle, electric vehicle, power generator set, material handling, renewable energy and industrial OEM markets. ***We innovate with engineered and off-the-shelf machine controls that add value for our customers.***

QUALITY DESIGN AND MANUFACTURING

We have an ISO9001:2015 registered design/manufacturing facility in Canada.

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 at https://www.axiomatic.com/service/.

COMPLIANCE

Product compliance details can be found in the product literature and/or on axiomatic.com. Any inquiries should be sent to sales@axiomatic.com.

SAFE USE

All products should be serviced by Axiomatic. Do not open the product and perform the service yourself.

This product can expose you to chemicals which are known in the State of California, USA to cause cancer and reproductive harm. For more information go to www.P65Warnings.ca.gov.

SERVICE

All products to be returned to Axiomatic require a Return Materials Authorization Number (RMA#) from sales@axiomatic.com. Please provide the following information when requesting an RMA number:

- Serial number, part number
- Runtime hours, description of problem
- Wiring set up diagram, application and other comments as needed

DISPOSAL

Axiomatic products are electronic waste. Please follow your local environmental waste and recycling laws, regulations and policies for safe disposal or recycling of electronic waste.

CONTACTS

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