SINGLE OUTPUT
CAN VALVE CONTROLLER
CANopen®

<u>USER MANUAL</u>

P/N: AX021101

ACRONYMS

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

REFERENCES

[DS-301]   CiA DS-301 V4.1 – CANopen® Application Layer and Communication Profile. CAN in Automation 2005

[DS-305]   CiA DS-305 V2.0 – Layer Setting Service (LSS) and Protocols. CAN in Automation 2006

[DS-404]   CiA DS-404 V1.2 – CANopen® profile for Measurement Devices and Closed Loop Controllers. CAN in Automation 2002

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

TABLE OF CONTENTS

1. OVERVIEW OF CONTROLLER

1.0. Description of Single Output Controller

The following User Manual describes the architecture and functionality an embedded single output CANopen® valve controller.

The CAN with Single Output Valve Controller (CAN-1O) simplifies control of proportional solenoids by supplying a current proportional to an input control from the CAN bus (CANopen®). It accepts power supply voltages from 9 to 36 VDC. This linear solenoid driver utilizes high frequency switching output (PWM) to provide a DC current output. Maximum current output is up to 2.5A. A current sensing circuit maintains output current regardless of changes in input voltage and coil resistance. The user can adjust maximum and minimum current. Ramp time, dither frequency and amplitude can also be adjusted to match the application. It also has short circuit proof in case of solenoid failure or miswiring. The unit is available with a DIN 43650 connection to mount directly on the coil. The setpoints are configurable using standard CANopen® configuration tools. An EDS file is provided. It has rugged packaging and performance for IP67, high vibration and off-highway machine environments. A 5-pin M12 connector is provided for power and CAN. Figure 1 shows the hardware features.
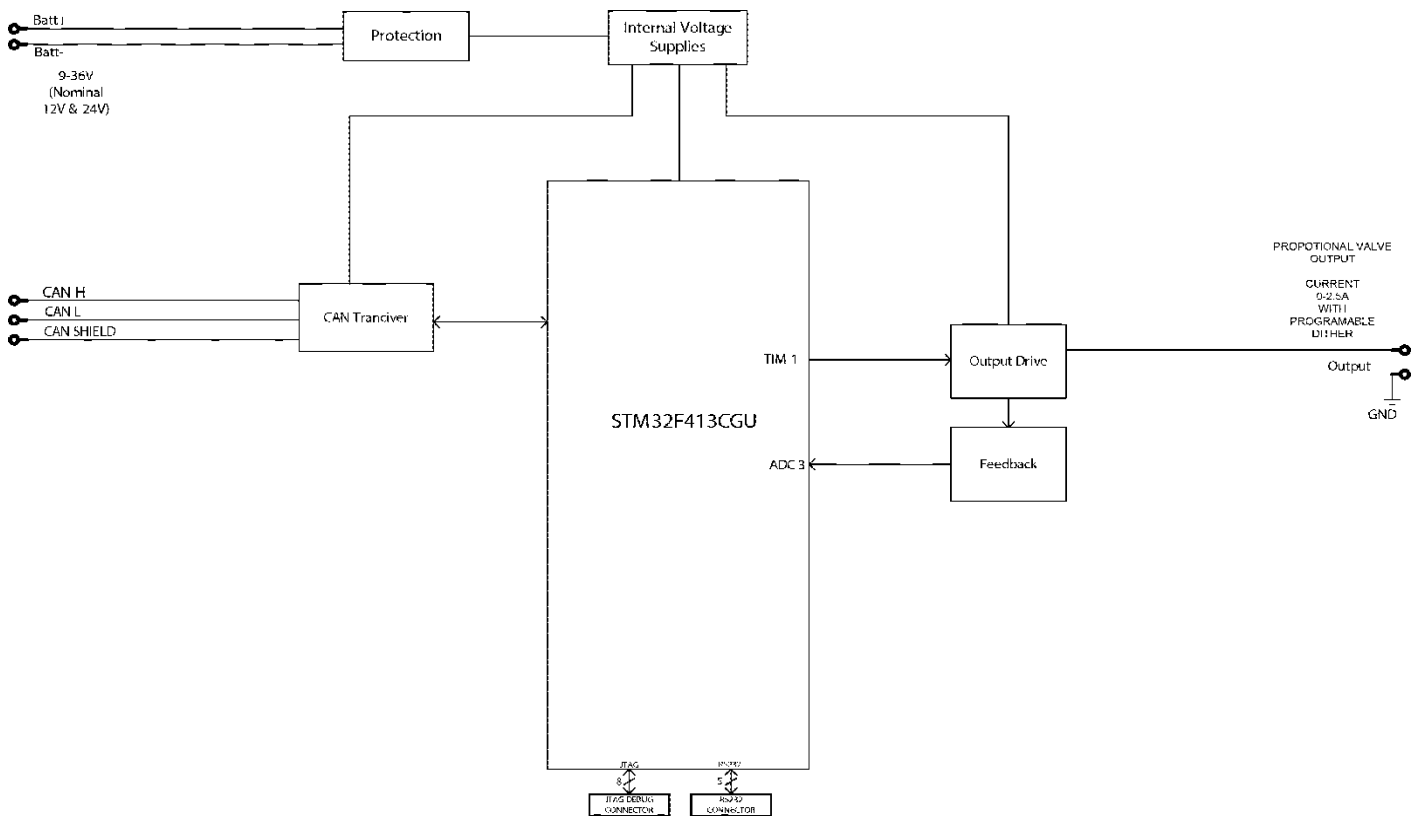
Figure 1 – Hardware Functional Block Diagram

The various function blocks supported by the CAN-1O are outlined in the following sections. All objects are user configurable using standard commercially available tools that can interact with a CANopen® Object Dictionary via an .EDS file.

1.1. Digital Output Function Block

The digital output (DO) function block only becomes applicable on the output when object 6130h, **AO Output Type**, is set to a digital output response (Type=1000 or 1020).
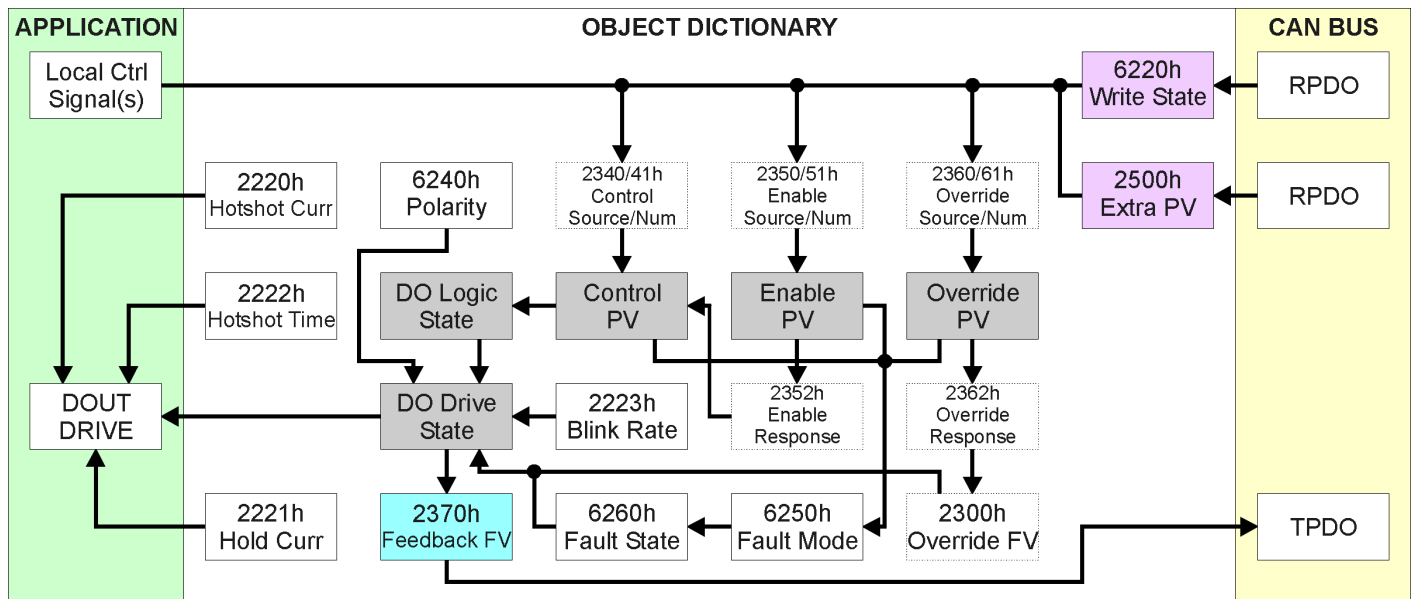
Figure 2 – Digital Output Objects

Several of the objects shown in the above diagram are associated with the Analog Output function block and are explained in detail in section 1.2. Therefore, this section will only elaborate on the objects unique to the DO function block.

An output can be controlled either by an on-board control signal (such as the result from a lookup table function) or a CANopen® object that has mapped to an RPDO. In the case of an output configured for a digital response, when a CANopen® Message has been selected as the 2340h **AO Control Input Source** (see Table 4), then data from the appropriate sub-index from write-mappable object 6220h **DO Write State** will be used as the control signal.

The Enable and Override Inputs and Responses for a digital output are the same as for an Analog Output and are evaluated in the same order. Therefore, what is described in section 1.2 for these also applied for the DO function block.

As with the AO function, the output will respond to the Control Input if and only if the following conditions have been met:
  a) No fault is detected for any of the control signals
  b) The override command is either ignored or false (Override Input)
  c) The output has not been disabled by a secondary signal (Enable Input)

When the output is being driven by the Control Input, the "DO Logic State" is set to OFF while the Control Input is zero and is set to ON whenever a non-zero value is written.

The resulting "DO Drive State" will depend on the object 6240h **DO Polarity**, as per Table 1. By default, normal on/off output logic is used.

Value	Meaning	DO Logic State	DO Drive State
0	**Normal On/Off**	OFF	OFF
		ON	ON
1	Inverse On/Off	OFF	ON
		ON	OFF
2	Latched Logic	ON to OFF	No Change
		OFF to ON	State Change (i.e. OFF to ON)
3	Blinking Logic	OFF	OFF
		ON	Toggling OFF and ON at the rate defined in object 2223h **DO Blink Rate** (in ms)

Table 1 – DO Polarity Options

The read-only mappable object 2370h **AO Feedback FV** will be loaded with the "DO Drive State" (0=OFF, 1=ON) when the output is setup for a digital type.

Outside of a straight ON/OFF digital output (where ON = +Vps applied to output pin), there is a second type of digital output called a "Hotshot." This output is designed to work with inductive loads (i.e. a hydraulic valve) that can be hotshot with a high current for a short period of time to fully open the load. Then, the current is dropped back to a lower holding value to keep it open until the "DO Drive State" turns off as shown in Figure 3.

Objects 2220h **DO Hotshot Current**, 2221h **DO Hold Current**, and 2222h **DO Hotshot Time** are used with this output type to drive the load. Since the output timer is used for the hotshot time, DO Polarity option 3, Blinking Logic does not apply with this output type. The response in this case will be the same as option 1, Normal On/Off logic.
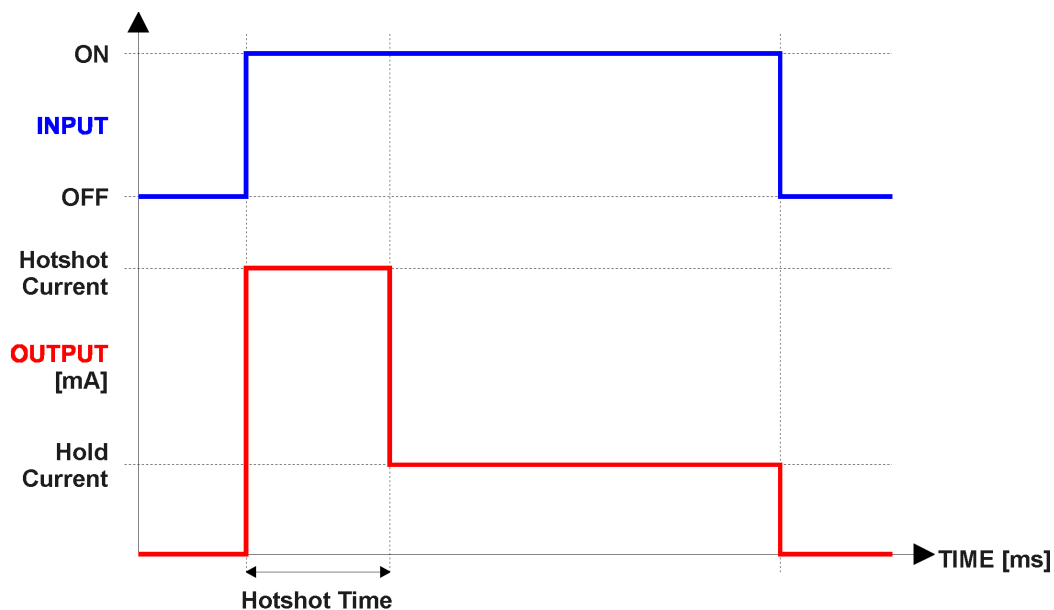
Figure 3 – Hotshot Digital Profile

As mentioned earlier, the output can be setup to react to a fault detected on any of the inputs to the function block (control, enable or override.) Should any one of these inputs be showing an error condition, object 6250h **DO Fault Mode** determines how the output will respond, per Table 2. By default, the output will revert to the state defined in object 6260h **DO Fault State**.

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

Table 2 – DO Fault Mode Options

1.2. Analog Output Function Block

The analog output (AO) function block is the default logic associate with the output.
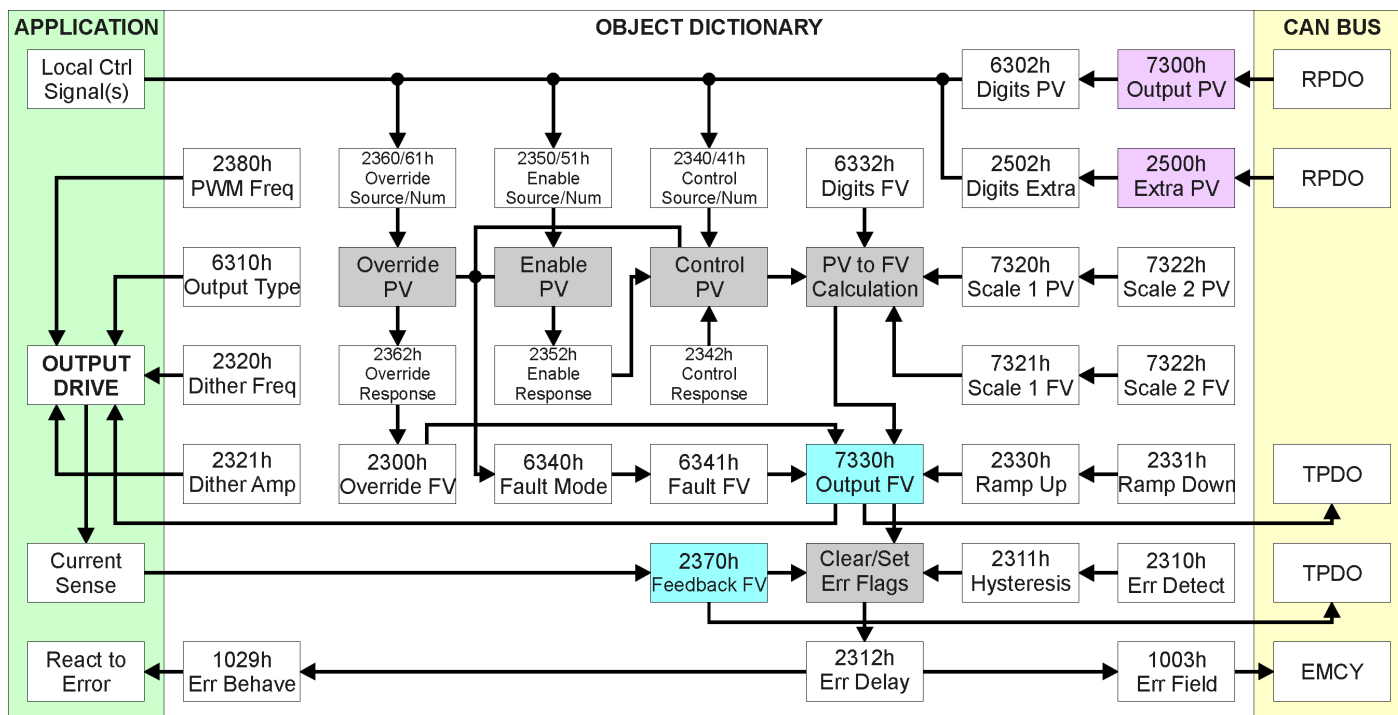
Figure 4 – Analog Output Objects

There are many objects associated with the analog output function block, but not all of them apply to all output types or control conditions. To start with, object 6310h **AO Output Type** defines how the output drive circuitry will be configures as per Table 3. This table also shows the output unit and range for each type. By default, the output is configured as proportional current type.

Value	Meaning	Range [Unit]
0	Output Disabled	N/A
10	Output Voltage	0 to 70 [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)

Table 3 – AO Output Type Options

The Current output has been factory calibrated for a close-loop PID control, and these objects should not be changed without proper consideration. In Voltage mode, the output is actually a high frequency PWM signal that is being adjusted by the processor such that the average voltage would match the target FV, up to the supply voltage. External filtering of the signal would have to be applied to get a true DC voltage. In PWM mode, the FV represents the output duty cycle. The digital output types have been covered in section 1.1.

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 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.
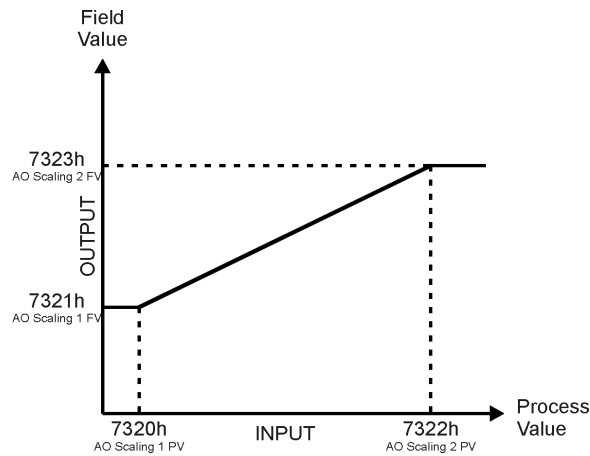
Figure 5 – Analog Output Linear Scaling PV to FV

An interesting feature of the CAN-1O is that the source for the PV input can be selected from the list of the logical function blocks supported by the controller. Any output from one function block can be selected as the control source for another. Not all options make sense in all cases, but the complete list of control sources is shown in Table 4. By default, the output is setup to respond to CANopen® Message RPDO1.

Value	Meaning
0	Control Source Not Used (Ignored)
1	CANopen® Message (RPDO)
2	Constant Function Block
3	PID Control Function Block
4	Lookup Table Function Block
5	Programmable Logic Function Block
6	Output Commanded Field Value
7	Output Feedback Field Value
8	Power Supply Measured
9	Processor Temperature Measured
10	Logic Selected Table Feedback

Table 4– Control Source Options

In addition to a source, each control also has a number which corresponds to the sub-index of the function block in question. Table 5 outlines the ranges supported for the number objects, depending on the source that had been selected.

Control Source	# Range	Object (Meaning)
Control Source Not Used	0	Ignored
Output Fault	*1*	*Output Current Fault ***
Power Supply Fault	*1*	*Power Supply Measured Fault ***
Temperature Fault	*1*	*Temperature Measure Fault ***
RPDO Timeout	*1*	*RPDO Timeout ***
CANopen® Message (RPDO)	1	7300h sub-index 1 or 6220h sub-index 1*
	2	2500h sub-index 1 (Extra Received PV 1)
	3	2500h sub-index 2 (Extra Received PV 2)
	4	2500h sub-index 3 (Extra Received PV 3)
	5	2500h sub-index 4 (Extra Received PV 4)
	6	2500h sub-index 5 (Extra Received PV 5)
	7	2500h sub-index 6 (Extra Received PV 6)
Constant Function Block	1	5010h sub-index 1 (always FALSE)
	2	5010h sub-index 2 (always TRUE)
	3	5010h sub-index 3 (Constant FV 3)
	4	5010h sub-index 4 (Constant FV 4)
	5	5010h sub-index 5 (Constant FV 5)
	6	5010h sub-index 6 (Constant FV 6)
PID Control Function Block	1	2460h sub-index 1 (PID Output FV 1)
Lookup Table Function Block	1	3017h (Lookup Table 1 Output Y-Axis PV)
	2	3027h (Lookup Table 2 Output Y-Axis PV)
	3	3037h (Lookup Table 3 Output Y-Axis PV)
	4	3047h (Lookup Table 4 Output Y-Axis PV)
	5	3057h (Lookup Table 5 Output Y-Axis PV)
	6	3067h (Lookup Table 6 Output Y-Axis PV)
Programmable Logic Function Block	1	30z7 (Lookup Table Selected by Logic 1)
	2	30z7 (Lookup Table Selected by Logic 2)
NOTE: The following options are meant more for diagnostic feedback, and should not be selected as a control source for logic inputs (i.e. output control or lookup table X-Axis)		
Output Commanded Field Value	1	7330h sub-index 1 or "DO1 Logic State"
Output Feedback Field Value	1	2370h sub-index 1 (AO1 FB or DO1 State)
Power Supply Measured	0 or 1	5020h (Power Supply FV)
Processor Temperature Measured	0 or 1	5030h (Processor Temperature FV)
Logic Selected Table Feedback	1	4140h (Logic Block 1 Selected Table)
	2	4240h (Logic Block 2 Selected Table)

* Depending on AO Output Type selected, either the AO Output PV or DO Write State will be used
Table 5 – Control Number Options Depending on Source Selected

For the analog outputs (and digital), there are three inputs to the function block, each one with a unique source and number object. For the control function (PV axis in Figure 5), objects 2340h **AO Control Input Source** and 2341h **AO Control Input Number** are used. For the enable function, objects 2350h **AO Enable Input Source** and 2351h **AO Enable Input Number** are used. Lastly,

for the override function, objects 2360h **AO Override Input Source** and 2361h **AO Override Input Number** are used. The Control Source together with Control Number determine which signal is used to drive the output. For example, setting Control Source to *Power Supply Fault* and Control Number to *1*, connects the configured stage to respond to any power supply faults the controller measures.

When using any control source as the X-Axis input to a function block, the corresponding scaling limits are defined as per Table 6. It is the responsibility of the user to make sure that the scaling objects for any function block are setup appropriately depending on the source selected for the X-Axis input.

Note that for the Output, the actual objects for the scaling (6302h, 7320h, 7322h) should be edited to match the objects defined in this table when the control source is changed.

Control Source	Scaling 1	Scaling 2	Dec Digits
CANopen® Message – Num 1	7230h	7322h	6302h
CANopen® Message – Num 2 to 7	2520h	2522h	2502h
Constant Function Block	N/A	N/A	N/A (float)
PID Control Function Block	0%	100%	1 (fixed)
Lookup Table Z Function Block (where Z = 1 to 6)	0 or lowest from 30z6h[1]	100 or highest from 30z6h[2]	30z3h
Programmable Logic Function	0%	100%	1 (fixed)
Output Commanded Field Value	7230h	7322h	6302h
Output Feedback Field Value	7230h	7322h	6302h
Power Supply Measured	0V	35V	N/A (float)
Processor Temperature Measured	-50.0°C	150°C	N/A (float)
Logic Selected Table Feedback	N/A	N/A	N/A

(1) Whichever value is smaller, (2) Whichever value is larger
Table 6 – Scaling Limits Per Control Source

As shown in Figure 5, the Output FV will be calculated based on the FV scaling selected. Since 7321h represents the value at or below the lowest control input received, it represents the minimum field value that will be applied at the output. Similarly, 7323h represents the maximum FV that will be applied.

While (7320h < 7322h) must always hold true, in order to get an inverse response (i.e. output decreases as the input increased), simply set 7321h higher than 7323h.

In general, the profile in Figure 5 holds true. In some cases, it may be desired that the minimum offset cannot be applied when the value is out of range, i.e. when using a profile with a deadband. For this reason, object 2342h **AO Control Response** has the options shown in Table 7.

Value	Meaning
0	Single Output Profile (Figure 11)
1	Output OFF below Scaling 1 PV
2	Output OFF above Scaling 2 PV

Table 7 – AO Control Response Options

The default configuration for the CAN-1O valve controller is that the current output is responding to changes from CANopen® message. The objects defaults listed in Table 8.

Object (Meaning)	Analog Output 1
7300h (AO Output PV)	Not Used
6302h (AO Decimal Digits PV)	3 (2102h, AI Dec Digits FV)
6310h (AO Output Type)	20 (Current)
7320h (AO Scaling 1 PV)	300
7321h (AO Scaling 1 FV)	300 [mA]
7322h (AO Scaling 2 PV)	1500
7323h (AO Scaling 2 FV)	1500 [mA]
6332h (AO Decimal Digits FV)	0 [mA]
2340h (AO Control Input Source)	1 (CANopen® Message)
2341h (AO Control Input Number)	1 (Message 1)
2342h (AO Control Response)	1 (OFF below Scaling 1 PV)
6340h (AO Fault Mode)	1 (Apply Pre-Defined FV)
7341h (AO Fault FV)	500 [mA]

Table 8 – AO Default Object Values

By default, the input is not used (control source is set to 0=Ignore), but it can be activated for safety interlocks or other more complex applications. Tables 9 and 10 show the options for object 2352h **AO Enable Response**, and 2362h **AO Override Response** respectively. In both cases, the default responses are bolded. When the override is applied, the output is driven to the value defined in object 2300h, **AO Override FV.**

Value	Meaning
0	Enable When ON
1	**Disable When ON**

Table 9 – AO Enable Response Options

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

Table 10 – AO Override Response Options

The output can be setup to react to a fault detected on any of the inputs to the function block (control, enable or override.) Should any one of these inputs be showing an error condition, object 6340 **AO Fault Mode** determines how the output will respond, per Table 11. By default, the output will be driven to the value defined in object 7341h **AO Fault FV**.

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

Table 11 – AO Fault Mode Options

The controller applies the logic shown in Figure 6 when evaluating what output FV to apply. Under normal conditions, i.e. when the control input is driving the output as shown in the highlighted box, there are ramping objects that can be applied to soften the output response. Object 2330h **AO Ramp Up** and object 2331 **AO Ramp Down** are both millisecond numbers that define how long it will take to ramp from AO Scaling 1 FV to AO Scaling 2 FV.

Object 2320h **AO Dither Frequency** and object 2321h **AO Dither Amplitude** are only applicable with current output types. The dither is a low frequency signal that is superimposed on-top of the high frequency output. While the dither frequency will match exactly what is in object 2320h, the exact amplitude of the dither will depend on the properties of the coil. When adjusting 2321h, select a value that is high enough to ensure an immediate 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. If 2321h is set to zero, dithering is disabled.

By default, current and voltage outputs are driven with a high frequency 25kHz signal. This value should not be lowered in this mode without taking into consideration how this affects the accuracy and stability of the current through the load. However, in PWM output mode, object 2380h **AO Output Frequency** can and should be adjusted to the desired frequency.

There are four other objects associated with the close-loop PID control of the current through an inductive load. These objects have been factory calibrated and should not be changed. However, the user does have access to these objects in the unlikely case that they should be adjusted. These objects are 2381h, **AO Current Sense Averaging Time**, 2382h, **AO Current PID Proportional Gain**, 2383h **AO Current PID Integral Time**, and 2384h **AO Current PID Derivative Time**. These objects must not be confused with PID objects in the PID function block which operates independently of the close-loop current control.
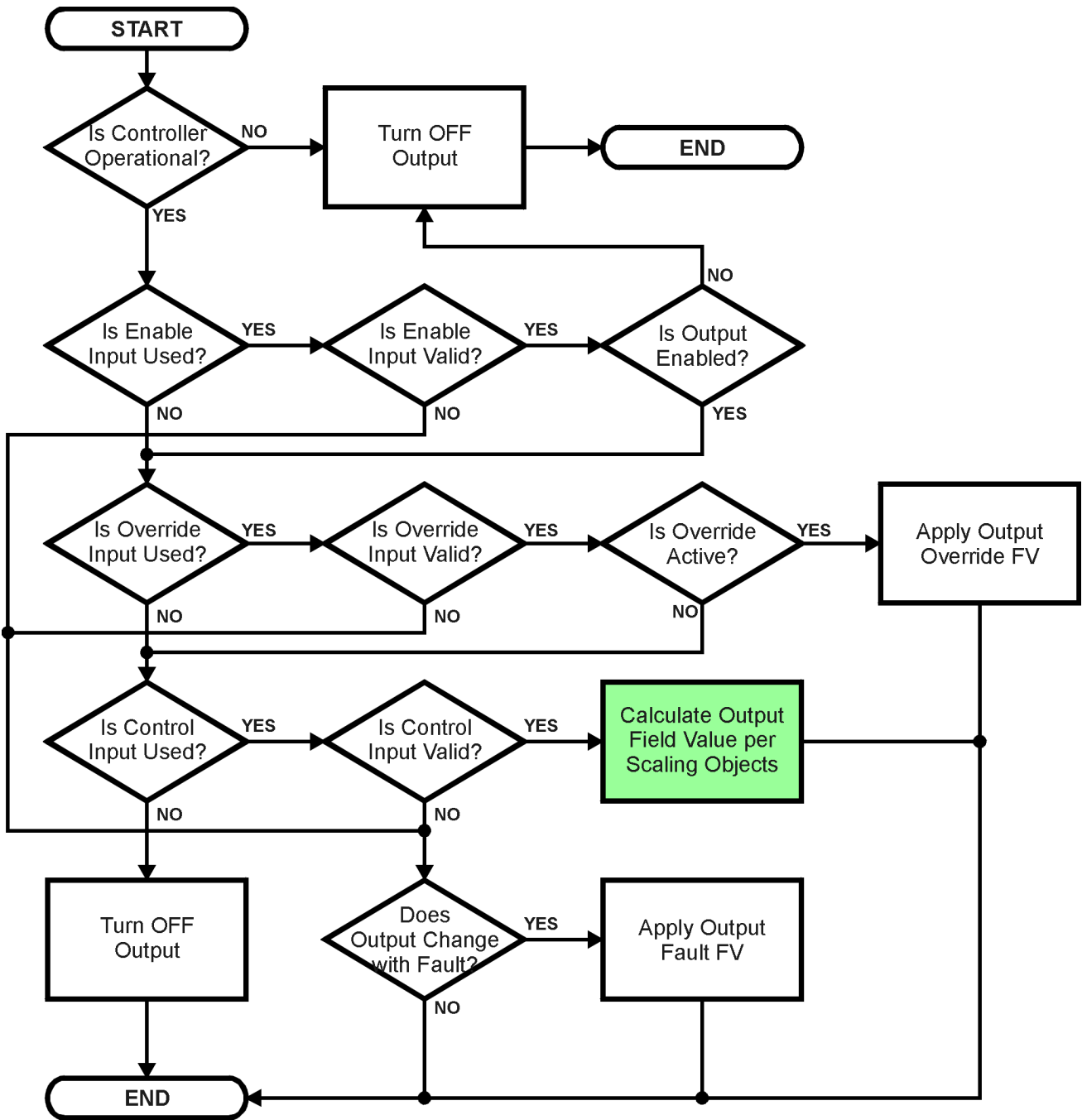
Figure 6 – Analog Output Logic Flowchart

In addition to the read-only mappable object 7330h **AO Output Field Value** (as represented by the green box above), there is another object 2370h **AO Feedback FV**, also read-only mappable. This object reflects the actual measured value at the output. It is also used to detect and flag an error if there is an open or short circuit at the output.

1.2.1.   Open/Short Circuit & Error Detection

If object 2310h **AO Error Detect Enable** is set to TRUE, then the absolute value between the desired output FV (7330h) and the measured feedback (2370h) is compared to 2311h **AO Error**

Clear Hysteresis. If the difference between the target and the actual exceeds the hysteresis value, then a fault is present. Since both open and short circuits read close to zero feedback, a signal is also sent to the processor whenever a short (to either GND or +Vcc) has occurred.

The controller will then flag an "Open Circuit" or "Short Circuit" fault. Both flags cannot be active at once. Setting either one of these flags automatically clears the other. If either flag stays active for the 2312h **AO Error Reaction Delay** time, then an appropriate EMCY message will be added to object 1003h **Pre-Defined Error Field**. The application will react to the EMCY message as defined by object 1029h **Error Behaviour** at the sub-index corresponding to an Input Fault. Refer to <mark>section 3.1.4 and 3.1.13</mark> for more information about objects 1003h and 1029h, including the complete list of EMCY messages.

Once the absolute difference between the target and feedback FV comes back with the tolerance defined in 2311h, the error flag is cleared. This means that when the output is commanded off, the flags are automatically reset, since the target and feedback are now both zero.

In order to prevent accidental setting/clearing of the open circuit error flag while the current is changing due to a newly commanded output, the target command value must remain constant for a period of time determined by the **Output Target Command Stable Timer**, object 2601h.

Only when the output target has remained constant for enough time for the feedback to have stabilized with the controller then compare the target and feedback values to check for an open circuit. This value should be set long enough to make sure the feedback will have stabilized properly after the largest step change expected under normal operating conditions.

1.2.2.   Zero Output Open Circuit Test

This controller also has the ability to detect and flag an open circuit (only in *'Proportional Current'* mode) even when the output is commanded OFF. If the target output is zero, the controller will execute an open circuit test sub-routine whereby it will activate the output at a low current **Zero Output Open Circuit Test Current,** object 2604h for a short period of time determined by **Zero Output Open Circuit Test ON Time**, object 2602h**.** At the end of the ON test period it will sample the feedback current, and if less than the **Zero Output Open Circuit Current OK** value, object 2605h, then the open circuit test counter will be incremented. The output will then be reset to zero for **Zero Output Open Circuit Test OFF Time**, object 2603h, after which the cycle repeats. If the current is measured to be less than the OK value for more than **Zero Output Open Circuit Test Counter** times, object 2606h, then the open circuit flag is set.

To disable the open circuit detection at zero feature simply set the **Zero Output Open Circuit Test Current,** object 2604h to 0mA or set **Zero Output Open Circuit Test Enabled**, object 2600h, to FALSE.

Once an open circuit has been flagged, it will be cleared once either the test current at zero comes above the "Current OK" value or the measured feedback comes back within the expected range of the target command as determined by the Hysteresis value. Since the open circuit will not disable the output (unless commanded OFF by some other logic) when the connection is fixed, the output automatically recovers and resumes normal operation.

1.3. PID Control Function Block

The PID control (PID) function blocks are not used by default.
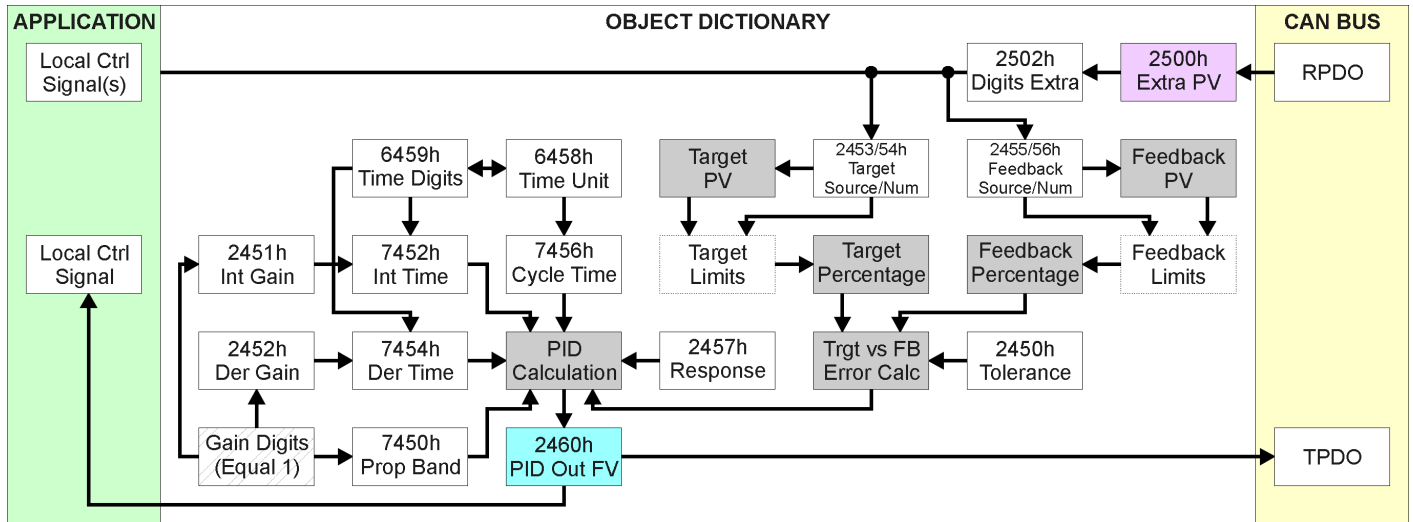
Figure 7 – PID Control Objects

As with the analog output block, the PID control function has control inputs associate with it that can be mapped to the output from any other function block. Objects 2453h **PID Target Source** and 2454h **PID Target Number** define what value the PID loop will attempt to maintain. For example, in the case of a setpoint (fixed) control application, this input can be mapped to one of object 5010h, a Constant FV. In this case, since there is no pre-defined range associate with a constant (see Table 6), the scaling limits will be set equal to those of the feedback input. Otherwise, the target input units do not have to match the feedback units, so long as they are scaled relative to one another.

Objects 2355h **PID Feedback Source** and 2356h **PID Feedback Number** define the close-loop input. Both the target and feedback use Tables 4 and 5 as the available options. The inputs are normalized to a percentage based on the associated scaling limits as defined in Table 6.

Object 2450h **PID Tolerance** defines the acceptable difference between the target and feedback, as a percentage, whereby an absolute difference smaller than this is treated as a 0% error.

Unless both the target and feedback inputs have legitimate control sources selected, the PID loop is disabled. When active, however, the PID algorithm will be called every 7456h **PID Cycle Time,** the default being every 10ms.

Object 6458h **PID Physical Unit Timing** is a read-only value and is defined in Seconds. The default value for object 6459h **PID Decimal Digits Timing** is 3, which means the object 7456h, along with other PID timing objects, are interpreted in milliseconds. Other time objects associated with the PID control are 7452h **PID Integral Action Time (Ti)** and 7454h **PID Derivative Action Time (Td).**

None time related objects use a fixed resolution of 1 decimal digit. These objects include 7450h **PID Proportional Band (G)**, 2450h **PID Tolerance**, 2451h **PID Integral Gain (Ki)**, and 2454h **PID Derivative Gain (Kd).**

By default, the PID loop is assumed to be controlling a single output which will increase/decrease as the feedback over/undershoots the target. However, some systems may require a push-pull response where one output comes on when over target, and the other when under. Object 2457h **PID Control Response** allows the user to select the response profile as needed from Table 12.

Value	Meaning
0	**Single Output**
1	On When Over Target
2	On When Below Target

Table 12 – PID Control Response Options

The PID algorithm used is shown below, with names in red being the object variables.   The result PIDOutput$_K$ is written to the read-only mappable object 2460h **PID Output Field Value** and is interpreted as a percentage value with 1 decimal place resolution. It can be used as the control source for another function block, i.e. one of the analog outputs.

$$T = Loop\_Update\_Rate*0.001$$

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

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

$$P_k = Error_k * P\_Gain$$

$$I_k = ErrorSum_k * I\_Gain$$

$$D_k = (Error_k-Error_{k-1}) * D\_Gain$$

$$PIDOutput_k = P_k + I_k + D_k$$

Figure 8 – PID Control Algorithm

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.

1.4. Lookup Table Function Block

The lookup table (LTz) function blocks are not used by default.
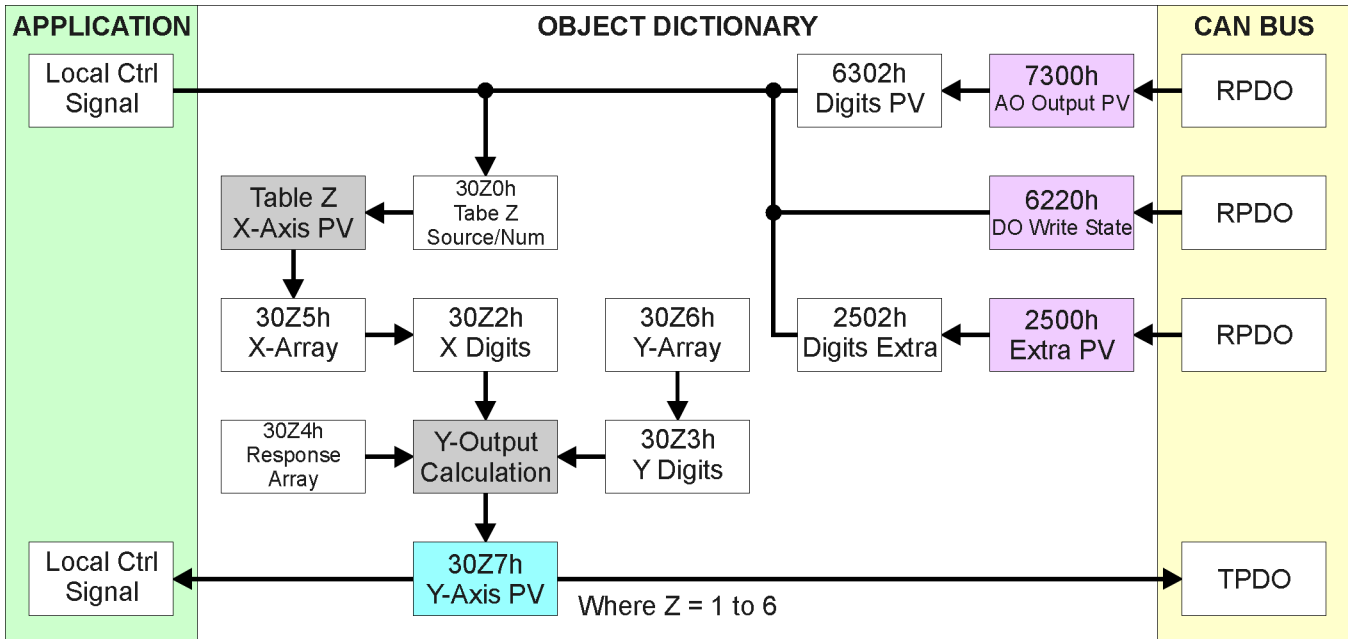
Figure 9 – Lookup Table Objects

Lookup tables are used to give an output response of up to 10 slopes per input. The array size of the objects 30z4h **LTz Point Response**, 30z5h **LTz Point X-Axis PV** and 30z6h **Point Y-Axis PV** shown in the block diagram above is therefore 11.

Note: If more than 10 slopes are required, a Logic Block can be used to combine up to three tables to get 30 slopes, as is described in Section 1.5.

There are two key parameters that will affect how this function block will behave. The objects 30z0h **Lookup Table z Input X-Axis Source** and 30z1h **Lookup Table z Input X-Axis Number** together define the control source for the function block. When it is changed, the table the values in object 30z5h need to be updated with new defaults based on the X-Axis source selected as described in Tables 4 and 5.

The second parameter that will affect the function block, is object **30z4h sub-index 1** which defines the "**X-Axis Type**". By default, the tables have a *'Data Response'* output (0). Alternatively, it can be selected as a *'Time Response'* (1), which is described later in Section 1.4.4.

1.4.1. X-Axis, Input Data Response

In the case where the "**X-Axis Type**" = *'Data Response',* the points on the X-Axis represents the data of the control source.

For most *'Data Responses'*, the default value at point (1,1) is [0,0].

The constraint on the X-Axis data is that the next index value is greater than or equal to the one below it, as shown in the equation below. Therefore, when adjusting the X-Axis data, it is recommended that X_{11} is changed first, then lower indexes in descending order.

$$MinInputRange <= X_1 <= X_2 <= X_3 <= X_4 <= X_5 <= X_6 <= X_7 <= X_8 <= X_9 <= X_{10} <= X_{11} <= MaxInputRange$$

As stated earlier, MinInputRange and MaxInputRange will be determined by the scaling objects associated with X-Axis Source that has been selected, as outlined in Table 6.

1.4.2. Y-Axis, Lookup Table Output

By default, it is assumed that the output from the lookup table function block will be a percentage value in the range of 0 to 100.

In fact, so long as all the data in the Y-Axis is $0<=Y[i]<=100$ (where i = 1 to 11) then other function blocks using the lookup table as a control source will have 0 and 100 as the Scaling 1 and Scaling 2 values used in linear calculation.

However, 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. **The Y-Axis does not have to be a percentage output but could represent full scale process values instead.**

In all cases, the controller looks at the **entire range** of the data in the Y-Axis sub-indexes and selects the lowest value as the MinOutRange and the highest value as the MaxOutRange. So long as they are not both within the 0 to 100 range, they are passed directly to other function blocks as the limits on the lookup table output. (i.e Scaling 1 and Scaling 2 values in linear calculations.)

Even if some of the data points are *'Ignored'* as described in Section 1.4.3, they are still used in the Y-Axis range determination. If not all the data points are going to be used, it is recommended that Y10 be set to the minimum end of the range, and Y11 to the maximum first. This way, the user can get predictable results when using the table to drive another function block, such as an analog output.

1.4.3. Point to Point Response

By default, all six lookup tables have a simple linear response from 0 to 100 in steps of 10 for both the X and Y axes. For a smooth linear response, each point in the 30z4h **LTz Point Response** array is setup for a *'Ramp To'* output.

Alternatively, the user could select a *'Step To'* response for 30z4h, where N = 2 to 11. 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. *(Recall: LTz Point Response sub-index 1 defines the X-Axis type)*

Figure 10 shows the difference between these two response profiles with the default settings.

RAMP RESPONSE (default)
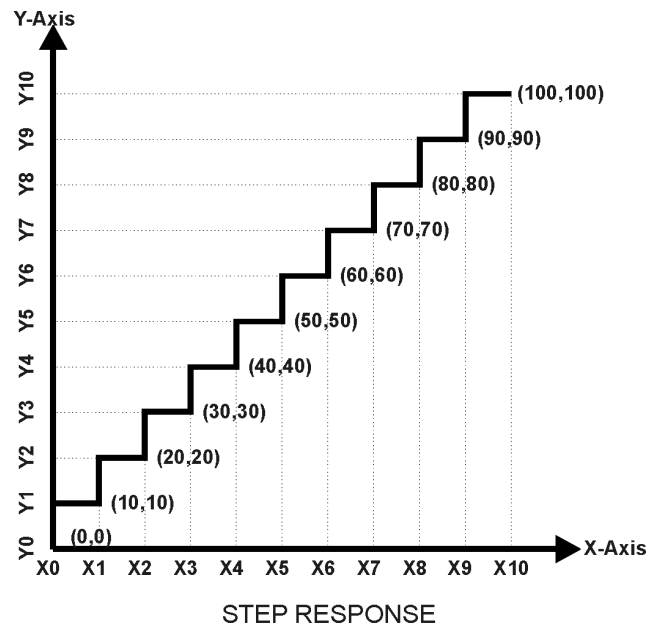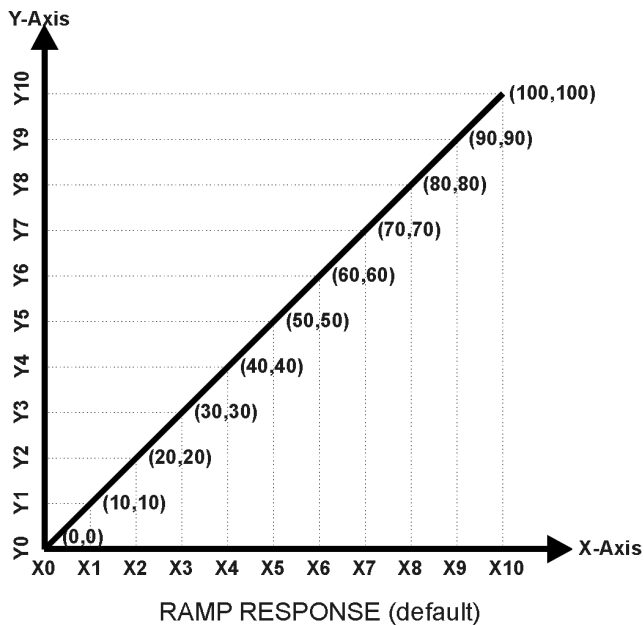
STEP RESPONSE

Figure 10 – Lookup Table Defaults with Ramp and Step Responses

Lastly, any point except (1,1) can be selected for an *'Ignore'* response. If **LTz Point Response sub-index N** is set to ignore, then all points from (X_N, Y_N) to (X_{11}, Y_{11}) 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. An example of where the same input is used as the X-Axis for two tables, but where the output profiles 'mirror' each other for a deadband joystick response is shown in Figure 11. The example shows a dual slope percentage output response for each side of the deadband, but additional slopes can be easily added as needed. *(Note: In this case, since the analog outputs are responding directly to the profile from the lookup tables, both would have object 2342h AO Control Response set to a 'Single Output Profile.')*
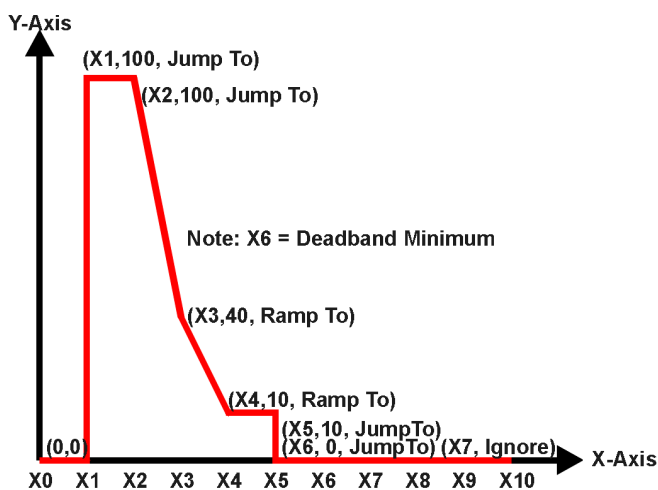
Figure A - Dual Slope "Profile B"
Joystick Deadband Response
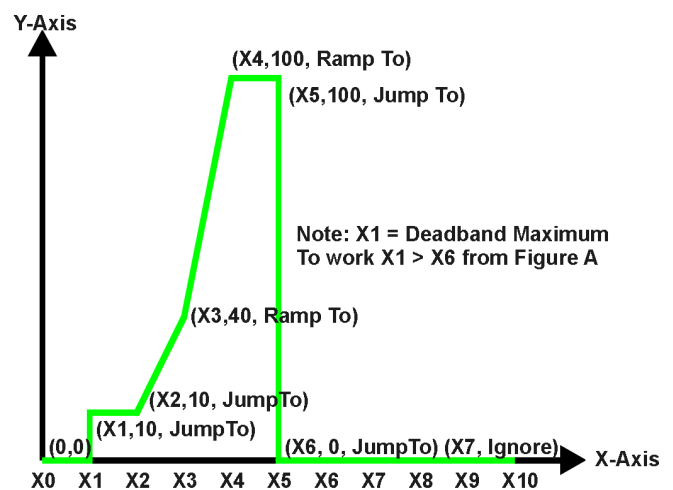
Figure B - Dual Slope "Profile A"
Joystick Deadband Response

Figure 11 – Lookup Table Examples to Setup for Dual-Slope Joystick Deadband Response

To summarize, Table 13 outlines the different responses that can be selected for object 30z4h, both for the X-Axis type and for each point in the table.

Sub-Index	Value	Meaning
1	0	Data Response (X-Axis Type)
2 to 11		Ignore (this point and all following it)
1	1	Time Response (X-Axis Type)
2 to 11		Ramp To (this point)
1	2	N/A (not an allowed option)
2 to 11		Jump To (this point)

Table 13 – LTz Point Response Options

1.4.4. X-Axis, Time Response

As mentioned in Section 1.2, 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.

When the control input is OFF, the output is always at zero. When the input comes ON, the profile ALWAYS starts at position (X_1, Y_1) which is 0 output for 0ms.

When using the lookup table to drive an output based on **time**, it is mandatory that objects 2330h **Ramp Up** and 2331h **Ramp Down** in the analog output function block be set to **zero**. Otherwise, the output result will not match the profile as expected. Recall, also, that the AO scaling should be set to match the Y-Axis scaling of the table in order to get a 1:1 response of AO Output FV versus LTz Output Y-Axis PV.

An application where the time response feature would be useful is filling a clutch when a transmission is engaged. An example of some fill profiles is shown in Figure 12.
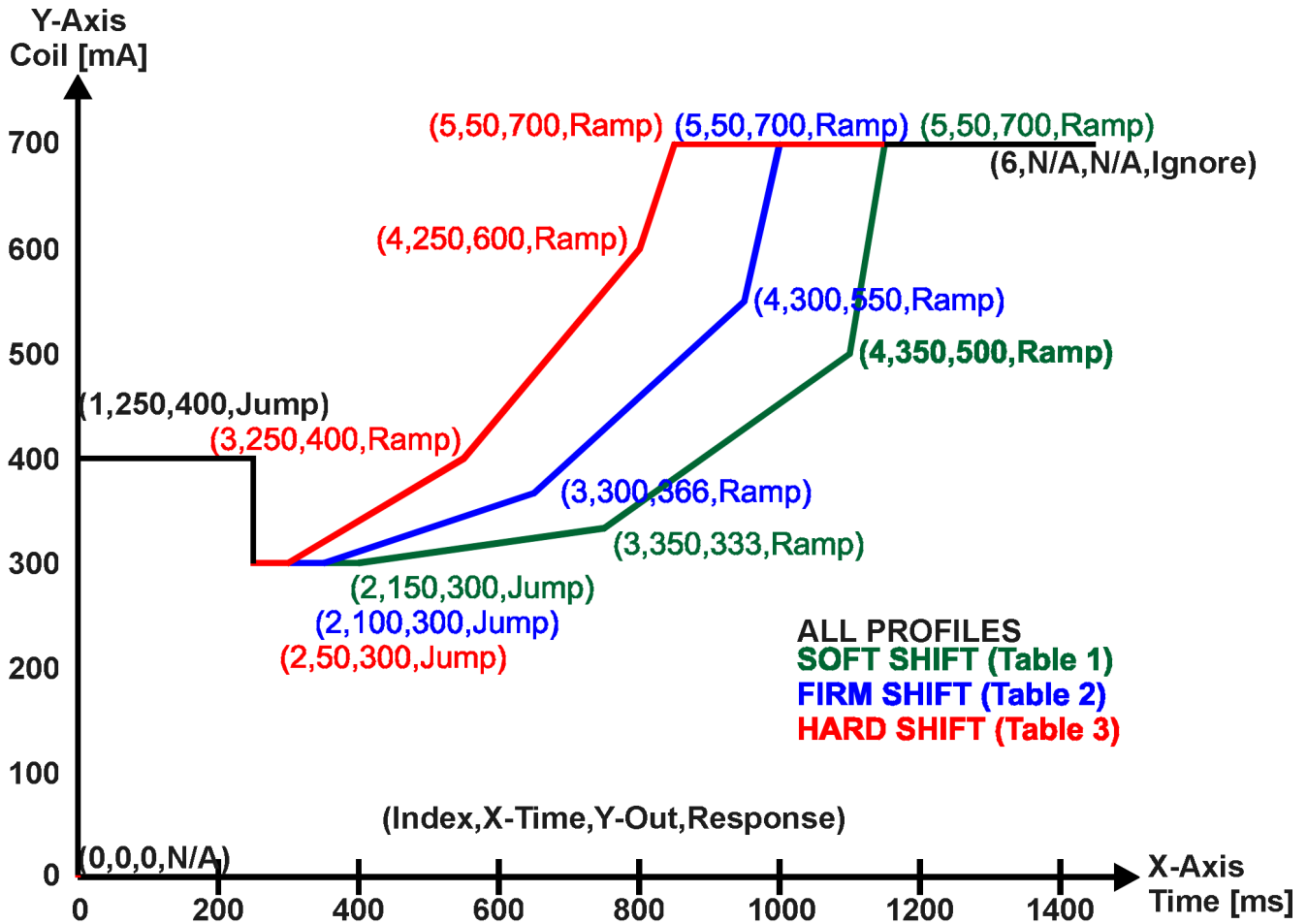
Figure 12 – Lookup Table Time Response Clutch Fill Profiles

In a time response, the data in object 30z5h **LTz Point X-Axis PV** is measured in milliseconds, and object 30z2h **LTz X-Axis Decimal Digits PV** is automatically set to 0. A minimum value of 1ms must be selected for all points other than sub-index 1 which is automatically set to [0,0]. The interval time between each point on the X-axis can be set anywhere from 1ms to 24 hours. [86,400,000 ms]

1.5. Programmable Logic Function Block

The programmable logic block (LBx) functions are not used by default.
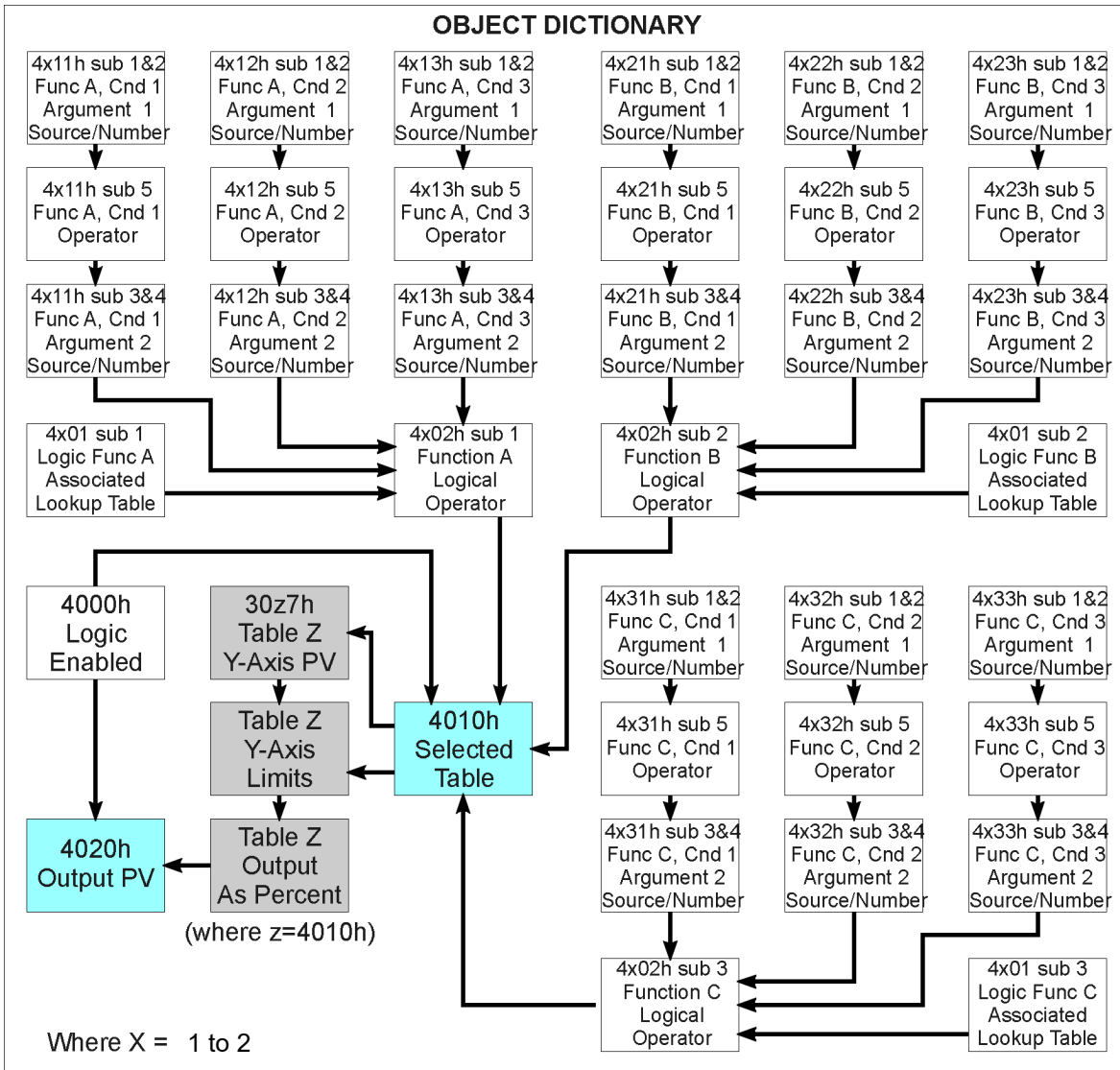
Figure 13 – Logic Block Objects

This function block is obviously the most complicated of them all, but very powerful. Any LBx (where X=1 to 2) can be linked with up to three lookup tables, any one of which would be selected only under given conditions. Any three tables (of the available 6) can be associated with the logic, and which ones are used is fully configurable on object 4x01 **LBx Lookup Table Number**.

Should the conditions be such that a particular table (A, B or C) has been selected as described in Section 1.5.2, then the output from the selected table, at any given time, will be passed directly to LBx's corresponding sub-index X in read-only mappable object 4020h **Logic Block Output PV**. The active table number can read from read-only object 4010h **Logic Block Selected Table**.

Therefore, an LBx allows up to three different responses to the same input, or three different responses to different inputs, to become the control for another function block, such as an analog

output. Here, the "**Control Source**" for the reactive block would be selected to be the *'Programmable Logic Function Block,'* as described in Section 1.2.

In order to enable any one of logic blocks, the corresponding sub-index in object 4000h **Logic Block Enable** must be set to TRUE. They are all disabled by default.

Logic is evaluated in the order shown in Figure 14. Only if a lower indexed table (A, B, C) has not been selected will the conditions for the next table be looked at. **The default table is always selected as soon as it is evaluated. It is therefore required that the default table always be the highest index in any configuration.**
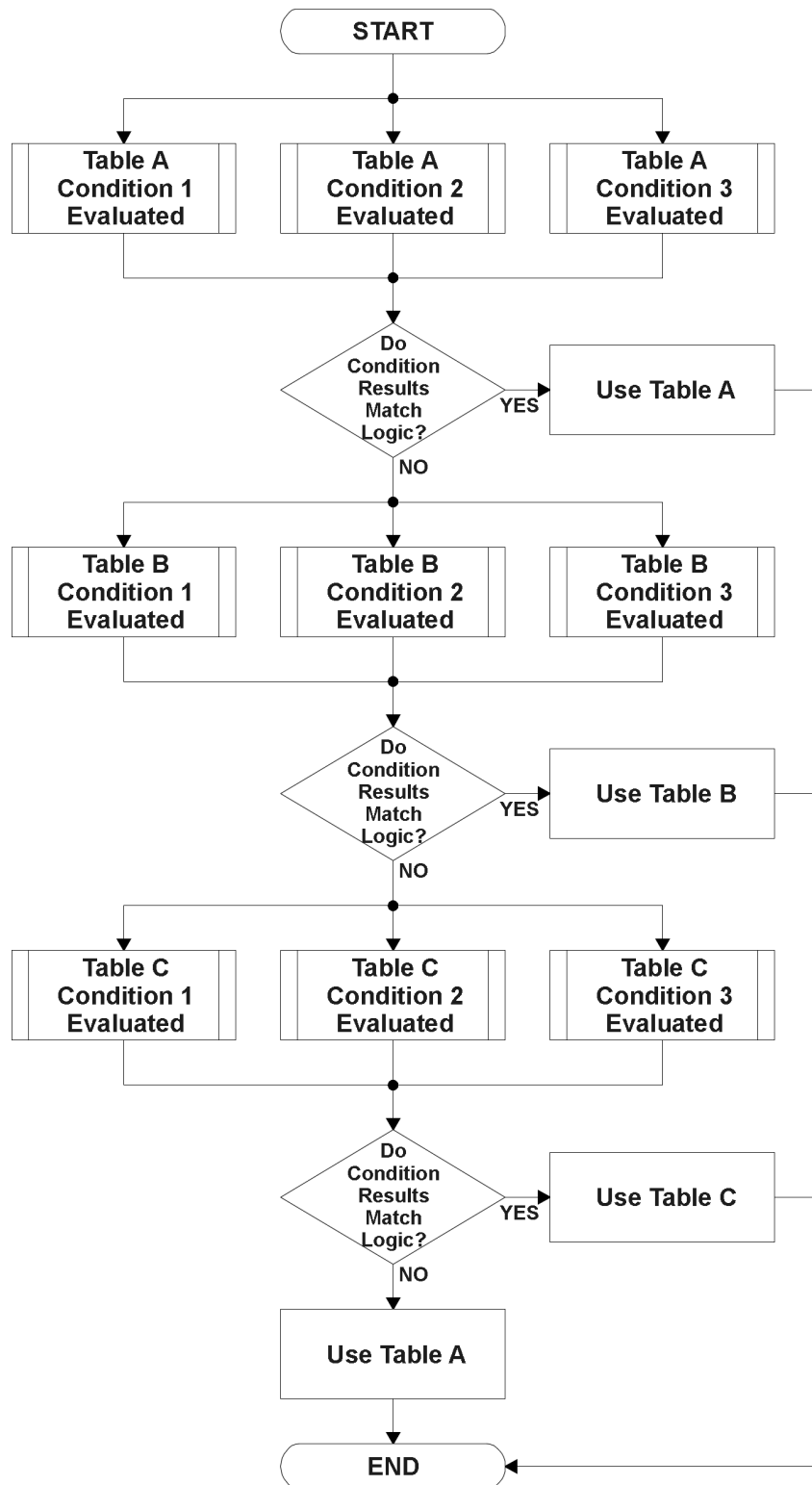
Figure 14 – Logic Block Flowchart

1.5.1. Conditions Evaluation

The first step in determining which table will be selected as the active table is to first evaluate the conditions associated with a given table. Each table has associated with it up to three conditions that can be evaluated. Conditional objects are custom DEFSTRUCT objects defined as shown in Table 14.

Index	Sub-Index	Name	Data Type
4xyz*	0	Highest sub-index supported	UNSIGNED8
	1	Argument 1 Source	UNSIGNED8
	2	Argument 1 Number	UNSIGNED8
	3	Argument 2 Source	UNSIGNED8
	4	Argument 2 Number	UNSIGNED8
	5	Operator	UNSIGNED8

* Logic Block X Function Y Condition Z, where X = 1 to 2, Y = A, B or C, and Z = 1 to 3

Table 14 – LBx Condition Structure Definition

Objects 4x11h, 4x12h and 4x13h are the conditions evaluated for selecting Table A.
Objects 4x21h, 4x22h and 4x23h are the conditions evaluated for selecting Table B.
Objects 4x31h, 4x32h and 4x33h are the conditions evaluated for selecting Table C.

Argument 1 is always a logical output from another function block, as listed in Table 4. As always, the input is a combination of the functional block objects 4xyzh sub-index 1 **"Argument 1 Source"** and **"Argument 1 Number."**

Argument 2 on the other hand, could either be another logical output such as with Argument 1, OR a constant value set by the user. To use a constant as the second argument in the operation, set **"Argument 2 Source"** to *'Constant Function Block',* and **"Argument 2 Number"** to the desired sub-index. When defining the constant, make sure it uses the same resolution (decimal digits) as the Argument 1 input.

Argument 1 is evaluated against Argument 2 based on the **"Operator"** selected in sub-index 5 of the condition object. The options for the operator are listed in Table 15, and the default value is always *'Equal'* for all condition objects.

Value	Meaning
0	**=, Equal**
1	!=, Not Equal
2	>, Greater Than
3	>=, Greater Than or Equal
4	<, Less Than
5	<=, Less Than or Equal

Table 15 – LBx Condition Operator Options

For example, a condition for a transmission control shift selection, as shown in Figure 12 in the previous section, could be that the Engine RPM be less than a certain value to select a Soft Fill profile. In this case, **"Argument 1 Source"** could be set to *'Analog Input Function Block'* (where

the input is configured for RPM pickup)*, **"Argument 2 Source"** to *'Constant Function Block'*, and the **"Operator"** to *'<, Less Than.'* Object 5010h Constant FV at sub-index **"Argument 2 Number"** would be set to whatever cutoff RPM the application required.

By default, both arguments are set to *'Control Source Not Used'* which disables the condition, and automatically results in a value of N/A as the result. Although it is generally considered that each condition will be evaluated as either TRUE or FALSE, the reality is that there could be four possible results, as described in Table 16.

Value	Meaning	Reason
0	False	(Argument 1) Operator (Argument 2) = False
1	True	(Argument 1) Operator (Argument 2) = True
2	Error	Argument 1 or 2 output was reported as being in an error state
3	Not Applicable	Argument 1 or 2 is not available (i.e. set to *'Control Source Not Used'*)

Table 16 – LBx Condition Evaluation Results

1.5.2. Table Selection

In order to determine if a particular table will be selected, logical operations are performed on the results of the conditions as determined by the logic in Section 1.5.1. There are several logical combinations that can be selected, as listed in Table 17. The default value for object 4x02h **LBx Function Logical Operator** is dependent on the sub-index. For sub-index 1 (Table A) and 2 (Table B), the *'Cnd1 And Cnd2 And Cnd3'* operator is used, whereas sub-index 3 (Table C) is setup as the *'Default Table''* response.

Value	Meaning
0	Default Table
1	Cnd1 And Cnd2 And Cnd3
2	Cnd1 Or Cnd2 Or Cnd3
3	(Cnd1 And Cnd2) Or Cnd3
4	(Cnd1 Or Cnd2) And Cnd3

Table 17 – LBx Function Logical Operator Options

Not every evaluation is going to need all three conditions. The case given in the earlier section, for example, only has one condition listed, i.e. that the Engine RPM be below a certain value. Therefore, it is important to understand how the logical operators would evaluate an Error or N/A result for a condition, as outlined in Table 18.

Logical Operator	Select Conditions Criteria
Default Table	Associated table is automatically selected as soon as it is evaluated.
Cnd1 And Cnd2 And Cnd3	**Should be used when two or three conditions are relevant, and all must be True to select the table.** If any condition equals False or Error, the table is not selected. An N/A is treated like a True. If all three conditions are True (or N/A), the table is selected. If((Cnd1==True) &&(Cnd2==True)&&(Cnd3==True)) Then Use Table
Cnd1 Or Cnd2 Or Cnd3	**Should be used when only one condition is relevant. Can also be used with two or three relevant conditions.** If any condition is evaluated as True, the table is selected. Error or N/A results are treated as False If((Cnd1==True) || (Cnd2==True) || (Cnd3==True)) Then Use Table
(Cnd1 And Cnd2) Or Cnd3	**To be used only when all three conditions are relevant.** If both Condition 1 and Condition 2 are True, OR Condition 3 is True, the table is selected. Error or N/A results are treated as False If(((Cnd1==True)&&(Cnd2==True)) || (Cnd3==True)) Then Use Table
(Cnd1 Or Cnd2) And Cnd3	**To be used only when all three conditions are relevant.** If Condition 1 And Condition 3 are True, OR Condition 2 And Condition 3 are True, the table is selected. Error or N/A results are treated as False If(((Cnd1==True)||(Cnd2==True)) && (Cnd3==True)) Then Use Table

Table 18 – LBx Conditions Evaluation Based on Selected Logical Operator

If the result of the function logic is TRUE, then the associated lookup table (see object 4x01h) is immediately selected as the source for the logic output. No further conditions for other tables are evaluated. For this reason, the *'Default Table'* should always be setup as the highest letter table being used (A, B or C) If no default response has been setup, the Table A automatically becomes the default when no conditions are true for any table to be selected. This scenario should be avoided whenever possible to not result in unpredictable output responses.

The table number that has been selected as the output source is written to sub-index X of read-only object 4010h **Logic Block Selected Table.** This will change as different conditions result in different tables being used.

1.5.3. Logic Block Output

Recall that Table Y, where Y = A, B or C in the LBx function block does NOT mean lookup table 1 to 3. Each table has object 4x01h LBx **Lookup Table Number** which allows the user to select which lookup tables they want associated with a particular logic block. The default tables associated with each logic block are listed in Table 19.

Programmable Logic Block Number	Table A – Lookup Table Block Number	Table B – Lookup Table Block Number	Table C – Lookup Table Block Number
1	1	2	3
2	4	5	6
3	1	2	3
4	4	5	6

Table 19 – LBx Default Lookup Tables

If the associated Lookup Table Z (where Z equals 4010h sub-index X) does not have an **"X-Axis Source"** selected, then the output of LBx will always be "Not Available" so long as that table is selected. However, should LTz be configured for a valid response to an input, be it Data or Time, the output of the LTz function block (i.e. the Y-Axis data that has been selected based on the X-Axis value) will become the output of the LBx function block so long as that table is selected.

The LBx output is always setup as a percentage, based on the range of the Y-Axis for the associated table (see Section 1.4.2). It is written to sub-index X of read-only object 4020h **Logic Block Output PV** with a resolution of 1 decimal place.

1.6. Miscellaneous Function Block

There are some other objects available which have not yet been discussed or mentioned briefly in passing (i.e. constants.) These objects are not necessarily associated with one another but are all discussed here.
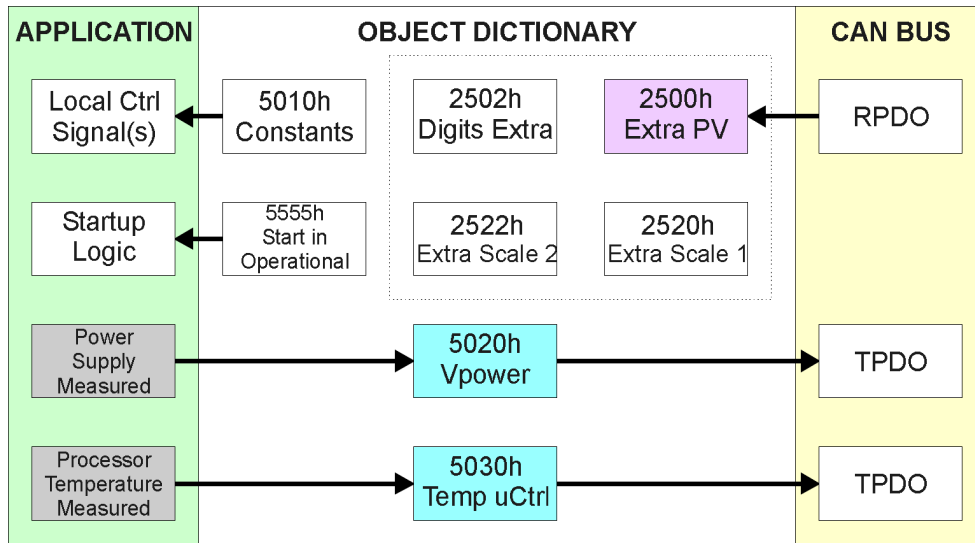
Figure 15 – Miscellaneous Objects

Objects 2500h **Extra Control Received PV**, 2502h **EC Decimal Digits PV**, 2520h **EC Scaling 1 PV** and 2522h **EC Scaling 2 PV** have been mentioned in Section 1.2, Table 5. These objects allow for additional data received on a CANopen® RPDO to be mapped independently to various function blocks as a control source. For example, a PID loop must have two inputs (target and feedback), so one of them has to come from the CAN bus. The scaling objects are provided to define the limits of the data when it is used by another function block, as shown in Table 6.

1.6.1. Power Supply and Processor Temperature

Objects 5020h **Power Supply FV** and 5030h **Processor Temperature FV** are available as read-only feedback for additional diagnostics.

Object 5021h is used to enable or disable Power Supply faults that can be used as a control source to the Dual LED for visual feedback. If object 5021h is enabled (1), then objects 5022h, **Under Voltage Threshold**, and 5023h, **Over Voltage Threshold** are used by the controller. These two configurable objects hold the desired values to trigger a supply fault. Object 5024h, **Hysteresis To Clear Fault**, is the number of Volts required for the supply to increase above or decrease below from the voltage entered in objects 5022h and 5023h, respectively.

Similarly, object 5031h enables or disables faults by the Processor Temperature measured. An **Over Temperature value** can be entered in object 5032h which, when reached and exceeded, will trigger a temperature fault. The temperature will need to decrease a value of **Hysteresis to Clear Temperature Fault,** object 5033h, below the temperature set in object 5032h.

1.6.2. Constant Data List

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 4 other sub-indexes provided for user selectable values. (Defaults 25, 50, 75 and 100)

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 the logic block, and they can also be used as a setpoint target for a PID control block.

1.6.3. Start in Operational Mode

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

When using the CAN-1O 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.

2. INSTALLATION INSTRUCTIONS

2.0. Dimensions and Pinout
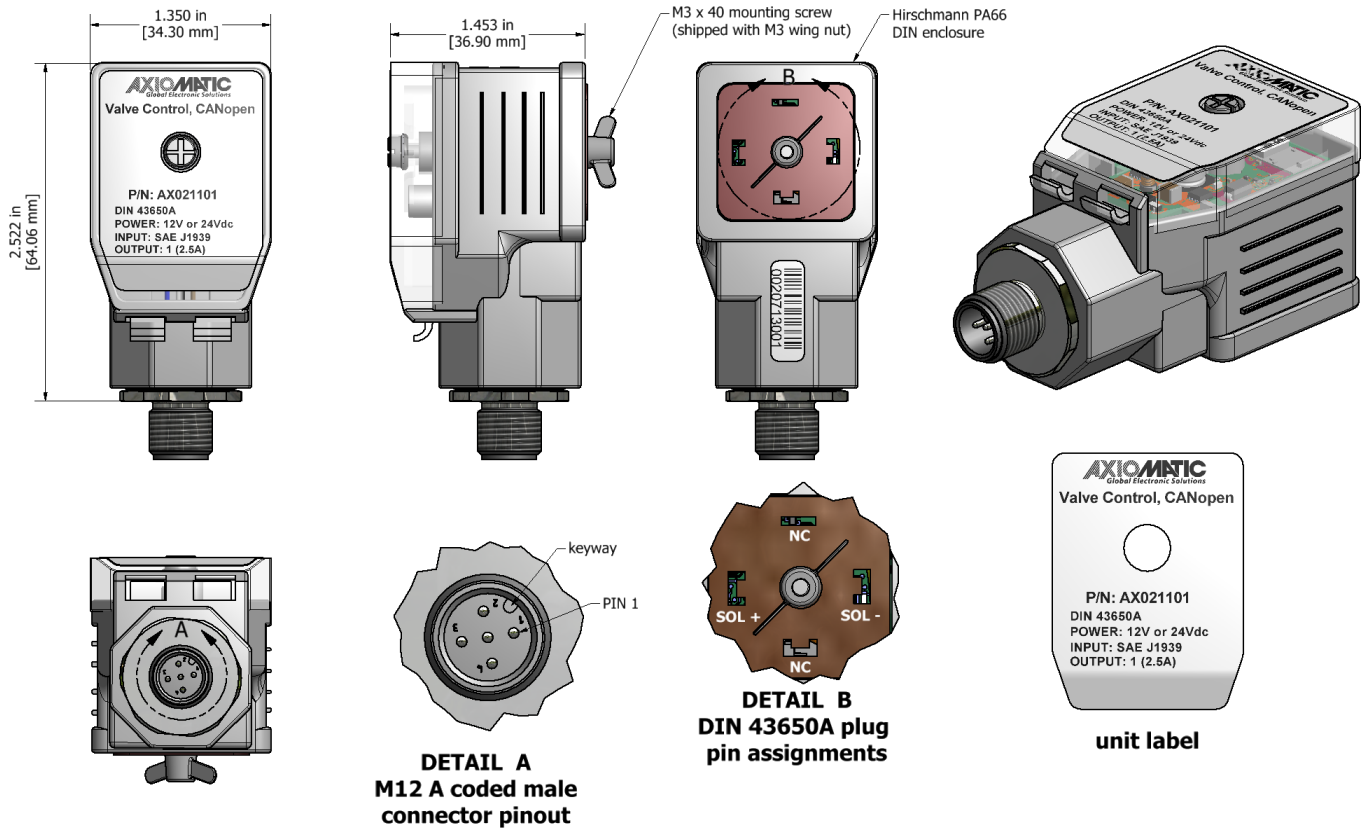
Figure 16 – Dimension Drawing

Note 1: For proper operation of the amplifier, match power supply voltage with rating of solenoid coil. Operating the amplifier with a supply voltage lower than the solenoid rated voltage may result in reduced maximum current output.
Note 2: The coil should have no polarity or protection diodes for proper operation of the device.
Note 3: The maximum current output of the amplifier should not exceed the current rating of the solenoid coil.

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CAN and I/O Connector	
Pin #	**Function**
1	Power +
2	Power -
3	CAN SH
4	CAN H
5	CAN L

Table 20 – Connector Pinout

2.1. Installation Instructions

CONNECTIONS & MOUNTING

6-pin Integral Connector (equivalent TE Deutsch P/N: DT04-6P) - mates to TE Deutsch P/N: DT06-6S
2-pin Integral Connector (equivalent TE Deutsch P/N: DT06-2S) - mates to as valve coil with an integral Connector (equivalent TE Deutsch P/N: DT04-2P)

Wires should be of the appropriate gauge to meet requirements of applicable electrical codes and suit the specifications of the connector(s).

NOISE – ELECTRICAL CONNECTIONS AND SHIELDING

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

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

All wires used must be 16 or 18 AWG.

CAN NETWORK CONSTRUCTION

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

CAN TERMINATION

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

3. CANOPEN® OBJECT DICTIONARY

The CANopen® object dictionary of the CAN-1O Controller is based on CiA device profile DS-404 V1.2 (device profile for Closed Loop Controllers). The object dictionary includes Communication Objects beyond the minimum requirements in the profile, as well as several manufacturer-specific objects for extended functionality.

3.0. NODE ID and BAUD RATE

By default, the CAN-1O Controller ships factory programmed with a Node ID = 127 (0x7F) and with Baud rate = 125 kbps.

3.0.1. 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.

3.0.2. Setting Node-ID

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

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

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

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

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

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

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

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

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

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

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

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

3.0.3.   Setting Baudrate

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

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

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

Item	Value	
COB-ID	0x7E5	
Length	3	
Data 0	0x13	(cs=19 for configure bit timing parameters)
Data 1	0x00	(switches to waiting state)
Data 2	Index	(select baudrate index per table 21)

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

Table 21 – LSS Baudrate Indexes

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

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

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

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

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

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

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

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

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

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

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

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

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

3.1. COMMUNICATION OBJECTS (DS-301 and DS-404)

The communication objects supported by the CAN-1O Controller are listed in the following table. A more detailed description of some of the objects is given in the following subchapters. Only those objects that have device-profile specific information are described. For more information on the other objects, refer to the generic CANopen® protocol specification DS-301 and DS-404.

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

3.1.1. Object 1000h: Device Type

This object contains information about the device type as per device profile DS-404. The 32-bit parameter is divided into two 16-bit values, showing General and Additional information as shown below.

MSB	LSB
Additional Information = 0xE01C	**General Information** = 0x0194 (404)

DS-404 defines the Additional Information field in the following manner:
0000h = reserved
0001h = digital input block
0002h = analog input block
0004h = digital output block
0008h = analog output block
0010h = controller block (aka PID)
0020h = alarm block
0040h … 0800h = reserved
1000h = reserved
2000h = lookup table block (manufacturer-specific)
4000h = programmable logic block (manufacturer-specific)
8000h = miscellaneous block (manufacturer-specific)

Object Description

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

Entry Description

Access	RO
PDO Mapping	No
Value Range	0xE01C0194
Default Value	0xE01C0194

3.1.2. Object 1001h: Error Register

This object is an error register for the device. Any time there is an error detected by the CAN-1O Controller, the Generic Error Bit (bit 0) is set. Only if there are no errors in the module will this bit will be cleared. No other bits in this register are used by the CAN-1O Controller.

Object Description

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

Entry Description

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

3.1.3. Object 1002h: Manufacturer Status Register

This object is used for manufacturer debug purposes.

3.1.4. Object 1003h: Pre-Defined Error Field

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

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

The CAN-1O Controller has a limitation of a maximum of 4 errors in the list. If the device registers more errors, the list will be truncated, and the oldest entries will be lost.

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

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

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

case, the manufacturer-specific field will therefore be 0x80nn. In both cases, the corresponding EMCY Error Code will be the Guard Error 0x8130.

When an analog output is not working as described in Section 1.2, then the Error Description will reflect what channel(s) is at fault using the following table. Also, if an RPDO is not received within the expected "Event Timer" period, an RPDO timeout will be flagged. Table 22 outlines the resulting Error Field Codes and their meanings.

Error Field Code	Error Description	Meaning	ID	Meaning	EMCY Code	Meaning
00000000h	EMCY Error Reset (fault no longer active)					
1001F002h	10h	Sensor Break (Open Circuit on AO)	01h	Analog Output 1	F002h	Output Overload
00012310h	00h	Short Circuit on AO	01h	Analog Output 1	2310h	Current at Output too High (short to GND or +Vcc)
00008100h	00h	RPDO Timeout	00h	Unspecified	8100h	Communication - generic
10008130h	10h	Lifeguard Event	00h	Unspecified	8130h	Lifeguard/Heartbeat Error
80nn8130h	80h	Heartbeat Timeout	nn	Node-ID	8130h	Lifeguard/Heartbeat Error

Table 22 – Pre-Defined Error Field Codes

Object Description

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

Entry Description

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

Sub-Index	1h to 4
Description	Standard error field
Access	RO
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	0

3.1.5. Object 100Ch: Guard Time

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

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

Object Description

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

Entry Description

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

3.1.6. Object 100Dh: Lifetime Factor

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

Object Description

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

Entry Description

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

3.1.7. Object 1010h: Store Parameters

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

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

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

On reception of the correct signature to an appropriate sub-index, the CAN-1O Controller will store the parameters in non-volatile memory, and then confirm the SDO transmission.

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

Object Description

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

Entry Description

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

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

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

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

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

3.1.8. Object 1011h: Restore Parameters

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

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

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

On reception of the correct signature to an appropriate sub-index, the CAN-1O Controller will restore the defaults in non-volatile memory, and then confirm the SDO transmission. **The default values are set valid only after the device is reset or power-cycled.** This means that the CAN-1O Controller will NOT start using the default values right away, but rather continue to run from whatever values were in the Object Dictionary prior to the restore operation.

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

Object Description

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

Entry Description

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

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

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

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

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

3.1.9.   Object 1016h: Consumer Heartbeat Time

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

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

Object Description

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

Entry Description

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

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

3.1.10. Object 1017h: Producer Heartbeat Time

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

Object Description

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

Entry Description

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

3.1.11. Object 1018h: Identity Object

The identity object indicates the data of the CAN-1O Controller, including vendor id, device id, software and hardware version numbers, and the serial number.

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

MSB   LSB

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

Object Description

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

Entry Description

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

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

Sub-Index	2h
Description	Product Code
Access	RO
PDO Mapping	No
Value Range	0xAA021101
Default Value	0xAA021101

Sub-Index	3h
Description	Revision Number
Access	RO
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	0x00010000

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

UMAX021101. CAN to Single Output Valve Drive CANopen® Controller. Version 1.1

51

3.1.12. Object 1020h: Verify Configuration

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

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

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

Object Description

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

Entry Description

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

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

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

3.1.13. Object 1029h: Error Behaviour

This object controls the state that the CAN-1O Controller will be set into in case of an error of the type associated with the sub-index.

A network fault is flagged when an RPDO is not received within the expected time period defined in the "Event Timer" of the associated communication objects, (see Section 3.2.14 for more information) or if a lifeguard or heartbeat message is not received as expected. Output faults are defined in Section 1.2.

For all sub-indexes, the following definitions hold true:
- 0 = Pre-Operational (node reverts to a pre-operational state when this fault is detected)
- 1 = No State Change (node remains in the same state it was in when the fault occurred)
- 2 = Stopped (node goes into stopped mode when the fault occurs)

Object Description

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

Entry Description

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

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

Sub-Index	2h
Description	Digital Input Fault (not used)
Access	RW
PDO Mapping	No
Value Range	See above
Default Value	1 (No State Change)

Sub-Index	3h
Description	Analog Input Fault (AI1)
Access	RW
PDO Mapping	No

Value Range	See above
Default Value	1 (No State Change)

Sub-Index	4h
Description	Digital Output Fault (not used)
Access	RW
PDO Mapping	No
Value Range	See above
Default Value	1 (No State Change)

Sub-Index	5h
Description	Analog Output Fault (AO1)
Access	RW
PDO Mapping	No
Value Range	See above
Default Value	1 (No State Change)

3.1.14. RPDO Behaviour

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

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

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

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

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

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

The CAN-1O Controller can support up to four RPDO messages. All RPDOs on the CAN-1O Controller use the similar default communication parameters, with the PDO IDs set according to the pre-defined connection set described in DS-301. Most RPDOs do not exist, there is no RTR allowed, they use 11-bit CAN-IDs (base frame valid) and they are all event-driven. While all four have valid default mappings defined (see below) only RPDO1 is enabled by default (i.e. RPDO exists).

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

Sub-Index	Value	Object
0	1	Number of mapped application objects in PDO
1	0x73000110	Analog Output 1 Process Value
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

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

Sub-Index	Value	Object
0	1	Number of mapped application objects in PDO
1	0x25000110	Extra Received 1 PV (i.e. PID Control Feedback 1 PV)
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

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

Sub-Index	Value	Object
0	4	Number of mapped application objects in PDO
1	0x25000310	Extra Received 3 PV (i.e. Lookup Table 1 X-Axis)
2	0x25000410	Extra Received 4 PV (i.e. Lookup Table 2 X-Axis)
3	0x25000510	Extra Received 5 PV (i.e. Lookup Table 3 X-Axis)
4	0x25000610	Extra Received 6 PV (i.e. Lookup Table 4 X-Axis)

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

Sub-Index	Value	Object
0	1	Number of mapped application objects in PDO
1	0x62200108	Digital Output 1 Write State 1 Output Line
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

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

Object Description

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

Entry Description

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

			X	RPDOx ID
Sub-Index	1h			
Description	COB-ID used by RPDO			
Access	RW		X	RPDOx ID
PDO Mapping	No		1	0200h
Value Range	See value definition in DS-301		2	0300h
Default Value	40000000h + RPDO1 + Node ID		3	0400h
	C0000000h + RPDOx + Node-ID		4	0500h

Node-ID = Node-ID of the module. The RPDO COB-IDs are automatically updated if the Node-ID is changed by LSS protocol.

80000000h in the COB-ID indicates that the PDO does not exist (destroyed)

04000000h in the COB-ID indicates that there is no RTR allowed on the PDO

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

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

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

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

Recall: A non-zero event timer for an RPDO means that it will result in a network fault

3.1.15. TPDO Behaviour

The CAN-1O Controller can support up to four TPDO messages. All TPDOs use the similar default communication parameters, with the PDO IDs set according to the pre-defined connection set described in DS-301. Most TPDOs do not exist, there is no RTR allowed, they use 11-bit CAN-IDs (base frame valid) and they are all time-driven. While all four have valid default mappings defined (see below) only TPDO1 is enabled by default (i.e. TPDO exists).

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

Sub-Index	Value	Object
0	1	Number of mapped application objects in PDO
1	0x23700110	Analog Output 1 Feedback Field Value
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

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

Sub-Index	Value	Object
0	1	Number of mapped application objects in PDO
1	0x73300110	Analog Output 1 Field Value
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

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

Sub-Index	Value	Object
0	1	Number of mapped application objects in PDO
1	0x24600110	PID Control Output 1 Field Value
2	0	Not used by default
3	0	Not used by default
4	0	Not used by default

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

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

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

Object Description

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

Entry Description

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

Sub-Index	1h		X	TPDOx ID
Description	COB-ID used by TPDO			
Access	RW		1	0180h
PDO Mapping	No		2	0280h
Value Range	See value definition in DS-301		3	0380h
Default Value	40000000h + TPDO1 + Node-ID		4	0480h
	C0000000h + TPDOx + Node-ID			

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

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

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

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

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

3.2. APPLICATION OBJECTS (DS-404)

Index (hex)	Object	Object Type	Data Type	Access	PDO Mapping
6220	DO Write State 1 Output Line	ARRAY	BOOLEAN	RW	Yes
6240	DO Polarity 1 Output Line	ARRAY	UNSIGNED8	RW	No
6250	DO Fault Mode 1 Output Line	ARRAY	UNSIGNED8	RW	No
6260	DO Fault State 1 Output Line	ARRAY	BOOLEAN	RW	No
7300	AO Output Process Value	ARRAY	INTEGER16	RW	Yes
6302	AO Decimal Digits PV	ARRAY	UNSIGNED8	RW	No
6310	AO Output Type	ARRAY	UNSIGNED16	RW	No
7320	AO Output Scaling 1 PV	ARRAY	INTEGER16	RW	No
7321	AO Output Scaling 1 FV	ARRAY	INTEGER16	RW	No
7322	AO Output Scaling 2 PV	ARRAY	INTEGER16	RW	No
7323	AO Output Scaling 2 FV	ARRAY	INTEGER16	RW	No
7330	AO Output Field Value	ARRAY	INTEGER16	RO	Yes
6332	AO Decimal Digits FV	ARRAY	UNSIGNED8	RW	No
6340	AO Fault Mode	ARRAY	UNSIGNED8	RW	No
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
7458	PID Physical Unit Timing	ARRAY	UNSIGNED32	RO	No
7459	PID Decimal Digits Timing	ARRAY	UNSIGNED8	RW	No

3.2.1. Object 6220h: DO Write State 1 Output Line

This object shall set a single digital output logic state when the corresponding DO is being controlled by a CANopen® Message (per Table 5 in Section 1.2).

Object Description

Index	6220h
Name	DO Write State 1 Output Line
Object Type	ARRAY
Data Type	BOOLEAN

Entry Description

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

Sub-Index	1h
Description	DO Write State
Access	RW
PDO Mapping	Yes
Value Range	0 (OFF) or 1 (ON)
Default Value	0 (OFF)

3.2.2. Object 6240h: DO Polarity 1 Output Line

This object defines the relationship between the logic state and the drive state of a single digital output, as described in Table 1.

Object Description

Index	6240h
Name	DO Polarity 1 Output Line
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	DO Polarity
Access	RW
PDO Mapping	No

Value Range	See Table 1
Default Value	0 (normal on/off)

3.2.3. Object 6250h: DO Fault Mode 1 Output Line

This object defines how a single digital output shall response when a fault condition is detected on any control input, as described in Table 2.

Object Description

Index	6250h
Name	DO Fault Mode 1 Output Line
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	DO Fault Mode
Access	RW
PDO Mapping	No
Value Range	See Table 2
Default Value	1 (apply pre-defined state)

3.2.4. Object 6260h: DO Fault State 1 Output Line

This object defines the pre-defined state of a single digital output when a fault condition is present, and the corresponding sub-index in object 6250h is enabled.

Object Description

Index	6260h
Name	DO Fault State 1 Output Line
Object Type	ARRAY
Data Type	BOOLEAN

Entry Description

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

Sub-Index	1h

Description	DO Fault State
Access	RW
PDO Mapping	No
Value Range	0 (OFF) or 1 (ON)
Default Value	1 (ON)

3.2.5. Object 7300h: AO Output Process Value

This object represents the process value of the output. It can be used as an input to the analog output function block when the input has been selected as controlled by a CANopen® Message (per Table 5 in Section 1.2).

Object Description

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

Entry Description

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

Sub-Index	1h
Description	AO Process Value
Access	RW
PDO Mapping	Yes
Value Range	Integer16
Default Value	No

3.2.6. Object 6302h: AO Decimal Digits PV

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

Object Description

Index	6302h
Name	AO Decimal Digits PV
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No

Value Range	1
Default Value	1

Sub-Index	1h
Description	AO Decimal Digits PV
Access	RW
PDO Mapping	No
Value Range	0 to 4
Default Value	3 [same as analog input: Volt to mV]

3.2.7.   Object 6310h: AO Output Type

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

Object Description

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

Entry Description

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

Sub-Index	1h
Description	AO Type
Access	RW
PDO Mapping	No
Value Range	See Table 3
Default Value	20 (current)

3.2.8.   Object 7320h: AO Output Scaling 1 PV

This object defines the minimum value of the input and should be specified to equal the corresponding scaling object of the control source, as outlined in Table 6. It will be scaled in the physical unit of the control source. The resolution will ALWAYS be dependent on object 6302h AO Decimal Digits PV, even when the output is not being controlled directly by the AO Output PV object 7300h. This object must always be smaller than object 7322h AO Output Scaling 2 PV.

Object Description

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

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

Sub-Index	1h
Description	AO1 Scaling 1 PV
Access	RW
PDO Mapping	No
Value Range	See Table 6
Default Value	300

3.2.9. Object 7321h: AO Output Scaling 1 FV

This object defines the output field value when the input data is at or below the AO Output Scaling 1 PV value as shown in Figure 5. It will be scaled in the physical unit of the output, dependent on type, with the resolution defined in object 6332h AO Decimal Digits FV. The value can be set anywhere within the allowable output range as outlined in Table 6. This value can be set higher than object 7323h AO Output Scaling 2 FV for an inverse response (i.e. decreasing) to an increasing input.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	AO1 Scaling 1 FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 3)
Default Value	300 [mA]

3.2.10. Object 7322h: AO Output Scaling 2 PV

This object defines the maximum value of the input and should be specified to equal the corresponding scaling object of the control source, as outlined in Table 6. It will be scaled in the

physical unit of the control source. The resolution will ALWAYS be dependent on object 6302h AO Decimal Digits PV, even when the output is not being controlled directly by the AO Output PV object 7300h. This object must always be larger than object 7322h AO Output Scaling 2 PV.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	AO1 Scaling 2 PV
Access	RW
PDO Mapping	No
Value Range	See Table 6
Default Value	1500

3.2.11. Object 7323h: AO Output Scaling 2 FV

This object defines the output field value when the input data is at or above the AO Output Scaling 2 PV value as shown in Figure 5. It will be scaled in the physical unit of the output, dependent on type, with the resolution defined in object 6332h AO Decimal Digits FV. The value can be set anywhere within the allowable output range as outlined in Table 3. This value can be set lower than object 7321h AO Output Scaling 1 FV for an inverse response (i.e. decreasing) to an increasing input.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	AO1 Scaling 2 FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 3)
Default Value	1500 [mA]

3.2.12. Object 7330h: AO Output Field Value

This object represents the target output drive field value as a result of the output logic described in Section 1.5, and the scaling applied as shown in Figure 5. It is defined in the physical unit of the output dependent on type, as outlined in Table 3. The resolution of the object is defined in object 6332h AO Decimal Digits FV.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	AO Field Value
Access	RO
PDO Mapping	Yes
Value Range	Integer16
Default Value	No

3.2.13. Object 6332h: AO Decimal Digits FV

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

Object Description

Index	6332h
Name	AO Decimal Digits FV
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported

Access	RO
PDO Mapping	No
Value Range	1
Default Value	1

Sub-Index	1h
Description	AO Decimal Digits FV
Access	RW
PDO Mapping	No
Value Range	0 to 4
Default Value	0 [mA]

3.2.14. Object 6340h: AO Fault Mode

This object defines how an analog output shall response when a fault condition is detected on any control input, as described in Table 13.

Object Description

Index	6340h
Name	AO Fault Mode
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	AO Fault Mode
Access	RW
PDO Mapping	No
Value Range	See Table 13
Default Value	1 (apply pre-defined FV)

3.2.15. Object 7341h: AO Fault FV

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

Object Description

Index	7341h
Name	AO Fault FV
Object Type	ARRAY

Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	AO Fault FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 3)
Default Value	500 [mA]

3.2.16. Object 7450h: PID Proportional Band

This object describes the proportional band gain (G in Figure 8) of the PID algorithm. The value is always interpreted as having a resolution of one digit after the decimal place.

Object Description

Index	7450h
Name	PID Proportional Band
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	PID Proportional Gain
Access	RW
PDO Mapping	No
Value Range	0 to 100 (0 to 10.0)
Default Value	50 [0.5]

3.2.17. Object 7452h: PID Integral Action Time

This object describes the integral time of the PID algorithm. The physical unit is always seconds, as defined in object 6458h, with the decimal digits (resolution) given in object 6459h. To prevent instability, it is recommended to never set this less than three times higher than object 7454h.

Object Description

Index	7452h

Name	PID Integral Action Time
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	PID Integral Time
Access	RW
PDO Mapping	No
Value Range	0.001 [sec] to 1 [sec]
Default Value	5 [ms to 0.005sec]

3.2.18.   Object 7454h: PID Derivative Action Time

This object describes the derivative time of the PID algorithm. The physical unit is always seconds, as defined in object 6458h, with the decimal digits (resolution) given in object 6459h. To prevent instability, it is recommended to never set this more than three times smaller than object 7452h.

Object Description

Index	7454h
Name	PID Derivative Action Time
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	PID Derivative Time
Access	RW
PDO Mapping	No
Value Range	0.001 [sec] to 1 [sec]
Default Value	1 [ms to 0.001sec]

3.2.19.   Object 7456h: PID Cycle Time

This object defines how frequently the PID loop is called. The physical unit is always seconds, as defined in object 6458h, with the decimal digits (resolution) given in object 6459h.

Object Description

Index	7456h
Name	PID Cycle Time
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	PID Cycle Time
Access	RW
PDO Mapping	No
Value Range	0.001 [sec] to 1 [sec]
Default Value	10 [ms to 0.010sec]

3.2.20. Object 6458h: PID Physical Unit Timing

This read-only object defines the physical unit of objects 7452h, 7454h and 7456h. It represents "seconds" as the unit used in all cases.

Object Description

Index	7458h
Name	PID Physical Unit Timing
Object Type	ARRAY
Data Type	UNSIGNED32

Entry Description

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

Sub-Index	1h
Description	PID Physical Unit Timing
Access	RO
PDO Mapping	No
Value Range	0003 0000h
Default Value	0003 0000h (seconds)

3.2.21. Object 6459h: PID Decimal Digits Timing

This object describes the number of digits following the decimal point (i.e. resolution) of the PID timing data, which is interpreted with data type Integer16 in objects 7452h, 7454h and 7456h.

Object Description

Index	6459h
Name	PID Decimal Digits Timing
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	PID Decimal Digits Timing
Access	RW
PDO Mapping	No
Value Range	0 to 4
Default Value	3 [ms]

3.3. MANUFACTURER OBJECTS

Index (hex)	Object	Object Type	Data Type	Access	PDO Mapping
2220	DO Hotshot Current 1 Output Line	ARRAY	INTEGER16	RW	No
2221	DO Hold Current 1 Output Line	ARRAY	INTEGER16	RW	No
2222	DO Hotshot Time 1 Output Line	ARRAY	UNSIGNED16	RW	No
2223	DO Blink Rate 1 Output Line	ARRAY	UNSIGNED16	RW	No
2300	AO Override Field 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
2320	AO Dither Frequency	ARRAY	UNSIGNED16	RW	No
2321	AO Dither Amplitude	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
2342	AO Control Input Response	ARRAY	UNSIGNED8	RW	No
2350	AO Enable Input Source	ARRAY	UNSIGNED8	RW	No
2351	AO Enable Input Number	ARRAY	UNSIGNED8	RW	No
2352	AO Enable Input Response	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 Input Response	ARRAY	UNSIGNED8	RW	No
2370	AO Feedback Field Value	ARRAY	INTEGER16	RO	Yes
2380	AO Output Frequency	ARRAY	UNSIGNED16	RW	No
2381	AO Current Sense Averaging Time	ARRAY	UNSIGNED16	RW	No
2382	AO Current PID Proportional Gain	ARRAY	FLOAT32	RW	No
2382	AO Current PID Integral Time	ARRAY	FLOAT32	RW	No
2382	AO Current PID Derivative Time	ARRAY	FLOAT32	RW	No
2450	PID Tolerance	ARRAY	INTEGER16	RW	No
2451	PID Integral Gain	ARRAY	INTEGER16	RW	No
2452	PID Derivative Gain	ARRAY	INTEGER16	RW	No
2453	PID Target Source	ARRAY	UNSIGNED8	RW	No
2454	PID Target Number	ARRAY	UNSIGNED8	RW	No
2455	PID Feedback Source	ARRAY	UNSIGNED8	RW	No
2456	PID Feedback Number	ARRAY	UNSIGNED8	RW	No
2457	PID Control Response	ARRAY	UNSIGNED8	RW	No
2460	PID Output Field Value	ARRAY	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
2600	Enable Open Circuit Test on Idle	ARRAY	UNSIGNED8	RW	No
2601	Target Stable Timer	VAR	UNSIGNED16	RW	No
2602	Open Circuit Test ON Time	VAR	UNSIGNED16	RW	No
2603	Open Circuit Test OFF Time	VAR	UNSIGNED16	RW	No
2604	Open Circuit Test Current	VAR	UNSIGNED16	RW	No
2605	Open Circuit Threshold Current	VAR	UNSIGNED16	RW	No

2606	Open Circuit Test Counter	VAR	UNSIGNED16	RW	No
30z0	LTz Input X-Axis Source	VAR	UNSIGNED8	RW	No
30z1	LTz Input X-Axis Number	VAR	UNSIGNED8	RW	No
30z2	LTz X-Axis Decimal Digits PV	VAR	UNSIGNED8	RW	No
30z3	LTz Y-Axis Decimal Digits PV	VAR	UNSIGNED8	RW	No
30z4	LTz Point Response	ARRAY	UNSIGNED8	RW	No
30z5	LTz Point X-Axis PV	ARRAY	INTEGER16	RW	No
30z6	LTz Point Y-Axis PV	ARRAY	INTEGER16	RW	No
30z7	LTz Output Y-Axis PV	ARRAY	INTEGER16	RO	Yes
4000	Logic Block Enable	ARRAY	UNSIGNED8	RW	No
4010	Logic Block Selected Table	ARRAY	UNSIGNED8	RW	No
4020	Logic Output Process Value	ARRAY	INTEGER16	RO	Yes
4x01	LBx Lookup Table Number	ARRAY	UNSIGNED8	RW	No
4x02	LBx Function Logical Operator	ARRAY	UNSIGNED8	RW	No
4x11	Logic Block A Function A Condition 1	ARRAY	RECORD	RW	No
4x12	Logic Block A Function A Condition 2	ARRAY	RECORD	RW	No
4x13	Logic Block A Function A Condition 3	ARRAY	RECORD	RW	No
4x21	Logic Block A Function B Condition 1	ARRAY	RECORD	RW	No
4x22	Logic Block A Function B Condition 2	ARRAY	RECORD	RW	No
4x23	Logic Block A Function B Condition 3	ARRAY	RECORD	RW	No
4x31	Logic Block A Function C Condition 1	ARRAY	RECORD	RW	No
4x32	Logic Block A Function C Condition 2	ARRAY	RECORD	RW	No
4x33	Logic Block A Function C Condition 3	ARRAY	RECORD	RW	No
5010	Constant Field Value	ARRAY	FLOAT32	RW	No
5020	Power Supply Field Value	VAR	FLOAT32	RO	Yes
5021	Enable Error Detection on Power Supply	VAR	UNSIGNED8	RW	No
5022	Under Voltage Threshold	VAR	UNSIGNED8	RW	No
5023	Over Voltage Threshold	VAR	UNSIGNED8	RW	No
5024	Hysteresis to Clear Supply Fault	VAR	UNSIGNED8	RW	No
5030	Processor Temperature Field Value	VAR	FLOAT32	RO	Yes
5031	Enable Error Detection on Temperature	VAR	UNSIGNED8	RW	No
5032	Over Temperature Threshold	VAR	UNSIGNED8	RW	No
5033	Hysteresis to Clear Temperature Fault	VAR	UNSIGNED8	RW	No
5555	Start in Operational Mode	VAR	BOOLEAN	RW	No
5B50	Change Baud Rate	VAR	UNSIGNED8	RW	No
5B51	Change Node ID	VAR	UNSIGNED8	RW	No

Where z = 1 to 6 and x = 1 to 2

3.3.1. Object 2220h: DO Hotshot Current 1 Output Line

This object is used to define the hotshot current that will be applied for the hotshot time when an output configured as a digital hotshot is turned ON. See Figure 3 for more information. The physical unit is mA, and it uses the same resolution as the AO Output FV, so object 6332 AO Decimal Digits FV applies.

Object Description

Index	2220h
Name	DO Hotshot Current 1 Output Line
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	DO Hotshot Current
Access	RW
PDO Mapping	Yes
Value Range	2221h (Hold Current) to Imax (3A)
Default Value	2000 [mA]

3.3.2. Object 2221h: DO Hold Current 1 Output Line

This object is used to define the hold current that will be maintained after the hotshot time while an output configured as a digital hotshot is ON. See Figure 3 for more information. The physical unit is mA, and it uses the same resolution as the AO Output FV, so object 6332 AO Decimal Digits FV applies.

Object Description

Index	2221h
Name	DO Hold Current 1 Output Line
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	DO Hold Current
Access	RW
PDO Mapping	Yes
Value Range	0 to 2220h (Hotshot Current)
Default Value	500 [mA]

3.3.3.   Object 2222h: DO Hold Time 1 Output Line

This object is used to define the time that the hotshot current will be applied when an output configured as a digital hotshot is turned ON. See Figure 3 for more information. The physical unit is milliseconds.

Object Description

Index	2222h
Name	DO Hotshot Time 1 Output Line
Object Type	ARRAY
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	DO Hotshot Time
Access	RW
PDO Mapping	Yes
Value Range	0 to 60,000
Default Value	1000 [ms]

3.3.4.   Object 2223h: DO Blink Rate 1 Output Line

This object is used only when an On/Off digital output (does not apply with a digital hotshot) has been specified for a blinking response by object 6240h DO Polarity. While the DO is commanded ON, it will blink on/off at the rate specified in this object. The physical unit is milliseconds.

Object Description

Index	2223h
Name	DO Blink Rate1 Output Line
Object Type	ARRAY
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	DO Blink Rate
Access	RW
PDO Mapping	Yes
Value Range	0 to 60,000
Default Value	500 [ms]

3.3.5. Object 2300h: AO Override Field Value

This object contains the pre-defined field value of an analog output when an override condition is active. It will be scaled in the physical unit of the output, dependent on type, with the resolution defined in object 6332h AO Decimal Digits FV.

Object Description

Index	2300h
Name	AO Override FV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	AO Override FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 3)
Default Value	750 [mA]

3.3.6. Object 2310h: AO Error Detect Enable

This object enables error detection and reaction associated with the analog output function block. When disabled, the input will not generate an EMCY code in object 1003h Pre-Defined Error Field should the control detect an open/short circuit at the load.

Object Description

Index	2310h
Name	AO Error Detect Enable
Object Type	ARRAY
Data Type	BOOLEAN

Entry Description

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

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

3.3.7. Object 2311h: AO Error Clear Hysteresis

This object is used to define the absolute difference that can be tolerated between the target output (as commanded by the control input) and the measured feedback. Any difference outside of the value will flag an open or short circuit fault. It is scaled in the physical unit of the output FV, i.e. object 6332h applies to this object.

Object Description

Index	2311h
Name	AO Error Clear Hysteresis
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	AO Error Clear Hysteresis
Access	RW
PDO Mapping	No
Value Range	0 to 10% of 7321h or 7323h, whichever is larger

Default Value	100 [mA]

3.3.8.   Object 2312h: AO Error Reaction Delay

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

Object Description

Index	2312h
Name	AO Error Reaction Delay
Object Type	ARRAY
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	AO Error Reaction Delay
Access	RW
PDO Mapping	No
Value Range	0 to 60,000
Default Value	1000 [ms]

3.3.9.   Object 2320h: AO Dither Frequency

This object defines the low frequency that is superimposed on the high output frequency (object 2380h) when an AO is configured as a current output. The dither frequency should be selected such that the valve will respond immediately to small changes in current. The physical unit for this object is Hertz.

Object Description

Index	2320h
Name	AO Dither Frequency
Object Type	ARRAY
Data Type	UNSIGNED16

Entry Description

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

Default Value	1

Sub-Index	1h
Description	AO1 Dither Frequency
Access	RW
PDO Mapping	No
Value Range	50 to 400
Default Value	200 [Hz]

3.3.10. Object 2321h: AO Dither Amplitude

This object defines the amplitude of the low frequency signal that is superimposed on the output when an AO is configured as a current output. A zero value in this object disables the dithering feature. Note, the actual dither amplitude will not match exactly what is defined in this object, as it will be dependent on the inductance of the coil. Rather, this object should be adjusted such that the valve will respond immediately to small changes in current. The physical unit for this object is milliamps. Object 6332h does NOT apply.

Object Description

Index	2321h
Name	AO Dither Amplitude
Object Type	ARRAY
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	AO Dither Amplitude
Access	RW
PDO Mapping	No
Value Range	0 to 500
Default Value	0 [mA] (dithering disabled)

3.3.11. Object 2330h: AO Ramp Up

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

Object Description

Index	2330h
Name	AO Ramp Up

Object Type	ARRAY
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	AO Ramp Up
Access	RW
PDO Mapping	No
Value Range	0 to 10,000
Default Value	1000 [ms]

3.3.12. Object 2331h: AO Ramp Down

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

Object Description

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

Entry Description

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

Sub-Index	1h
Description	AO Ramp Down
Access	RW
PDO Mapping	No
Value Range	0 to 10,000
Default Value	1000 [ms]

3.3.13. Object 2340h: AO Control Input Source

This object defines the type of input that will be used to control the analog (or digital) output as shown in the logic flowchart in Figure 6. The available control sources on the CAN-1O controller are listed in Table 4. Not all sources would make sense to control the AO, and it is the user's responsibility to select a source that makes sense for the application.

Object Description

Index	2340h
Name	AO Control Input Source
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	AO Control Input Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	2 (analog input function block)

3.3.14. Object 2341h: AO Control Input Number

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

Object Description

Index	2341h
Name	AO Control Input Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Default Value	1

Sub-Index	1h
Description	AO Control Input Number
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	1 (analog input 1)

3.3.15. Object 2342h: AO Control Response

This object defines the response profile of the analog output FV with respect to the input PV (as selected by objects 2340h/2341h.) Normally it will follow the profile shown in Figure 5. However, in some cases the offset will be disabled (i.e. output at 0) when the PV is below 7320h Scaling 1 PV or alternatively above the 7322h Scaling 2 PV. The options for this object are listed in Table 7.

Object Description

Index	2342h
Name	AO Control Response
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	AO1 Control Response
Access	RW
PDO Mapping	No
Value Range	See Table 7
Default Value	1 (off below scaling 1 PV)

3.3.16. Object 2350h: AO Enable Input Source

This object defines the type of input that will be used to enable/disable the analog (or digital) output as shown in the logic flowchart in Figure 6. The available control sources on the CAN-1O controller are listed in Table 4. Not all sources would make sense to enable the AO, and it is the user's responsibility to select a source that makes sense for the application.

Object Description

Index	2350h
Name	AO Enable Input Source

Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	AO Enable Input Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (control not used)

3.3.17. Object 2351h: AO Enable Input Number

This object defines the number of the source that will be used to enable/disable the analog (or digital) output as shown in the logic flowchart in Figure 6. The available control numbers are dependent on the source selected, as shown in Table 5. Once selected, the control will be interpreted as a digital input.

Object Description

Index	2351h
Name	AO Enable Input Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	AO Enable Input Number
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 (null source selected)

3.3.18. Object 2352h: AO Enable Response

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

Object Description

Index	2352h
Name	AO Enable Response
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	AO Enable Response
Access	RW
PDO Mapping	No
Value Range	See Table 9
Default Value	1 (disable when input on)

3.3.19. Object 2360h: AO Override Input Source

This object defines the type of input that will be used to active the override value for the analog (or digital) output as shown in the logic flowchart in Figure 6. The available control sources on the CAN-1O controller are listed in Table 4. Not all sources would make sense to enable the AO, and it is the user's responsibility to select a source that makes sense for the application.

Object Description

Index	2360h
Name	AO Override Input Source
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	AO Override Input Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (control not used)

3.3.20. Object 2361h: AO Override Input Number

This object defines the number of the source that will be used to override the analog (or digital) output as shown in the logic flowchart in Figure 6. The available control numbers are dependent on the source selected, as shown in Table 5. Once selected, the control will be interpreted as a digital input.

Object Description

Index	2361h
Name	AO Override Input Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	AO Override Input Number
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 (null source selected)

3.3.21. Object 2362h: AO Override Response

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

Object Description

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

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

Sub-Index	1h
Description	AO Override Response
Access	RW
PDO Mapping	No
Value Range	See Table 10
Default Value	0 (override when input on)

3.3.22. Object 2370h: AO Feedback Field Value

This read-only object reflects the actual measured current feedback of an analog output. For other output types (i.e. voltage, PWM or digital,) it will reflect the target Output FV or State (for DO type) based on PV vs. FV calculations (see Figure 5) and applied ramps. It can be mapped to a PDO for diagnostic purposes. It will be scaled in the physical unit of the output, dependent on type, with the resolution defined in object 6332h AO Decimal Digits FV.

Object Description

Index	2370h
Name	AO Feedback FV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	AO Feedback FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 3)
Default Value	No

3.3.23. Object 2380h: AO Output Frequency

This object is meant to be used only with analog output type PWM. It defines the fixed output frequency that will be used, as the duty cycle will be the Output FV. It can be changed with other output types (i.e. current or voltage), but Axiomatic will no longer guarantee the accuracy or responsiveness of the output as the frequency decreases. Very low output frequencies (i.e. <2500Hz) can destabilize the current PID loop. The physical unit for this object is Hertz.

Object Description

Index	2380h
Name	AO Output Frequency
Object Type	ARRAY
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	AO1 Output Frequency
Access	RW
PDO Mapping	No
Value Range	1 to 25,000
Default Value	25000 [Hz]

3.3.24. Object 2381h: AO Current Sensor Averaging Time

This object defines how frequently the current feedback measurement will be taken. The physical unit for this object is milliseconds.

Object Description

Index	2381h
Name	AO Current Sensor Averaging Time
Object Type	ARRAY
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	AO Current Sensor Averaging Time
Access	RW
PDO Mapping	No
Value Range	1 to 1000
Default Value	100 [ms]

3.3.25. Object 2382h: AO Current PID Proportional Gain

This object has been factory calibrated and should be changed with caution. Axiomatic will no longer guarantee the accuracy or responsiveness of the current output when this value is changed. It is provided as a writeable object in case the output frequency is changed, and the user wants to try and optimize the current PID loop. Axiomatic does not recommend this.

Object Description

Index	2382h
Name	AO Current PID Proportional Gain
Object Type	ARRAY
Data Type	FLOAT32

Entry Description

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

Sub-Index	1h
Description	AO Current Sensor Averaging Time
Access	RW
PDO Mapping	No
Value Range	FLOAT32
Default Value	0.8

3.3.26. Object 2383h: AO Current PID Integral Time

This object has been factory calibrated and should be changed with caution. Axiomatic will no longer guarantee the accuracy or responsiveness of the current output when this value is changed. It is provided as a writeable object in case the output frequency is changed, and the user wants to try and optimize the current PID loop. Axiomatic does not recommend this.

Object Description

Index	2383h
Name	AO Current PID Integral Time
Object Type	ARRAY
Data Type	FLOAT32

Entry Description

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

Sub-Index	1h
Description	AO Current PID Integral Time
Access	RW
PDO Mapping	No
Value Range	FLOAT32
Default Value	0.03

3.3.27. Object 2384h: AO Current PID Derivative Time

This object has been factory calibrated and should be changed with caution. Axiomatic will no longer guarantee the accuracy or responsiveness of the current output when this value is changed. It is provided as a writeable object in case the output frequency is changed, and the user wants to try and optimize the current PID loop. Axiomatic does not recommend this.

Object Description

Index	2384h
Name	AO Current PID Derivative Time
Object Type	ARRAY
Data Type	FLOAT32

Entry Description

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

Sub-Index	1h
Description	AO Current PID Derivative Time
Access	RW
PDO Mapping	No
Value Range	FLOAT32
Default Value	0.001

3.3.28. Object 2450h: PID Tolerance

This object defines the allowable absolution difference between the target and the feedback, below which the error will be interpreted as zero (i.e. PID output stops changing). The physical unit for this object is percentage, and the value is always interpreted as having a resolution of one digit after the decimal place.

Object Description

Index	2450h
Name	PID Tolerance
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	PID Tolerance
Access	RW
PDO Mapping	No
Value Range	0 to 100 (0% to 10%)
Default Value	10 [1%]

3.3.29. Object 2451h: PID Integral Gain

This object describes the integral gain of the PID algorithm. The value is always interpreted as having a resolution of one digit after the decimal place.

Object Description

Index	2451h
Name	PID Integral Gain
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	PID Integral Gain
Access	RW
PDO Mapping	No
Value Range	0 to 100
Default Value	10 [1.0]

3.3.30. Object 2452h: PID Derivative Gain

This object describes the derivative gain of the PID algorithm. The value is always interpreted as having a resolution of one digit after the decimal place.

Object Description

Index	2452h
Name	PID Derivative Gain
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	PID Derivative Gain
Access	RW
PDO Mapping	No
Value Range	0 to 100
Default Value	10 [1.0]

3.3.31. Object 2453h: PID Target Source

This object defines the type of input that will be used to determine the target process value for the PID control loop. The available control sources on the CAN-1O controller are listed in Table 4. Not all sources would make sense to use as a PID target source, and it is the user's responsibility to select a source that makes sense for the application. A selection of "Control Source Not Used" disables the associated PID control function block.

Object Description

Index	2453h
Name	PID Target Source
Object Type	ARRAY

Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	PID Target Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (control not used, PID disabled)

3.3.32. Object 2454h: PID Target Number

This object defines the number of the source that will be used as the target PV for the PID control loop. The available control numbers are dependent on the source selected, as shown in Table 5. Once selected, the control will convert the commanded target into a percentage value using the scaling limits of the control source/number as defined in Table 6.

Object Description

Index	2454h
Name	PID Target Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	PID Target Number
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 (null source selected)

3.3.33. Object 2455h: PID Feedback Source

This object defines the type of input that will be used to determine the feedback process value for the PID control loop. The available control sources on the CAN-1O controller are listed in Table 4. Not all sources would make sense to use as a PID feedback source, and it is the user's responsibility to select a source that makes sense for the application. A selection of "Control Source Not Used" disables the associated PID control function block.

Object Description

Index	2455h
Name	PID Feedback Source
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	PID Feedback Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (control not used, PID disabled)

3.3.34. Object 2456h: PID Feedback Number

This object defines the number of the source that will be used as the feedback PV for the PID control loop. The available control numbers are dependent on the source selected, as shown in Table 5. Once selected, the control will convert the measured/received feedback into a percentage value using the scaling limits of the control source/number as defined in Table 6.

Object Description

Index	2456h
Name	PID Feedback Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Default Value	1

Sub-Index	1h
Description	PID Feedback Number
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 (null source selected)

3.3.35. Object 2457h: PID Control Response

This object defines the output profile for the PID control function block in a push-pull dual output system. The options for this object are listed in Table 12.

Object Description

Index	2457h
Name	PID Control Response
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	PID Control Response
Access	RW
PDO Mapping	No
Value Range	See Table 12
Default Value	0 (single output)

3.3.36. Object 2460h: PID Output Field Value

This read-only output contains the PID control function block FV (as a percentage) that can be used as the input source for another function block (i.e. analog output.) It will be a value between 0 to 100% as per the algorithm defined in Figure 4. The physical unit for this object is percentage, and the value is always interpreted as having a resolution of one digit after the decimal place.

Object Description

Index	2460h
Name	PID Output FV
Object Type	ARRAY
Data Type	INTEGER16

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

Sub-Index	1h
Description	PID Output FV
Access	RO
PDO Mapping	Yes
Value Range	0 to 1000 (0 to 100%)
Default Value	No

3.3.37. Object 2500h: EC Extra Received Process Value

This object provides an extra control source in order to allow other function blocks to be controlled by data received from a CANopen® RPDO. It functions similarly to any other writeable, mappable PV object, such as 7300h AO Output PV.

Object Description

Index	2500h
Name	EC Extra Received PV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	6
Default Value	6

Sub-Index	1h to 6h (x = 1 to 6)
Description	ECx Received PV
Access	RW
PDO Mapping	Yes
Value Range	Integer16
Default Value	No

3.3.38. Object 2502h: EC Decimal Digits PV

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

Object Description

Index	2502h
Name	EC Decimal Digits PV
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	6
Default Value	6

Sub-Index	1h to 6h (x = 1 to 6)
Description	ECx Decimal Digits PV
Access	RW
PDO Mapping	No
Value Range	0 to 4
Default Value	1 (0.1 resolution)

3.3.39. Object 2520h: EC Scaling 1 PV

This object defines the minimum value of the extra control source. It used as the Scaling 1 value by other functions blocks when the EC has been selected as the source for the X-Axis data, i.e. as seen in Figure 5. There is no physical unit associate with the data, but it uses the same resolution as the received PV as defined in object 2502h, EC Decimal Digits PV. This object must always be smaller than object 2522h EC Scaling 2 PV.

Object Description

Index	2520h
Name	EC Scaling 1 PV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	6
Default Value	6

Sub-Index	1h to 6h (x = 1 to 6)
Description	ECx Scaling 1 PV
Access	RW
PDO Mapping	No
Value Range	-32768 to 2522h sub-index X
Default Value	0

3.3.40. Object 2522h: EC Scaling 2 PV

This object defines the maximum value of the extra control source. It used as the Scaling 2 value by other functions blocks when the EC has been selected as the source for the X-Axis data, i.e. as seen in Figure 5. There is no physical unit associate with the data, but it uses the same resolution as the received PV as defined in object 2502h, EC Decimal Digits PV. This object must always be larger than object 2520h EC Scaling 1 PV.

Object Description

Index	2522h
Name	EC Scaling 2 PV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	6
Default Value	6

Sub-Index	1h to 6h (x = 1 to 6)
Description	ECx Scaling 2 PV
Access	RW
PDO Mapping	No
Value Range	2520h sub-index X to 32767
Default Value	1000 (100.0)

3.3.41. Object 2600h: Enable Open Circuit Test on Idle

This object determines if the controller runs open-circuit tests when the output(s) are idle. For more details on this object please refer to Section 1.2.2.

Object Description

Index	2600h
Name	Enable Open Circuit Test on Idle
Object Type	ARRAY
Data Type	UNSIGNED8

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

Sub-Index	1h
Description	Enable Open Circuit Test on Idle
Access	RW
PDO Mapping	No
Value Range	FALSE; TRUE
Default Value	FALSE (0)

3.3.42. Object 2601h: Target Stable Timer

This object defines the settling time for feedback current measurements. This is useful for instances where the target current is continually changing to avoid false open circuit flags. For more details on this object please refer to Section 1.2.1.

Object Description

Index	2601h
Name	Target Stable Timer
Object Type	VAR
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	Target Stable Timer
Access	RW
PDO Mapping	No
Value Range	1-1000 (ms)
Default Value	500 (ms)

3.3.43. Object 2602h: Open Circuit Test ON Time

This object defines the duration of time that the controller will engage an open-circuit-test-enabled output to check for open circuit conditions. This object together with object 2603h create the period at which the open circuit test will be performed. For more details on this object please refer to Section 1.2.2.

Object Description

Index	2602h (Shared between outputs)
Name	Open Circuit Test ON Time
Object Type	VAR
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	Open Circuit Test ON Time
Access	RW
PDO Mapping	No
Value Range	1-1000 (ms)
Default Value	50 (ms)

3.3.44. Object 2603h: Open Circuit Test OFF Time

This object defines the duration of time that the controller will disengage an open-circuit-test-enabled output after the ON (object 2602h) has finished. This object together with object 2602h create the period at which the open circuit test will be performed. For more details on this object please refer to Section 1.2.2.

Object Description

Index	2603h (Shared between outputs)
Name	Open Circuit Test OFF Time
Object Type	VAR
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	Open Circuit Test OFF Time
Access	RW
PDO Mapping	No
Value Range	1-1000 (ms)

Default Value	600 (ms)

3.3.45. Object 2604h: Open Circuit Test Current

This object defines the amplitude of the current signal used to perform the open circuit test during the ON time (object 2602h). For more details on this object please refer to Section 1.2.2.

Object Description

Index	2604h (Shared between outputs)
Name	Open Circuit Test Current
Object Type	VAR
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	Open Circuit Test Current
Access	RW
PDO Mapping	No
Value Range	1-200 (mA)
Default Value	100 (mA)

3.3.46. Object 2605h: Open Circuit Threshold Current

This object defines the feedback current measurement value of the open circuit test that determines whether there is in fact an open circuit. For more details on this object please refer to Section 1.2.2.

Object Description

Index	2605h (Shared between outputs)
Name	Open Circuit Threshold Current
Object Type	VAR
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	Open Circuit Threshold Current
Access	RW
PDO Mapping	No
Value Range	1-200 (mA)
Default Value	15 (mA)

3.3.47. Object 30z0h: LTz Input X-Axis Source

This object defines the type of input that will be used to determine the X-Axis input process value for the lookup table function. The available control sources on the CAN-1O controller are listed in Table 4. Not all sources would make sense to use as an X-Axis input, and it is the user's responsibility to select a source that makes sense for the application. A selection of "Control Source Not Used" disables the associated lookup table function block.

Object Description

Index	30z0h (where z = 1 to 6)
Name	LTz Input X-Axis Source
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (control not used, PID disabled)

3.3.48. Object 30z1h: LTz Input X-Axis Number

This object defines the number of the source that will be used as the X-Axis input PV for the lookup table function. The available control numbers are dependent on the source selected, as shown in Table 5. Once selected, the limits for the points on the X-Axis will be constrained by the scaling objects of the control source/number as defined in Table 6.

Object Description

Index	30z1h (where z = 1 to 6)
Name	LTz Input X-Axis Number
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 (null control source)

3.3.49. Object 30z2h: LTz X-Axis Decimal Digits PV

This object describes the number of digits following the decimal point (i.e. resolution) of the X-Axis input data and the points in the lookup table. It should be set equal to the decimal digits used by the PV from the control source/number as defined in Table 6.

Object Description

Index	30z2h (where z = 1 to 6)
Name	LTz X-Axis Decimal Digits PV
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	0 to 4 (see Table 6)
Default Value	0

3.3.50. Object 30z3h: LTz Y-Axis Decimal Digits PV

This object describes the number of digits following the decimal point (i.e. resolution) of the Y-Axis points in the lookup table. When the Y-Axis output is going to be the input to another function block (i.e. an analog output), it is recommended that this value be set equal to the decimal digits used by the block that is using the lookup table as the control source/number.

Object Description

Index	30z3h (where z = 1 to 6)
Name	LTz Y-Axis Decimal Digits PV
Object Type	VARIABLE
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	0 to 4
Default Value	0

3.3.51. Object 30z4h: LTz Point Response

This object determines the Y-Axis output response to changes in the X-Axis input. The value set in sub-index 1 determines the X-Axis type (i.e. data or time), while all other sub-indexes determine the response (ramp, step, ignore) between two points on the curve. The options for this object are listed in Table 13. See Figure 10 for an example of the difference between a step and ramp response.

Object Description

Index	30z4h (where z = 1 to 6)
Name	LTz Point Response
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	11
Default Value	11

Sub-Index	1h
Description	X-Axis Type
Access	RW
PDO Mapping	No
Value Range	See Table 13 (0 or 1)
Default Value	0 (x-axis data response)

Sub-Index	2h to 11h (x = 2 to 11)
Description	LTz Point X Response
Access	RW
PDO Mapping	No
Value Range	See Table 13 (0, 1 or 2)
Default Value	1 (ramp to response)

3.3.52. Object 30z5h: LTz Point X-Axis PV

This object defines the X-Axis data for the 11 calibration points on the lookup table, resulting in 10 different output slopes.

When a data response is selected for the X-Axis type (sub-index 1 of object 30z4), this object is constrained such that X1 cannot be less than the Scaling 1 value of the selected control source/number, and X11 cannot be more than the Scaling 2 value. The rest of the points are constrained by the formula below. The physical unit associate with the data will be that of the selected input, and it will use the resolution defined in object 30z2h, LTz X-Axis Decimal Digits PV.

$MinInputRange <= X_1 <= X_2 <= X_3 <= X_4 <= X_5 <= X_6 <= X_7 <= X_8 <= X_9 <= X_{10} <= X_{11} <= MaxInputRange$

When a time response has been selected, each point on the X-Axis can be set anywhere from 1 to 86,400,000ms.

Object Description

Index	30z5h (where z = 1 to 6)
Name	LTz Point X-Axis PV
Object Type	ARRAY
Data Type	INTEGER32

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	11
Default Value	11

Sub-Index	1h to 11h (x = 1 to 11)	
Description	LTz Point X-Axis PVx	
Access	RW	
PDO Mapping	No	
Value Range	See above (data)	1 to 86400000 (time)
Default Value	10*(x-1)	No

3.3.53. Object 30z6h: LTz Point Y-Axis PV

This object defines the Y-Axis data for the 11 calibration points on the lookup table, resulting in 10 different output slopes. The data is unconstrained and has no physical unit associate with it. It will use the resolution defined in object 30z3h, LTz Y-Axis Decimal Digits PV.

Object Description

Index	30z6h (where z = 1 to 6)
Name	LTz Point Y-Axis PV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	11
Default Value	11

Sub-Index	1h to 11h (x = 1 to 11)
Description	LTz Point Y-Axis PVx
Access	RW
PDO Mapping	No
Value Range	Integer16
Default Value	10*(x-1) [i.e. 0, 10, 20, 30, … 100]

3.3.54. Object 30z7h: LTz Output Y-Axis PV

This read-only object contains the lookup table function block PV that can be used as the input source for another function block (i.e. analog output.) The physical unit for this object is undefined, and it will use the resolution defined in object 30z3h, LTz Y-Axis Decimal Digits PV.

Object Description

Index	30z7h (where z = 1 to 6)
Name	LTz Output Y-Axis PV
Object Type	VARIABLE
Data Type	INTEGER16

Entry Description

Sub-Index	0h
Access	RO
PDO Mapping	Yes
Value Range	Integer16
Default Value	No

3.3.55. Object 4000h: Logic Block Enable

This object defines whether or not the logic shown in Figure 14 will be evaluated.

Object Description

Index	4000h
Name	Logic Block Enable
Object Type	ARRAY
Data Type	BOOLEAN

Entry Description

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

Sub-Index	1h to 2h (x = 1 to 2)
Description	LBx Enable
Access	RW
PDO Mapping	No
Value Range	0 (FALSE) or 1 (TRUE)
Default Value	0 [FALSE]

3.3.56. Object 4010h: Logic Block Selected Table

This read-only object reflects what table has been selected as the output source for the logic block after the evaluation shown in Figure 14 has been performed.

Object Description

Index	4010h
Name	Logic Block Selected Table
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h to 2h (x = 1 to 2)
Description	LBx Selected Table
Access	RO
PDO Mapping	Yes
Value Range	1 to 6
Default Value	No

3.3.57. Object 4020h: Logic Block Output PV

This read-only object reflects the output from the selected table, interpreted as a percentage. The limits for the percentage conversion are based on the range of the lookup tables Y-Axis Output PV as shown in Table 6.

Object Description

Index	4020h
Name	Logic Block Output PV
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h to 2h (x = 1 to 2)
Description	LBx Output PV
Access	RO
PDO Mapping	Yes

Value Range	Dependent on Selected Table
Default Value	No

3.3.58. Object 4x01h: LBx Lookup Table Numbers

This object determines which of the six lookup tables supports on the CAN-1O are associated with a particular function within the given logic block. Up to three tables can be linked to each logic function.

Object Description

Index	4x01h (where x = 1 to 2)
Name	LBx Lookup Table Numbers
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	3
Default Value	3

Sub-Index	1h to 3h (y = A to C)
Description	LBx Lookup Table Y Number
Access	RW
PDO Mapping	No
Value Range	1 to 6
Default Value	See Table 19

3.3.59. Object 4x02h: LBx Function Logical Operator

This object determines how the results of the three conditions for each function are to be compared to one another to determine the overall state of the function output. There are up to three functions that can be evaluated in each logic block. The options for this object are defined in Table 17. See Section 1.5 for more information about how this object is used.

Object Description

Index	4x02h (where x = 1 to 2)
Name	LBx Function Logical Operator
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No

Value Range	3
Default Value	3

Sub-Index	1h to 3h (y = A to C)
Description	LBx Function Y Logical Operator
Access	RW
PDO Mapping	No
Value Range	See Table 17
Default Value	Function A = 1 (and all) Function B = 1 (and all) Function C = 0 (default)

3.3.60. Object 4x11h: LBx Function A Condition 1
3.3.61. Object 4x12h: LBx Function A Condition 2
3.3.62. Object 4x13h: LBx Function A Condition 3
3.3.63. Object 4x21h: LBx Function B Condition 1
3.3.64. Object 4x22h: LBx Function B Condition 2
3.3.65. Object 4x23h: LBx Function B Condition 3
3.3.66. Object 4x31h: LBx Function C Condition 1
3.3.67. Object 4x32h: LBx Function C Condition 2
3.3.68. Object 4x33h: LBx Function C Condition 3

These objects, 4xyzh, represent Logic Block z, Function y, Condition z, where x = 1 to 2, y = A to C, and z = 1 to 3. All of these objects are a special type of record, defined in Table 14. Information on how to use these objects is defined in Section 1.5.

Object Description

Index	4xyzh
Name	LBx Function y Condition z
Object Type	RECORD
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	Argument 1 Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	1 (CANopen® Message)

Sub-Index	2h
Description	Argument 1 Number

Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	3 (EC Received PV 1)

Sub-Index	3h
Description	Argument 2 Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	3 (Constant PV)

Sub-Index	4h
Description	Argument 2 Number
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	3 (Constant FV 3)

Sub-Index	5h
Description	Operator
Access	RW
PDO Mapping	No
Value Range	See Table 15
Default Value	0 (Equals)

3.3.69. Object 5010h: Constant Field Value

This object is provided to allow the user to compare against a fixed value, i.e. for setpoint control in a PID loop, or in a conditional evaluation for a logic block. The first two values in this object are fixed at FALSE (0) and TRUE (1). There are four other sub-indexes provide for other unconstrained data.

Object Description

Index	5010h
Name	Constant Field Value
Object Type	ARRAY
Data Type	FLOAT32

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	6
Default Value	6

Sub-Index	1h

Description	Constant False
Access	RO
PDO Mapping	No
Value Range	0
Default Value	0 (false)

Sub-Index	2h
Description	Constant True
Access	RO
PDO Mapping	No
Value Range	1
Default Value	1 (true)

Sub-Index	3h
Description	Constant FV 3
Access	RW
PDO Mapping	No
Value Range	Float32
Default Value	25.0

Sub-Index	4h
Description	Constant FV 4
Access	RW
PDO Mapping	No
Value Range	Float32
Default Value	50.0

Sub-Index	5h
Description	Constant FV 5
Access	RW
PDO Mapping	No
Value Range	Float32
Default Value	75.0

Sub-Index	6h
Description	Constant FV 6
Access	RW
PDO Mapping	No
Value Range	Float32
Default Value	100.0

3.3.70. Object 5020h: Power Supply Field Value

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

Object Description

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

Entry Description

Sub-Index	0h
Access	RO
PDO Mapping	Yes
Value Range	0 to 35 [V]
Default Value	No

3.3.71. Object 5021h: Enable Error Detection on Power Supply

This write-able object is available to enable faults on power supply measured in the system. When this object is enabled, objects 5022h-5024h are used to determine fault triggers and fault clear thresholds. For more information please refer to Section 1.6.1.

Object Description

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

Entry Description

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

3.3.72. Object 5022h: Under Voltage Threshold

This object is used to set the value at which a supply fault will trigger if the measured supply falls below it. If object 5021h is disabled, this value is ignored. For more information please refer to Section 1.6.1.

Object Description

Index	5022h
Name	Under Voltage Threshold
Object Type	VARIABLE

Data Type	UNSIGNED8

Entry Description

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

3.3.73. Object 5023h: Over Voltage Threshold

This object is used to set the value at which a supply fault will trigger if the measured supply falls above it. If object 5021h is disabled, this value is ignored. For more information please refer to Section 1.6.1.

Object Description

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

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	Object 522h… 36V
Default Value	35 (V)

3.3.74. Object 5024h: Hysteresis to Clear Supply Fault

This object is used to set the value by which the supply voltage needs to increase or decrease to clear the fault set by an under voltage or over voltage, respectively. If object 5021h is disabled, this value is ignored. For more information please refer to Section 1.6.1.

Object Description

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

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	1V…30V
Default Value	5 (V)

3.3.75. Object 5030h: Processor Temperature Field Value

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

Object Description

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

Entry Description

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

3.3.76. Object 5031h: Enable Error Detection on Temperature

This write-able object is available to enable faults on temperature measured in the system. When this object is enabled, objects 5032h-5033h are used to determine fault triggers and fault clear thresholds. For more information please refer to Section 1.6.1.

Object Description

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

Entry Description

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

3.3.77. Object 5032h: Over Temperature Threshold

This object is used to set the value at which a temperature fault will trigger if the measured microcontroller temperature falls above it. If object 5031h is disabled, this value is ignored. For more information please refer to Section 1.6.1.

Object Description

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

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	0…150 (DegC)
Default Value	85 (DegC)

3.3.78. Object 5033: Hysteresis to Clear Temperature Fault

This object is used to set the value by which the temperature needs to decrease to clear the fault set by an over temperature event. If object 5031h is disabled, this value is ignored. For more information please refer to Section 1.6.1.

Object Description

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

Entry Description

Sub-Index	0h
Access	RW
PDO Mapping	No
Value Range	0…150 (DegC)
Default Value	25 (DegC)

3.3.79. Object 5555h: Start in Operational Mode

This object allows the unit to start in Operational mode without requiring the presence of a CANopen® Master on the network. It is intended to be used only when running the CAN-1O controller as a stand-alone module. This should always be set FALSE whenever it is connected to a standard master/slave network.

Object Description

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

Entry Description

Sub-Index	0h

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

3.3.80. Object 5B50h: Change Baud Rate

The CAN-1O Controller could be configured to different baud rates by changing the value in this object. The options for this object are defined in Table 21.

Object Description

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

Entry Description

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

3.3.81. Object 5B51h: Change Node ID

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

Object Description

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

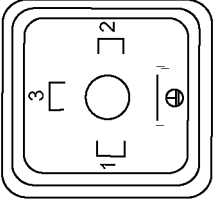*Entry Description*

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

4. TECHNICAL SPECIFICATIONS

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/.

Technical Specifications:

Power Supply Input - Nominal	12Vdc or 24Vdc nominal (9…36 VDC power supply range)
Protection	Reverse polarity protection is provided. Overvoltage protection is provided.
CAN port	Model AX021101: 1 CANopen®
Range of maximum output current	Up to 2.5 A Minimum and maximum current are user adjustable. Overcurrent protection Short circuit protection in hardware 1mA resolution, accuracy +/-2% error
Output types	User configurable output types, including: • Proportional Current • Hotshot Current • PWM • Proportional Voltage • Digital ON/OFF
Solenoid resistance selection (nominal)	Nominal resistance of solenoid coil should comply with: Rcoil ≤ (Vpower supply - 1.5 V)/I-max.
Current Ramp Ttime	User configurable 0-10 sec. independent
Dither Amplitude Current Dither Frequency	User configurable 0 to 10% of rated maximum current 50 to 400 Hz (+/-10% of full scale)
Microprocessor	STM32F413CGUx 32-bit, 1024 Kbit program flash
Quiescent Current	23 mA @ 12Vdc 14 mA @ 24Vdc Typical
Control Logic	User programmable functionality. Refer to User Manual UMAX021101.
User Interface	EDS File Standard CANopen® tools
Software Flashing	Not supported
Operating Conditions	-40 to 85 °C (-40 to 185 °F)
Protection	IP67 when correctly installed with lid, o-ring/washer and base gasket
Weight	0.15 lb. (0.068 kg)
Approvals	CE marking
Vibration (Pending)	MIL-STD-202G, Method 204D test condition C (Sine) and Method 214A, test condition B (Random) 10 g peak (Sine) 7.68 Grms peak (Random)
Shock (Pending)	MIL- STD-202G, Method 213B, test condition A 50g (half sine pulse, 9ms long, 8 per axis)
Enclosure	Hirschmann GDME 2011 black housing (PA material, 94 V1), central screw M3 x 40, transparent cover, washer and o-ring, nitrile rubber gasket DIN 43650-A contact arrangement with 18 mm spacing (plug-style to mount on valve) Contacts: Sn, PA, 94V1 Approvals: VDE, SEV, GL Refer to the dimensional drawing.

Electrical Connections	One M12 5-position, A-coded Connector, Binder P/n: 09 0437 87 05 1 Power + 2 Power - 3 CAN L 4 CAN H 5 CAN SH DIN 43650A connection to solenoid: NOTE: The EARTH pin (or GND) on the DIN43650A plug is not connected in the AX021101. So, the Input Signal shield wire should be drained at the equipment end. PIN 2 is Solenoid - PIN 3 is Not Used. The Earth GND is not connected. The input signal shield wire should be drained at the equipment end. PIN 1 is Solenoid +
Mating Wire Harness	Ordering p/n AX070139 5 pin A coded female straight plug, M12 2 m unterminated jacketed wire harness

5. VERSION HISTORY

User Manual Version	Date	Author	Modifications
1	Dec 18th, 2018	Jessica Chen	Initial Draft
-	May 31, 2019	Amanda Wilkins	Updated pinout
1.1	August 8, 2023	Kiril Mojsov	Performed Legacy Updates

OUR PRODUCTS

AC/DC Power Supplies

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DC/DC Power Converters

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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.

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