



USER MANUAL UMAX030541
Version V1.2

CAN TO 4 ANALOG OUTPUTS CONTROLLER

With CANopen®

USER MANUAL

P/N: AX030541

ACRONYMS

| | |
|----------|--|
| AO | Analog Output |
| 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 |
| D.C. | Duty Cycle |
| EDS | Electronic Data Sheet |
| EMCY | Emergency |
| LSB | Least Significant Byte (or Bit) |
| LSS | Layer Settling Service |
| LUT | Lookup Table |
| MSB | Most Significant Byte (or Bit) |
| NMT | Network Management |
| RO | Read Only Object |
| RPDO | Received Process Data Object |
| RW | Read/Write Object |
| SDO | Service Data Object |
| TPDO | Transmitted Process Data Object |
| WO | Write Only Object |

REFERENCES

- [DS-301] CiA DS-301 V4.1 – CANopen® Application Layer and Communication Profile. CAN in Automation 2005
- [DS-305] CiA DS-305 V2.0 – Layer Setting Service (LSS) and Protocols. CAN in Automation 2006
- [DS-401] CiA DS-404 V1.2 – CANopen® profile for Measurement Devices and Closed Loop Controllers. CAN in Automation 2002

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Contents

| | |
|---|-----------|
| 1. OVERVIEW OF CONTROLLER | 6 |
| 1.1. DESCRIPTION OF THE CONTROLLER | 6 |
| 1.2. DIGITAL OUTPUT FUNCTION BLOCK | 7 |
| 1.3. ANALOG OUTPUT FUNCTION BLOCK | 9 |
| 1.4. LOOKUP TABLE FUNCTION BLOCK | 17 |
| 1.4.1 X-Axis, Input Data Response | 18 |
| 1.4.2 Y-Axis, Lookup Table Output | 18 |
| 1.4.3 Point to Point Response | 19 |
| 1.4.4 X-Axis, Time Response | 20 |
| 1.5. PROGRAMMABLE LOGIC FUNCTION BLOCK | 22 |
| 1.5.1 Conditions Evaluation | 25 |
| 1.5.2 Table Selection | 26 |
| 1.5.3 Logic Block Output | 28 |
| 1.6. MATH FUNCTION BLOCK | 29 |
| 1.7. MISCELLANEOUS FUNCTION BLOCK | 32 |
| 2. INSTALLING INSTRUCTIONS | 35 |
| 2.1. DIMENSIONS AND PINOUT | 35 |
| 2.2. INSTALLATION INSTRUCTIONS | 36 |
| 3. CANOPEN® OBJECT DICTIONARY | 37 |
| 3.1. NODE ID AND BAUDRATE | 37 |
| 3.1.1 LSS Protocol to Update | 37 |
| 3.2. COMMUNICATION OBJECTS (DS-301 AND DS-404) | 42 |
| 3.2.1 Object 1000h: Device Type | 43 |
| 3.2.2 Object 1001h: Error Register | 43 |
| 3.2.3 Object 1002h: Manufacturer Status Register | 44 |
| 3.2.4 Object 1003h: Pre-Defined Error Field | 44 |
| 3.2.5 Object 100Ch: Guard Time | 46 |
| 3.2.6 Object 100Dh: Life Time Factor | 46 |
| 3.2.7 Object 1010h: Store Parameters | 47 |
| 3.2.8 Object 1011h: Restore Parameters | 48 |
| 3.2.9 Object 1016h: Consumer Heartbeat Time | 50 |
| 3.2.10 Object 1017h: Producer Heartbeat Time | 50 |
| 3.2.11 Object 1018h: Identity Object | 51 |
| 3.2.12 Object 1020h: Verify Configuration | 52 |
| 3.2.13 Object 1029h: Error Behaviour | 53 |
| 3.2.14 RPDO Behaviour | 54 |
| 3.2.15 TPDO Behaviour | 57 |
| 3.3. APPLICATION OBJECTS (DS-404) | 60 |
| 3.3.1 Object 6220h: DO Write State 1 Output Line | 61 |
| 3.3.2 Object 6250h: DO Fault Mode 1 Output Line | 61 |
| 3.3.3 Object 6260h: DO Fault State 1 Output Line | 62 |
| 3.3.4 Object 6302h: AO Decimal Digits PV | 62 |
| 3.3.5 Object 6310h: AO Output Type | 63 |
| 3.3.6 Object 6332h: AO Decimal Digits FV | 63 |
| 3.3.7 Object 6340h: AO Fault Mode | 64 |
| 3.3.8 Object 7300h: AO Output Process Value | 65 |
| 3.3.9 Object 7320h: AO Output Scaling 1 PV | 65 |
| 3.3.10 Object 7321h: AO Output Scaling 1 FV | 66 |
| 3.3.11 Object 7322h: AO Output Scaling 2 PV | 67 |
| 3.3.12 Object 7323h: AO Output Scaling 2 FV | 67 |
| 3.3.13 Object 7330h: AO Output Field Value | 68 |
| 3.3.14 Object 7341h: AO Fault Field Value | 69 |
| 3.4. MANUFACTURER OBJECTS | 70 |
| 3.4.1 Object 2223h: DO Blink Rate 1 Output Line | 73 |

| | | |
|--------|---|-----|
| 3.4.2 | Object 2240h: DO Digital Range..... | 73 |
| 3.4.3 | Object 2241h: DO Polarity 1 Output Line..... | 74 |
| 3.4.4 | Object 2300h: AO Override Field Value | 74 |
| 3.4.5 | Object 2330h: AO Ramp Up | 75 |
| 3.4.6 | Object 2331h: AO Ramp Down | 76 |
| 3.4.7 | Object 2340h: AO Control Input Source..... | 76 |
| 3.4.8 | Object 2341h: AO Control Input Number | 77 |
| 3.4.9 | Object 2342h: AO Control Response..... | 78 |
| 3.4.10 | Object 2350h: AO Enable Input Source | 78 |
| 3.4.11 | Object 2351h: AO Enable Input Number..... | 79 |
| 3.4.12 | Object 2352h: AO Enable Response | 80 |
| 3.4.13 | Object 2360h: AO Override Input Source..... | 80 |
| 3.4.14 | Object 2361h: AO Override Input Number | 81 |
| 3.4.15 | Object 2362h: AO Override Response..... | 82 |
| 3.4.16 | Object 2370h: AO Feedback Field Value | 82 |
| 3.4.17 | Object 2380h: AO Output Frequency..... | 83 |
| 3.4.18 | Object 2500h: EC Extra Received Process Value | 83 |
| 3.4.19 | Object 2502h: EC Decimal Digits PV | 84 |
| 3.4.20 | Object 2520h: EC Scaling 1 PV..... | 84 |
| 3.4.21 | Object 2522h: EC Scaling 2 PV..... | 85 |
| 3.4.22 | Object 3yz0h: LTyz Input X-Axis Source..... | 86 |
| 3.4.23 | Object 3yz1h: LTyz Input X-Axis Number | 86 |
| 3.4.24 | Object 3yz2h: LTyz Auto Repeat..... | 87 |
| 3.4.25 | Object 3yz3h: LTyz X-Axis Decimal Digits PV | 87 |
| 3.4.26 | Object 3yz4h: LTyz Y-Axis Decimal Digits PV | 88 |
| 3.4.27 | Object 3yz5h: LTyz Point Response | 88 |
| 3.4.28 | Object 3yz6h: LTyz Point X-Axis PV | 89 |
| 3.4.29 | Object 3yz7h: LTyz Point Y-Axis PV..... | 90 |
| 3.4.30 | Object 3yz8h: LTyz Output Y-Axis PV | 90 |
| 3.4.31 | Object 3300h: Logic Block Enable | 91 |
| 3.4.32 | Object 3310h: Logic Block Selected Table..... | 91 |
| 3.4.33 | Object 3320h: Logic Block Output PV..... | 92 |
| 3.4.34 | Object 3x01h: LB(x-3) Lookup Table Numbers | 93 |
| 3.4.35 | Object 3x02h: LB(x-3) Function Logical Operator | 93 |
| 3.4.36 | Object 3x11h: LB(x-3) Function A Condition 1 | 94 |
| 3.4.37 | Object 3x12h: LB(x-3) Function A Condition 2 | 94 |
| 3.4.38 | Object 3x13h: LB(x-3) Function A Condition 3 | 94 |
| 3.4.39 | Object 3x21h: LB(x-3) Function B Condition 1 | 94 |
| 3.4.40 | Object 3x22h: LB(x-3) Function B Condition 2 | 94 |
| 3.4.41 | Object 3x23h: LB(x-3) Function B Condition 3 | 94 |
| 3.4.42 | Object 3x31h: LB(x-3) Function C Condition 1..... | 94 |
| 3.4.43 | Object 3x32h: LB(x-3) Function C Condition 2..... | 94 |
| 3.4.44 | Object 3x33h: LB(x-3) Function C Condition 3..... | 94 |
| 3.4.45 | Object 4000h: Math Function Enable | 95 |
| 3.4.46 | Object 4021h: Math Output Scaling 1 PV..... | 96 |
| 3.4.47 | Object 4023h: Math Output Scaling 2 PV..... | 97 |
| 3.4.48 | Object 4030h: Math Output Process Value..... | 97 |
| 3.4.49 | Object 4032h: Math Output Decimal Digits PV | 98 |
| 3.4.50 | Object 4y00h: Math Y Input Source | 98 |
| 3.4.51 | Object 4y01h: Math Y Input Number | 99 |
| 3.4.52 | Object 4y02h: Math Y Input Function Number | 100 |
| 3.4.53 | Object 4y03h: Math Y Input Decimal Digits FV | 100 |
| 3.4.54 | Object 4y20h: Math Y Input Scaling 1 FV | 101 |
| 3.4.55 | Object 4y22h: Math Y Input Scaling 2 FV | 102 |
| 3.4.56 | Object 4y40h: Math Y Input Gain | 102 |
| 3.4.57 | Object 4y50h: Math Y Operator | 103 |
| 3.4.58 | Object 5010h: Constant Field Value..... | 104 |
| 3.4.59 | Object 5020h: Power Supply Field Value | 107 |

- 3.4.60 Object 5021h: Enable Error Detection on Power Supply 107
- 3.4.61 Object 5022h: Under Voltage Threshold..... 108
- 3.4.62 Object 5023h: Over Voltage Threshold 108
- 3.4.63 Object 5024h: Hysteresis to Clear Supply Fault..... 108
- 3.4.64 Object 5025h: Enable Power Supply Fault Disables Outputs 109
- 3.4.65 Object 5030h: Processor Temperature Field Value 109
- 3.4.66 Object 5031h: Enable Error Detection on Temperature 110
- 3.4.67 Object 5032h: Over Temperature Threshold 110
- 3.4.68 Object 5033h: Hysteresis to Clear Temperature Fault 111
- 3.4.69 Object 5034h: Enable Temperature Fault Shutdown..... 111
- 3.4.70 Object 5550h: Enable Automatic Updates 111
- 3.4.71 Object 5555h: Start in Operational Mode..... 112
- 3.4.72 Object 5B50h: Change Baud Rate 112
- 3.4.73 Object 5B51h: Change Node ID..... 113
- 4 TECHNICAL SPECIFICATIONS..... 114**
- 5 VERSION HISTORY..... 116**

1. OVERVIEW OF CONTROLLER

1.1. Description of the Controller

This CAN to 4 Analog Outputs Controller (CAN-4AOUT) with CANopen® is designed for versatile control of four digital/analog outputs. The sophisticated control algorithms allow the user to program the controller for a wide range of applications without the need for custom software. Figure 1 below shows the hardware features.

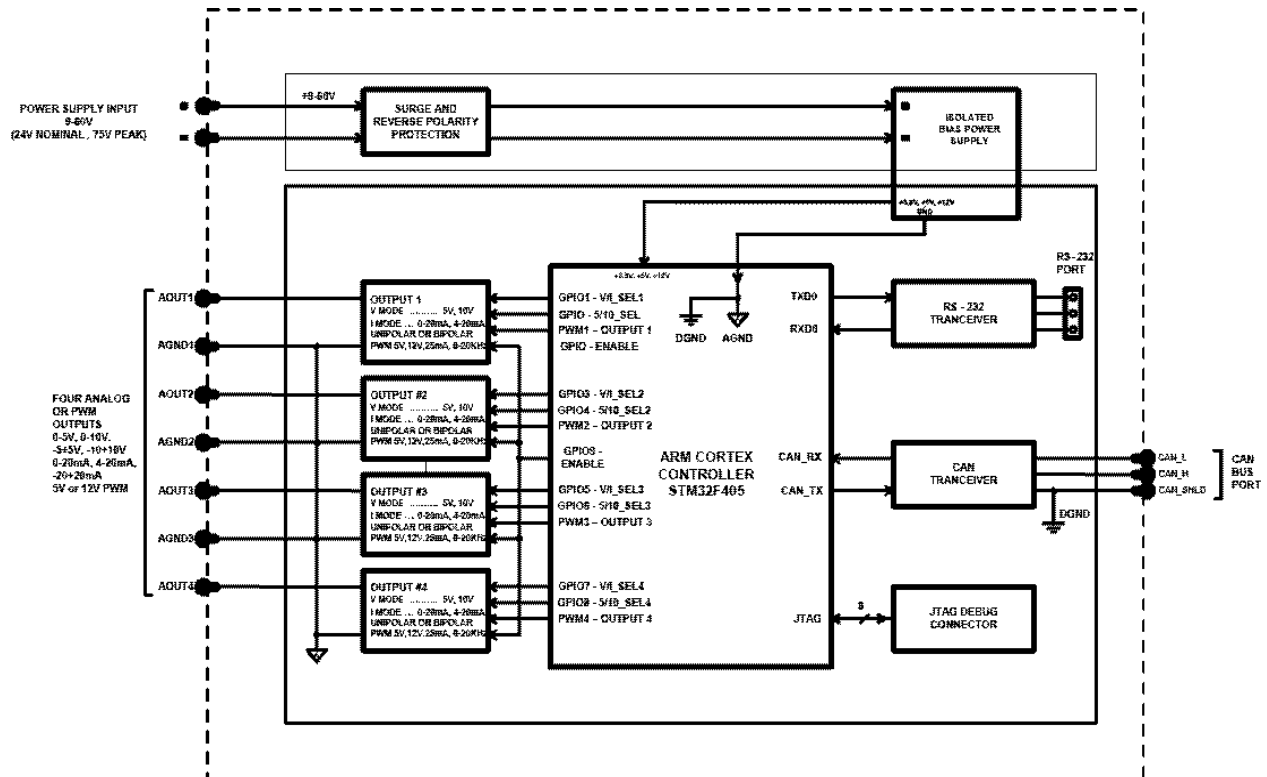


Figure 1 – Hardware Functional Block Diagram

The controller has 4 Digital/Analog outputs that can be configured as: *Analog Current*, *Analog Voltage*, *Digital PWM*, *Digital Frequency* and *Digital ON/OFF*. All outputs can be configured to use any of the on-board inputs as either a control signal or an enable signal and/or it can be integrated into a CANopen® network of controllers.

All I/O and logical function blocks on the unit are inherently independent from one another but can be programmed to interact in many ways. They will be described in the following sections. All objects are user configurable using standard commercially available tools that can interact with a CANopen® Object Dictionary via an .EDS file.

1.2. Digital Output Function Block

There are two types of universal output function blocks, one for the digital outputs and the other for the analog outputs. While both types of function blocks are driving the same outputs, they are just treated as separate function blocks here for ease of explanation. The digital output (DO) function block only becomes applicable on the output when object 6310h, **AO Output Type**, is set to *Digital ON/OFF* output response (Type=1000).

Several other objects are associated with the Analog Output function block and will be explained in detail in section 1.3. 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 Source** (see Table 5), data from the appropriate sub-index from the 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 will be described in section 1.3 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 state is logically set to OFF while the Control Input is zero and is set to ON whenever a non-zero value is written. By default, *Normal On/Off* logic is used. The resulting “DO Drive State” will depend on the object 2241h **DO Polarity**, as per Table 1.

| 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.

There is an object 2240h **DO Vps range** determines if the output is at +5V or +12V when ON, the options are shown in Table 2.

| Value | Meaning |
|-------|---------|
| 0 | 0-+5V |
| 1 | 0-+12V |

Table 2 – Object 2240h - DO VPS Range Options

For *Digital ON/OFF*, if a non-digital control is selected for this type, the command state will be OFF at or below the minimum input, ON at or above the maximum input, and it will not change in between those points. In other words, the input will have built in hysteresis, as shown in Figure 1. This relationship is true for any function block that has a non-digital input mapped to a digital control.

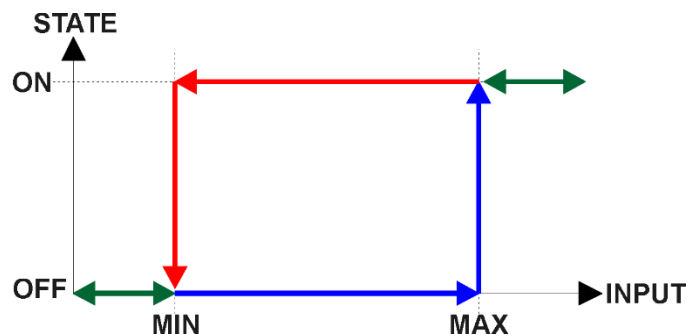


Figure 2 – Analog Input Read as Digital

As mentioned in the Controller Overview, any digital 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 3. By default, 2, *Apply Pre-Defined State*, is set for the digital output and it will revert to the state defined in object 6260h **DO Fault State** (ON/OFF), which is set to 0, *OFF* by default.

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

Table 3 – Object 6250h - DO Fault Mode Options

1.3. Analog Output Function Block

The analog output (AO) function block is the default logic associate with all four outputs. 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 configured as per Table 4. This table also shows the output units and default ranges for each type. By default, analog outputs are configured as *10, Output Voltage* types.

| Value | Meaning | Range [Unit] |
|-----------|-----------------------|-----------------------------|
| 0 | Output Disabled | N/A |
| 10 | Output Voltage | -10000 to 10000 [mV] |
| 20 | Output Current | -20 to 20 [mA] |
| 30 | Output Frequency | 0 to 30000 [Hz] |
| 40 | Output PWM | 0 to 1000 [0.1% D.C.] |
| 1000 | Digital ON/OFF | 0 (OFF) or 1 (ON) |

Table 4 – Object 6310h - AO Output Type Options

When the output type is changed, all objects related to the output (scaling PV, Decimal Digits PV, etc) are automatically updated by default. Object 5550h **Enable Auto Updates** enables/disables automatic updates. When disabled (set to False), the objects are to be manually configured.

Ranges in table are the largest ranges for each type, the actual ranges for the outputs can be configured by Object 7320h **AO Scaling 1 PV**, 7321h **AO Scaling 1 FV**, 7322h **AO Scaling 2 PV** and 7323h **AO Scaling 2 FV**, together when Objects 7300h **AO Output PV** is used to control the proportional outputs. The control signal of the outputs will have associated with it a minimum and maximum values. Besides type Digital ON/OFF, all the other output types are always responding in a linear fashion to changes in the control source per the calculation in Figure 3.

$$y = mx + a$$

$$m = \frac{Y_{\max} - Y_{\min}}{X_{\max} - X_{\min}}$$

$$a = Y_{\min} - m * X_{\min}$$

Figure 3 – Linear Slope Calculations

X and Y are defined as:

Xmin = “**AO Scaling 1 PV**”
 Xmax = “**AO Sacling 2 PV**”

Ymin = “**AO Scaling 1 FV**”
 Ymax = “**AO Scaling 2 FV**”

In all cases, while the X-axis has the constraint that $X_{min} < X_{max}$, there is no such limitation on the Y-axis. This allows for a negative slope so that as the control input signal increases, the target output value decreases. Or it allows output to follow control signal inversely.

The relationship between the Process Value (input) and the Field Value (output) is a linear one, as shown in Figure 4. However, the output will use the 7321h **AO Scaling 1 FV** as minimum and 7323h **AO Scaling 2 FV** as maximum limits to the drive, such that the output will hold at the minimum and maximum FV points, as shown in the figure.

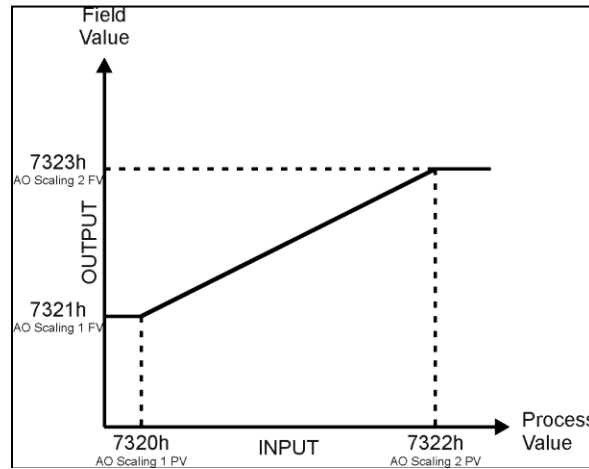


Figure 4 – Analog Output Linear Scaling PV to FV

The controller allows for the PV input can be selected from the list of the logical function blocks supported by the controller. As a result, any output from one function block can be selected as the control source for another. Keep in mind that not all options make sense in all cases, but the complete list of control sources is shown in Table 5.

| Value | Meaning |
|-------|-----------------------------------|
| 0 | Control Source Not Used (Ignored) |
| 1 | CANopen® Message (RPDO) |
| 2 | Constant Function Block |
| 3 | Lookup Table Function Block |
| 4 | Mathematical 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 |

Table 5 – 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 6 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 |
| CANopen® Message (RPDO) | 1 | 7300h sub-index 1 or 6220 sub-index 1* |
| | 2 | 7300h sub-index 2 or 6220 sub-index 2* |
| | 3 | 7300h sub-index 3 or 6220 sub-index 3* |
| | 4 | 7300h sub-index 4 or 6220 sub-index 4* |
| | 5 | 2500h sub-index 1 (Extra Received PV 1) |
| | 6 | 2500h sub-index 2 (Extra Received PV 2) |
| | 7 | 2500h sub-index 3 (Extra Received PV 3) |
| | 8 | 2500h sub-index 4 (Extra Received PV 4) |
| | 9 | 2500h sub-index 5 (Extra Received PV 5) |
| | 10 | 2500h sub-index 6 (Extra Received PV 6) |
| <i>* Depending on AO Output Type selected, either the AO Output PV or DO Write State will be used</i> | | |
| 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) |
| | 7 | 5010h sub-index 7 (Constant FV 7) |
| | 8 | 5010h sub-index 8 (Constant FV 8) |
| | 9 | 5010h sub-index 9 (Constant FV 9) |
| | 10 | 5010h sub-index 10 (Constant FV 10) |
| | 11 | 5010h sub-index 11 (Constant FV 11) |
| | 12 | 5010h sub-index 12 (Constant FV 12) |
| | 13 | 5010h sub-index 13 (Constant FV 13) |
| | 14 | 5010h sub-index 14 (Constant FV 14) |
| | 15 | 5010h sub-index 15 (Constant FV 15) |
| Lookup Table Function Block | 1 | 3018h (Lookup Table 1 Output Y-Axis PV) |
| | 2 | 3028h (Lookup Table 2 Output Y-Axis PV) |
| | 3 | 3038h (Lookup Table 3 Output Y-Axis PV) |
| | 4 | 3048h (Lookup Table 4 Output Y-Axis PV) |
| | 5 | 3058h (Lookup Table 5 Output Y-Axis PV) |
| | 6 | 3068h (Lookup Table 6 Output Y-Axis PV) |
| | 7 | 3078h (Lookup Table 7 Output Y-Axis PV) |
| | 8 | 3088h (Lookup Table 8 Output Y-Axis PV) |
| | 9 | 3098h (Lookup Table 9 Output Y-Axis PV) |
| | 10 | 3108h (Lookup Table 10 Output Y-Axis PV) |
| | 11 | 3118h (Lookup Table 11 Output Y-Axis PV) |
| | 12 | 3128h (Lookup Table 12 Output Y-Axis PV) |

| | | |
|--|-----|--|
| Mathematical Function Block | 1 | 4030h sub-index 1 (Math Output PV 1) |
| | 2 | 4030h sub-index 2 (Math Output PV 2) |
| | 3 | 4030h sub-index 3 (Math Output PV 3) |
| | 4 | 4030h sub-index 4 (Math Output PV 4) |
| | 5 | 4030h sub-index 5 (Math Output PV 5) |
| | 6 | 4030h sub-index 6 (Math Output PV 6) |
| Programmable Logic Function Block | 1 | 3xy8h (Lookup Table Selected by Logic 1) |
| | 2 | 3xy8h (Lookup Table Selected by Logic 2) |
| | 3 | 3xy8h (Lookup Table Selected by Logic 3) |
| | 4 | 3xy8h (Lookup Table Selected by Logic 4) |
| <i>NOTE: The following options should be considered for diagnostic feedback, and should not be selected as a control source for logic inputs (i.e. lookup table X-Axis)</i> | | |
| Output Commanded Field Value | 1 | 7330h sub-index 1 |
| | 2 | 7330h sub-index 2 |
| | 3 | 7330h sub-index 3 |
| | 4 | 7330h sub-index 4 |
| Output Feedback Field Value | 1 | 2370h sub-index 1 (AO1/DO1 FB) |
| | 2 | 2370h sub-index 2 (AO2/DO2 FB) |
| | 3 | 2370h sub-index 3 (AO3/DO3 FB) |
| | 4 | 2370h sub-index 4 (AO4/DO4 FB) |
| Power Supply Measured | N/A | 5020h (Power Supply FV) |
| Processor Temperature Measured | N/A | 5030h (Processor Temperature FV) |

Table 6 – Control Number Options Depending on Source Selected

When using any control source as the X-Axis input to a function block, the corresponding scaling limits are defined as per Table 7. 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.

| Control Source | Scaling 1 | Scaling 2 | Dec Digits |
|---|--|--|-------------|
| CANopen® Message – Num 1 to 4 | 7320h | 7322h | 6302h |
| CANopen® Message – Num 5 to 10 | 2520h | 2522h | 2502h |
| Constant Function Block | N/A | N/A | N/A (float) |
| Lookup Table yz Function Block (where yz = 01 to 12) | 0 or lowest from 3yz6h ^(*) | 100 or highest from 3yz6h ^(**) | 3yz3h |
| Mathematical Function | 4021h | 4023h | 4032h |
| Programmable Logic Function | 0% | 100% | 1 (fixed) |
| Output Commanded Field Value | 7320h | 7322h | 6302h |
| Output Feedback Field Value | 7320h | 7322h | 6302h |
| Power Supply Measured | N/A | N/A | 1 (fixed) |
| Processor Temperature Measured | N/A | N/A | 1 (fixed) |

(*) - Whichever value is smaller; (**) - Whichever value is larger

Table 7 – 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 shown in Figure 5 holds true. However, in some cases it may be desired that the minimum offset not to be applied when the value is outside of the range, i.e. when using a joystick profile with a deadband. For this reason, object 2342h **AO Control Response** has the options shown in Table 8.

| Value | Meaning |
|-------|--------------------------------------|
| 0 | Single Output Profile (Figure 5) |
| 1 | Output OFF below Scaling 1 PV |
| 2 | Output OFF above Scaling 2 PV |

Table 8 – Object 2342 - AO Control Response Options

Enable and Override inputs have been mentioned several times already. By default, neither inputs are used (Object 2350 **Enable Source** and Object 2360 **Override Source** are set to 0=Ignore), but they can be activated for safety interlocks or other more complex applications. Table 9 shows the options for object 2352h **AO Enable Response**.

| Value | Meaning |
|----------|---------------------------------------|
| 0 | Enable When ON, Else Shut OFF |
| 1 | Enable When ON, Else Ramp OFF |
| 2 | Enable When ON, Else Keep Last Value |
| 3 | Enable When OFF, Else Shut OFF |
| 4 | Enable When OFF, Else Ramp OFF |
| 5 | Enable When OFF, Else Keep Last Value |

Table 9 – Object 2352h - AO Enable Response Options

Table 10 shows options for object 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 | Override When ON |
| 1 | Override When OFF |

Table 10 – Object 2362h - AO Override Response Options

When an input to the output block goes into 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 – Object 6340 - AO Fault Mode Options

The controller applies the logic shown in Figure 5 when evaluating what output FV to apply.

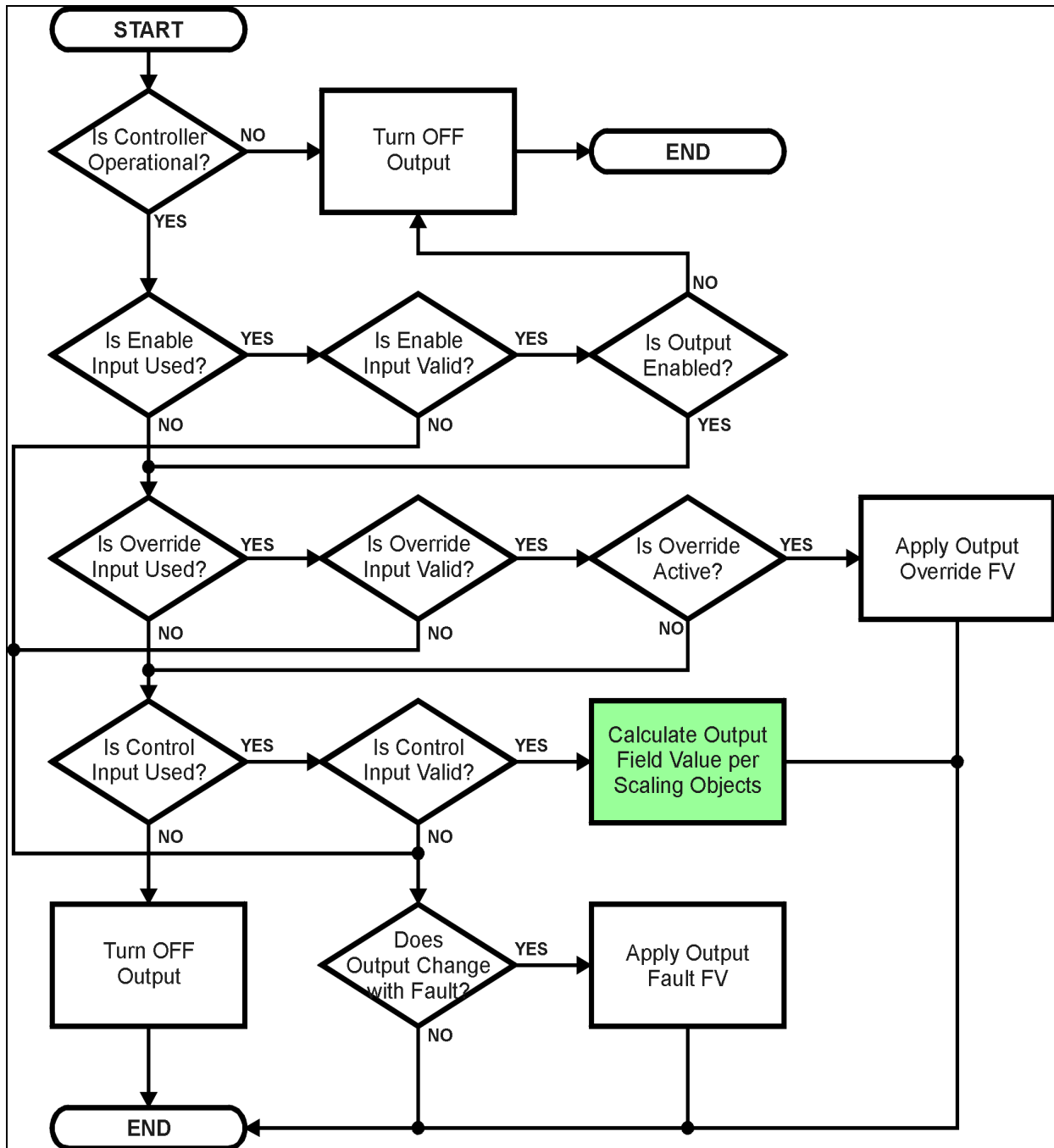


Figure 5 – Analog Output Logic Flowchart

Under normal conditions, i.e. when the control input is driving the output as shown in the green box, there are ramping objects that can be applied to soften the output response. Object 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.

By default, when the outputs are in Output Current/Output Voltage mode, outputs are driven with a high frequency 25kHz signal. It can be changed through object 2380h **AO Output Frequency**. However, this value should not be lowered under these two modes without taking into consideration how this affects the accuracy and stability of the outputs. When the outputs are in Output PWM mode, object 2380h can be used to change the desired frequency of the waveform while when in Output Frequency mode, it is used to change the duty cycle of the output waveform.

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 sent value to the output.

1.4. Lookup Table Function Block

The lookup table (LTyz) function blocks are not used by default, where yz can be 01 to 10.

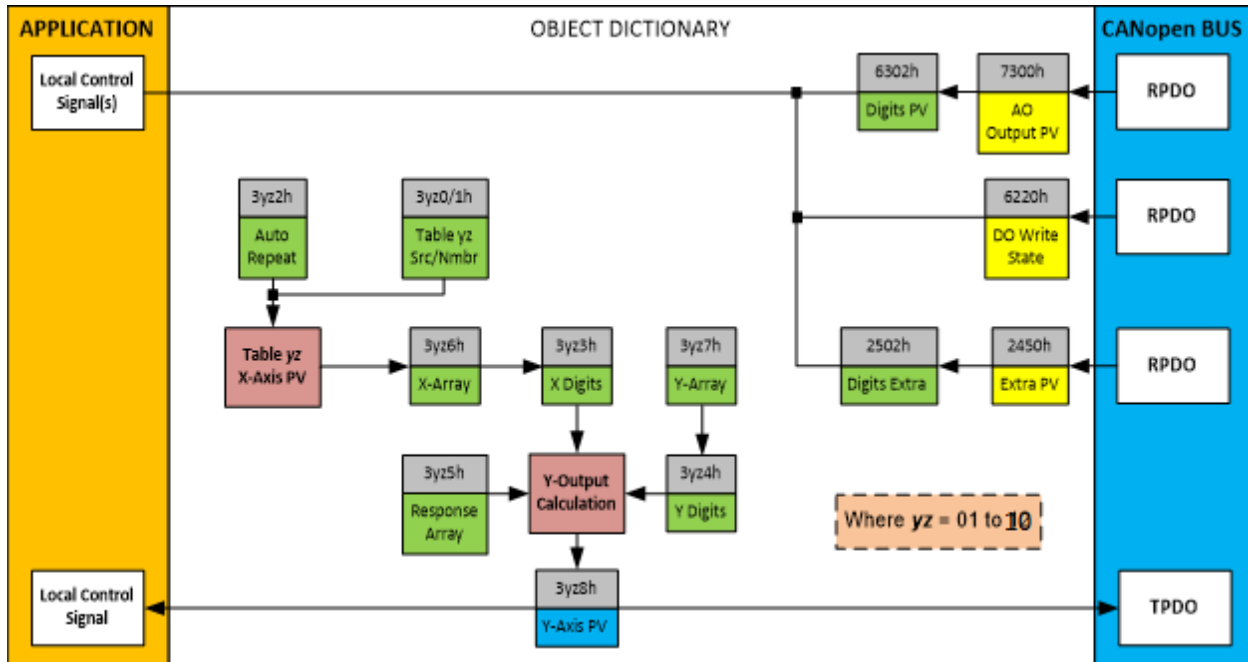


Figure 6 – Lookup Table Objects

Lookup tables are used to give an output response of up to 10 slopes per input. The array size of the objects 3yz5h **LTyz Point Response**, 3yz6h **LTyz Point X-Axis PV** and 3yz7h **Point Y-Axis PV** shown in the block diagram above is therefore 11.

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

A parameter that will affect the function block is object 3yz5h **LTyz Point Response** sub-index 1 which defines the “**X-Axis Type**”. By default, the table have a ‘*Data Response*’ output (0). Alternatively, it can be selected as a ‘*Time Response*’ (1).

There are two (or three) other key parameters that will affect how this function block will behave depending on the “**X-Axis Type**” chosen. If chosen ‘*Data Response*’, then the objects 3yz0h **Lookup Table yz Input X-Axis Source** and 3yz1h **Lookup Table yz Input X-Axis Number** together define the control source for the function block. When it is changed, the table values in object 3yz6h and 3yz3h **LTyz X-Axis Decimal Digits PV** need to be updated with new defaults based on the X-Axis source selected as described in Tables 5 and 6. If however, the “**X-Axis Type**” is chosen to be ‘*Time Response*’, an additional parameter is taken into consideration - object 3yz2h, **Lookup Table yz Auto Repeat**. These will be described in more detail 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.

However, should the minimum input be less than zero, for example a resistive input that is reflecting temperature in the range of -40°C to 210°C, then the object 3yz8h **LTyz Point X-Axis PV** sub-index 1 will be set to the minimum instead, in this case -40°C.

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 X₁₁ is changed first, then lower indexes in descending order.

$$\text{MinInputRange} \leq X_1 \leq X_2 \leq X_3 \leq X_4 \leq X_5 \leq X_6 \leq X_7 \leq X_8 \leq X_9 \leq X_{10} \leq X_{11} \leq \text{MaxInputRange}$$

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 7.

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 $0 \leq Y[i] \leq 100$ (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 calculations shown in Table 7.

However, the Y-Axis has no constraints on the data that it represents. This means that inverse, 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.

1.4.3 Point to Point Response

By default, all 10 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 3yz5h **LTyz Point Response** array is setup for a 'Ramp To' output.

Alternatively, the user could select a 'Step To' response for 3yz5h sub-index N, 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: *LTyz Point Response* sub-index 1 defines the X-Axis type)

Figure 7 shows the difference between these two response profiles with the default settings.

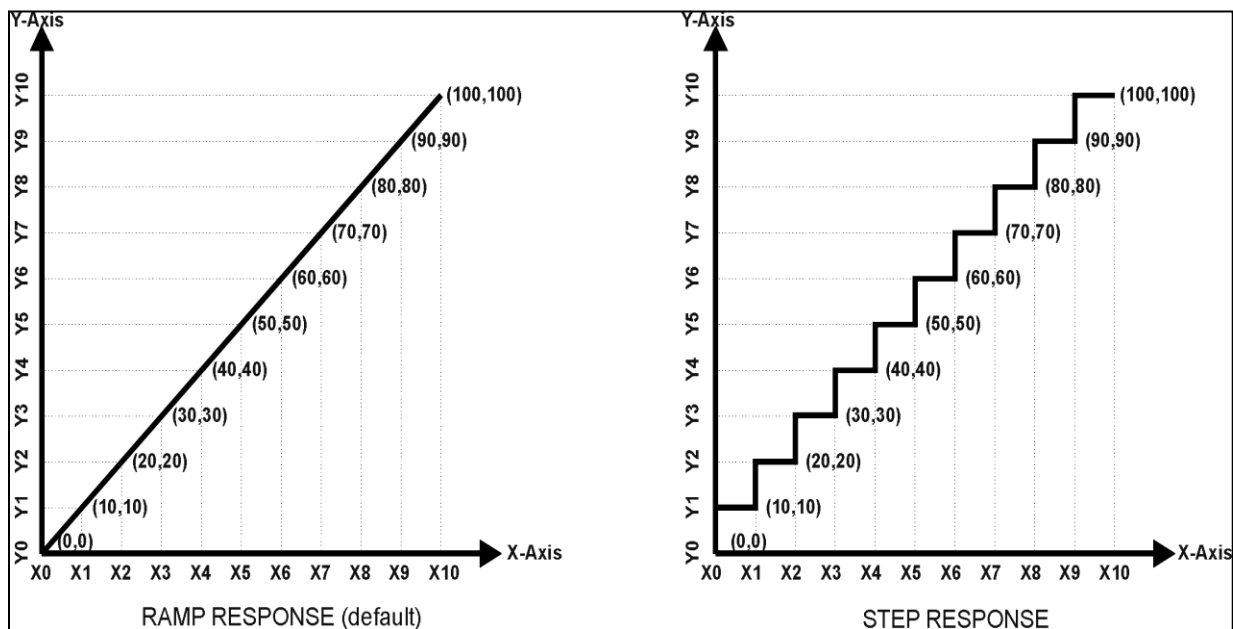


Figure 7 – Lookup Table Defaults with Ramp and Step Responses

Lastly, any point except (1,1) can be selected for an 'Ignore' response. If object 3yz5h **LTyz 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 8. The example shows a dual slope percentage output response for each side of the deadband, but additional slopes can be easily added as needed.

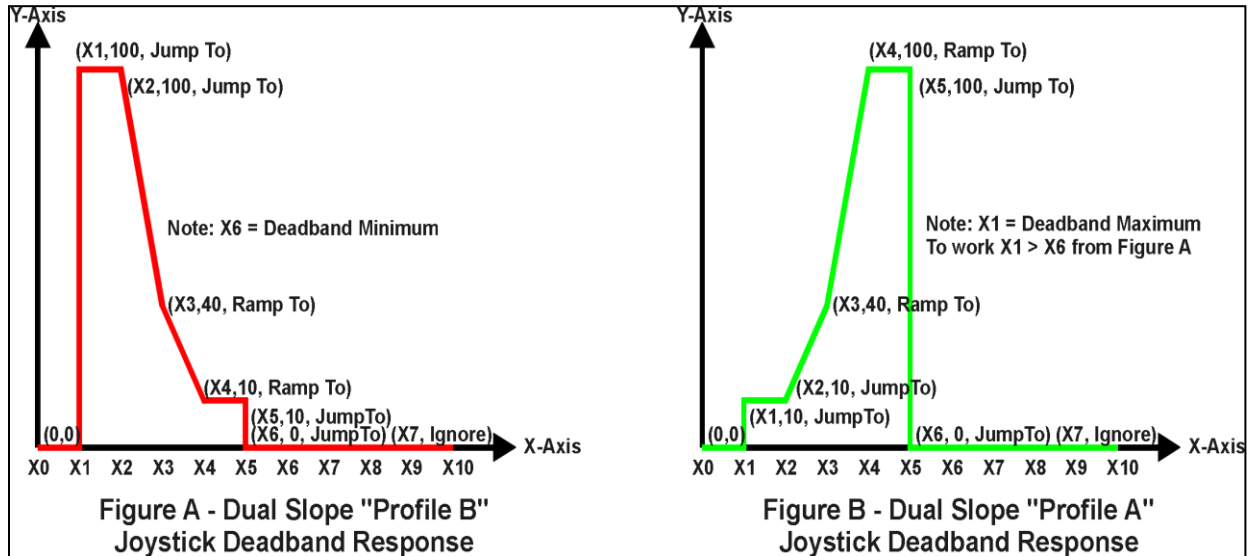


Figure 8 – Lookup Table Examples to Setup for Dual-Slope Joystick Deadband Response

To summarize, Table 12 outlines the different responses that can be selected for object 3yz4h, 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 12 – LTyz Point Response Options

1.4.4 X-Axis, Time Response

As mentioned in Section 1.4.1, 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.

With this response, the sequence will start depending on two parameters:

- **Lookup Table yz Input X-Axis Source** Object 3yz0h and;
- **Lookup Table yz Auto Repeat** Object 3yz2h

By default, the “Auto Repeat” object is set to FALSE (0). In this case, the lookup table will react in the following way:

The X-Axis control source is treated as a digital input. When the control input is ON, the output will be changed over a period of time based on the profile in the lookup table. Once the profile has finished (i.e. reached index 11, or an ‘Ignored’ response), the output will remain at the last output at the end of the profile until the control input turns OFF.

However, when the “Auto Repeat” object is set to TRUE (1), the lookup table will react in the following way:

When the control input is ON, the output will be changed over a period of time based on the profile in the lookup table. Once the profile has finished (i.e. reached index 11, or an ‘Ignored’ response), the lookup table will revert back to the first point in the table and Auto Repeat the sequence. This will continue for as long as the input remains ON. Once the input turns OFF, the lookup table sequence will stop and the output of the lookup table is zero.

Note: When the control input is OFF, the output is always at zero. When the input comes ON, the profile will **ALWAYS** start at position (X₁, Y₁) which is 0 output for 0ms.

In a time response, the data in object 3yz8h **LTyz Point X-Axis PV** is measured in milliseconds, and object 3yz3h **LTyz 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 blocks (LB(x-3)) functions are not used by default.

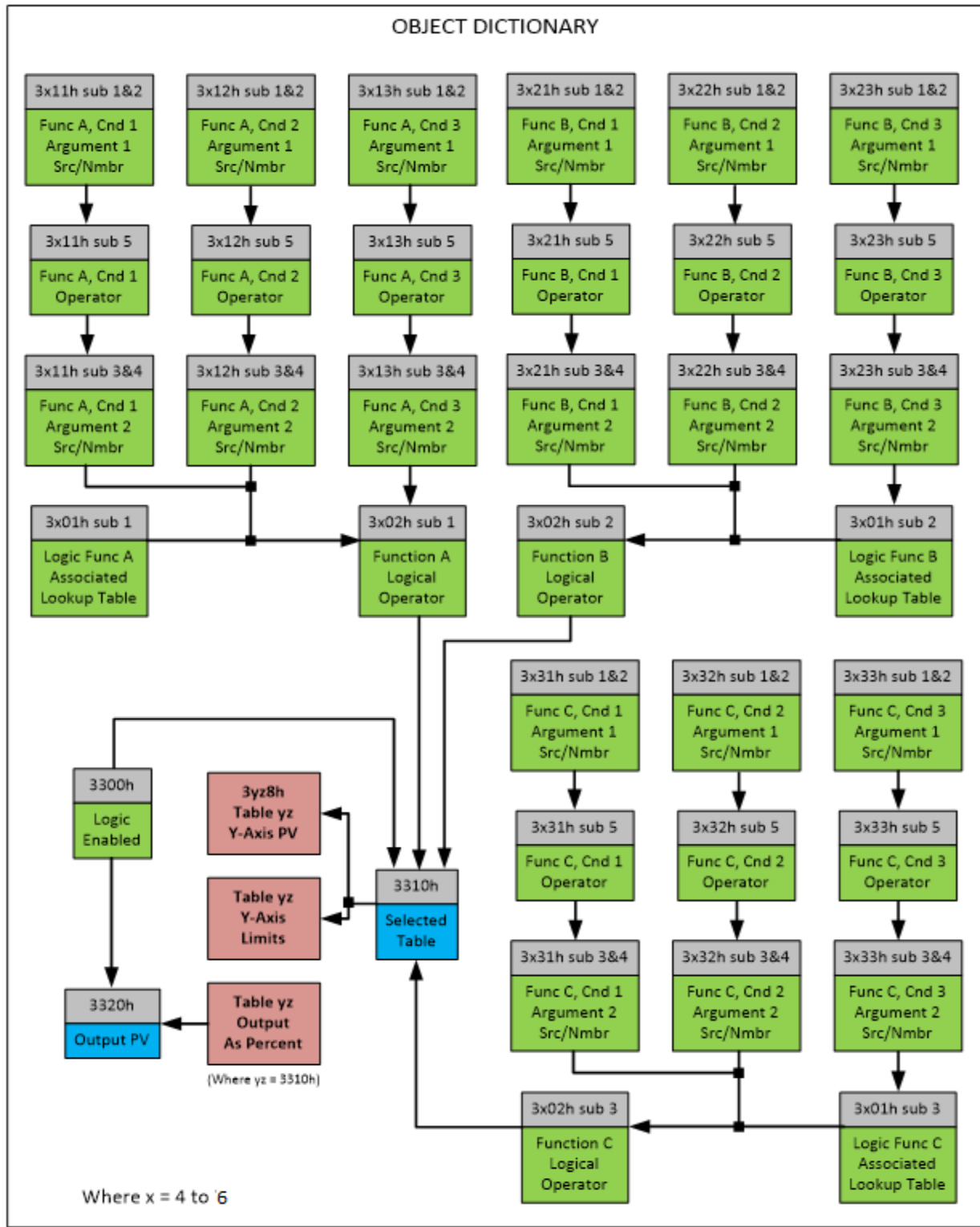


Figure 9 – Logic Block Objects

This function block is obviously the most complicated of them all, but very powerful. Any LB(x-3) (where X= 4 to 6) 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 10) can be associated with the logic, and which ones are used is fully configurable on object 3x01 **LB(x-3) 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 LB(x-3)'s corresponding sub-index X in read-only mappable object 3320h **Logic Block Output PV**. The active table number can read from read-only object 3310h **Logic Block Selected Table**.

Note: In this document, the term *LB(x-3)* refers to Logic Blocks 1 to 3. Due to the CANopen® Object indices, Logic Block 1 begins at 3401h, where x, in this case, is 4.

Therefore, an LB(x-3) 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. Here, the “**Control Source**” for the reactive block would be selected to be the ‘*Programmable Logic Function Block*,’ as described in Section 1.3.

In order to enable any one of logic blocks, the corresponding sub-index in object 3300h **Logic Block Enable** must be set to TRUE. They are all disabled by default.

Logic is evaluated in the order shown in Figure 10. 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.**

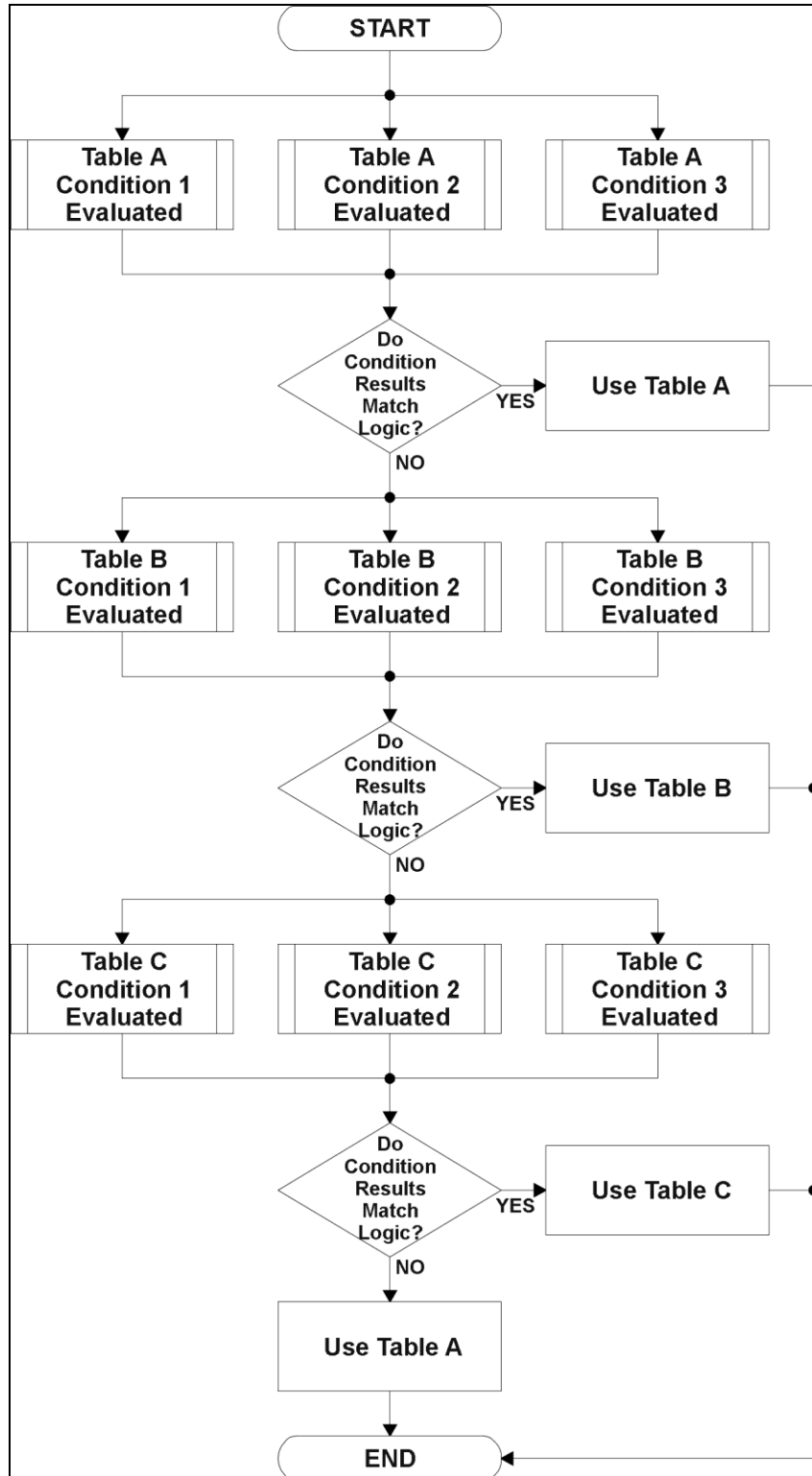


Figure 10 – Logic Block Flowchart

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 13.

| Index | Sub-Index | Name | Data Type |
|-------|-----------|-----------------------------|-----------|
| 3xyz* | 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 = 4 to 6, Y = A, B or C, and Z = 1 to 3

Table 13 – LB(x-3) Condition Structure Definition

Objects 3x11h, 3x12h and 3x13h are the conditions evaluated for selecting Table A. Objects 3x21h, 3x22h and 3x23h are the conditions evaluated for selecting Table B. Objects 3x31h, 3x32h and 3x33h are the conditions evaluated for selecting Table C.

Argument 1 is always a logical output from another function block, as listed in Table 5. As always, the input is a combination of the functional block objects 3xyz_h 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 14, 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 14 – LB(x-3) Condition Operator Options

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 15.

| 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 <i>'Control Source Not Used'</i>) |

Table 15 – LB(x-3) 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 16. The default value for object 3x02h **LB(x-3) 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 16 – LB(x-3) Function Logical Operator Options

Not every evaluation is going to need all three conditions. For example, check if the Engine RPM is below a certain value only has one condition listed. 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 17.

| Logical Operator | Select Conditions Criteria |
|----------------------------|--|
| Default Table | Associated table is automatically selected as soon as it is evaluated. |
| Cnd1 And Cnd2 And Cnd3 | <p>Should be used when two or three conditions are relevant, and all must be True to select the table.</p> <p>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.</p> <p>If((Cnd1==True) &&(Cnd2==True)&&(Cnd3==True)) Then Use Table</p> |
| Cnd1 Or Cnd2 Or Cnd3 | <p>Should be used when only one condition is relevant. Can also be used with two or three relevant conditions.</p> <p>If any condition is evaluated as True, the table is selected. Error or N/A results are treated as False</p> <p>If((Cnd1==True) (Cnd2==True) (Cnd3==True)) Then Use Table</p> |
| (Cnd1 And Cnd2) Or Cnd3 | <p>To be used only when all three conditions are relevant.</p> <p>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</p> <p>If(((Cnd1==True)&&(Cnd2==True)) (Cnd3==True)) Then Use Table</p> |
| (Cnd1 Or Cnd2) And Cnd3 | <p>To be used only when all three conditions are relevant.</p> <p>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</p> <p>If(((Cnd1==True) Cnd2==True) && (Cnd3==True)) Then Use Table</p> |

Table 17 – LB(x-3) Conditions Evaluation Based on Selected Logical Operator

If the result of the function logic is TRUE, then the associated lookup table (see object 3x01h) 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 so as 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 3310h **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 LB(x-3) function block does NOT mean lookup table 1 to 3. Each table has object 3x01h LB(x-3) **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 18.

| 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 | 7 | 8 | 9 |

Table 18 – LB(x-3) Default Lookup Tables

If the associated Lookup Table YZ (where YZ equals 3310h sub-index X) does not have an “**X-Axis Source**” selected, then the output of LB(x-3) will always be “Not Available” so long as that table is selected. However, should LTyz be configured for a valid response to an input, be it Data or Time, the output of the LTyz function block (i.e. the Y-Axis data that has been selected based on the X-Axis value) will become the output of the LB(x-3) function block so long as that table is selected.

The LB(x-3) 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 3320h **Logic Block Output PV** with a resolution of 1 decimal place.

1.6 Math Function Block

There are 4 mathematic function blocks that allow the user to define basic algorithms. Math function block Z = 1 to 4 will be enabled based on sub-index Z in object 4000h **Math Enable**.

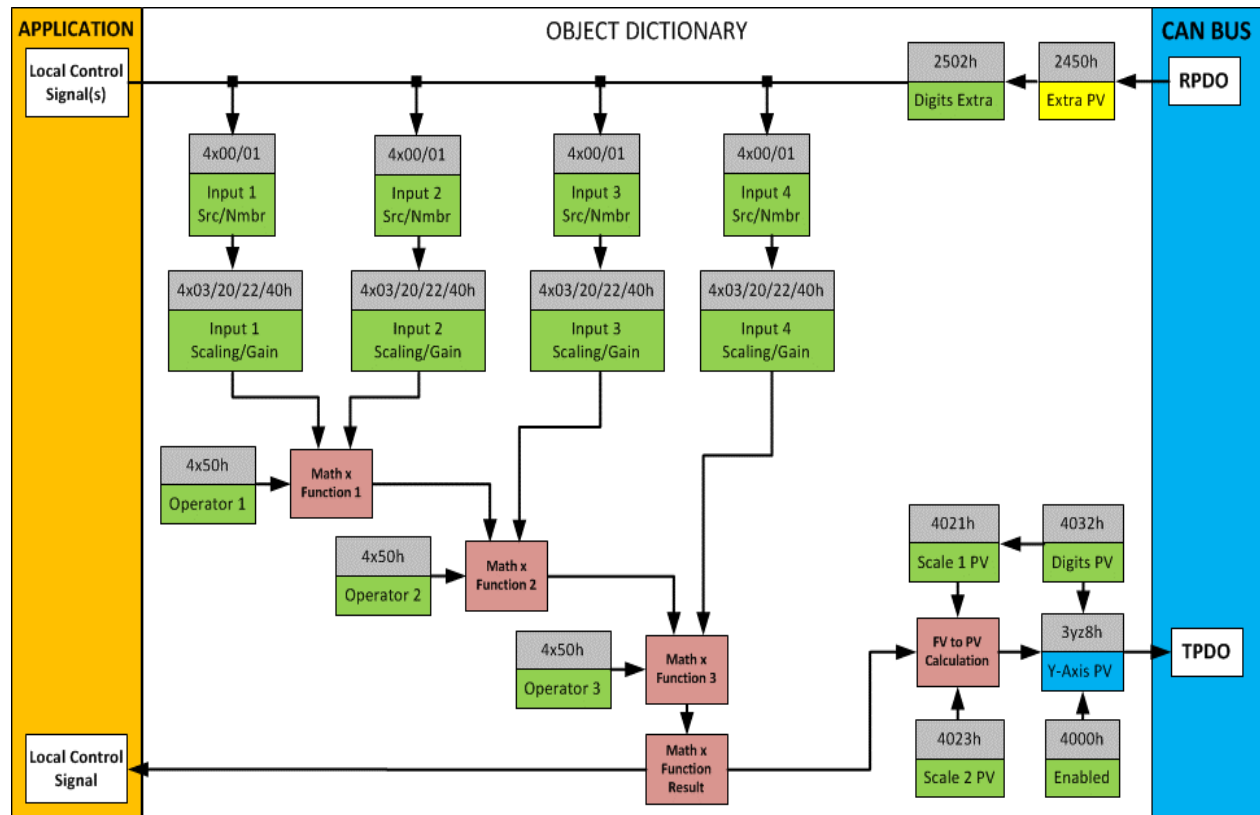


Figure 11 – Math Function Block Objects

A math function block can take up to four input signals, as listed in Table 5 in Section 1.3. Each input is then scaled depends on the associated scaling and gain objects. A “Math Input X” is determined by the corresponding sub-index $X = 1$ to 4 of the objects 4y00h **Math Y Input Source** and 4y01h **Math Y Input Number**. Here, $y = 1$ to 4; corresponding the Math 1- Math 4.

Inputs are converted into a percentage value based on objects 4y20h **Math Y Scaling 1 FV** and 4y22h **Math Y Scaling 2 FV**. Before being used in the calculation, these objects apply the resolution shift defined by object 4y03h **Math Y Decimal Digits FV**. As with any other function block using a control source for the X-Axis in a conversion, the scaling objects should be selected to match the values in the control’s corresponding objects as per Table 5.

For additional flexibility, the user can also adjust object 4y40h **Math Y Input Gain**. This object has a fixed decimal digit resolution of 2, and a range of -100 to 100. By default, each input has a gain of 1.0.

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

For each input pair, the appropriate arithmetic or logical operation is performed on the two inputs, InA and InB, according to the associated function in sub-index of InB in object 4y50h **Math Y Operator**. The list of selectable function operations is defined in Table 19.

| | | |
|----|------|--|
| 0 | = | True when InA Equals InB |
| 1 | != | True when InA Not Equal InB |
| 2 | > | True when InA Greater Than InB |
| 3 | >= | True when InA Greater Than or Equal InB |
| 4 | < | True when InA Less Than InB |
| 5 | <= | True when InA Less Than or Equal InB |
| 6 | OR | True when InA or InB is True |
| 7 | NOR | True when InA and InB are False |
| 8 | AND | True when InA and InB are True |
| 9 | NAND | True when InA and InB are not both True |
| 10 | XOR | True when InA/InB is True, but not both |
| 11 | XNOR | True when InA and InB are both True or False |
| 12 | + | Result = InA plus InB |
| 13 | - | Result = InA minus InB |
| 14 | x | Result = InA times InB |
| 15 | / | Result = InA divided by InB |
| 16 | MIN | Result = Smallest of InA and InB |
| 17 | MAX | Result = Largest of InA and InB |

Table 19 – Object 4y50h Math Function Operators

For Function 1, InA and InB are Math Inputs 1 and 2, respectively.

For Function 2, InA is the result of Function 2 and InB is Math Input 3, respectively.

For Function 3, InA is the result of Function 3 and InB is Math Input 4, respectively.

Exclusively **within** a Math Block, there is a third control parameter: Object 4y02h, **Math Y Function Number**. This parameter allows for the result of any Function (1, 2 or 3) to be the input to any **Math Input Y** within the same Math Block. Therefore, **Math Y Input Source** must be a Math Block and **Math Y Input Number** must be the same number as being configured. When these four parameters match, if **Math Y Function Number** is set to 1, 2, or 3, the respective input will be the result of the Function selected. By default, **Math Y Function Number** is set to 0 – in which case this parameter is ignored and uses the Math Block output result. These functions can only be used **within** the Math Block. They can not be used for other Math Blocks or logic blocks.

This allows for more versatility within the Math Block. For a valid result in each Function, both inputs must be non-zero value (other than '*Control Source Not Used*'). Otherwise, the corresponding Function is ignored. Furthermore, for a valid/expected output result in each Math Block, it is necessary to keep in mind how the Functions link to one another within the Math Block. As an example, consider all 6 inputs to be CANopen® Messages 1 to 6 (thus using all 3 Functions). Since all 3 functions are used but Function 3 has no relation to Function 1 or 2, the result of the Math Block will be the result of Function 3, thus, ignoring Functions 1 and 2.

For logical operators (6 to 11), any SCALED input greater than or equal to 0.5 is treated as a TRUE input. For logic output operators (0 to 11), the result of the calculation for the function will always be 0 (FALSE) or 1 (TRUE).

Error data (i.e. input measured out of range) is always treated as a 0.0 input into the function.

For the arithmetic functions (12 to 17), it is recommended to scale the data such that the resulting operation will not exceed full scale (0 to 100%) and saturate the output result.

When dividing, a zero InB value will always result in a zero output value for the associated function. When subtracting, a negative result will always be treated as a zero, unless the function is multiplied by a negative one, or the inputs are scaled with a negative coefficient first.

The resulting final mathematical output calculation is in the appropriate physical units using object 4021h **Math Output Scaling 1 PV** and 4023h **Math Output Scaling 2 PV**. These objects are also considered the Min and Max values of the Math Block output and apply the resolution shift defined by object 4032h **Math Output Decimal Digits PV**. The result is written to read-only object 4030h **Math Output PV**. These scaling objects should also be taken into account when the Math Function is selected as the input source for another function block, as outlined in Table 5.

1.7 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.

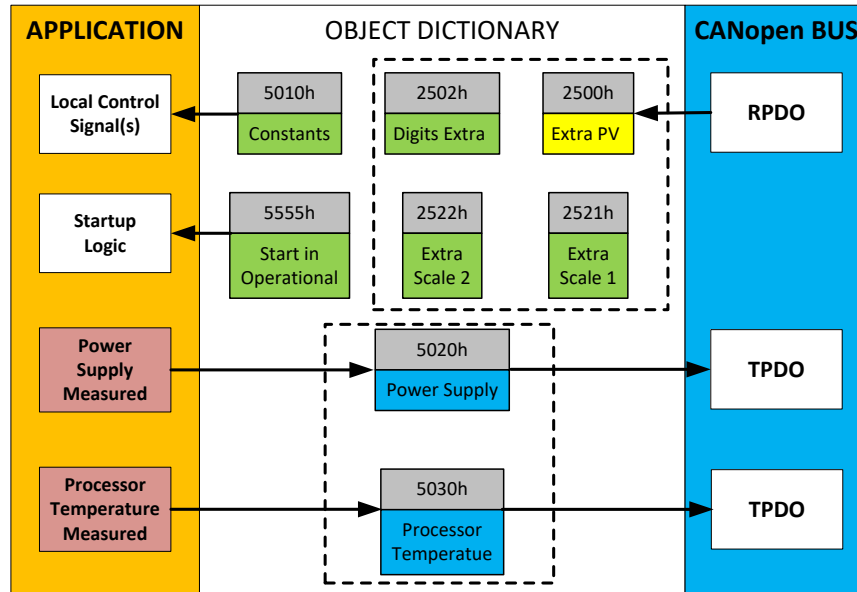


Figure 12 – Miscellaneous Objects

Extra RPDO Messages

Objects 2500h **Extra Control Received PV**, 2502h **EC Decimal Digits PV**, 2502h **EC Scaling 1 PV** and 2522h **EC Scaling 2 PV** have been mentioned in Section 1.3, Table 7. These objects allow for additional data received on a CANopen® RPDO to be mapped independently to various function blocks as a control source. The scaling objects are provided to define the limits of the data when it is used by another function block, as shown in Table 5.

Constant Values

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

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

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

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. 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.

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

An appropriate EMCY message will be added to object 1003h **Pre-Defined Error Field** when there is a fault detected. The application will react to the EMCY message as defined by object 1029h **Error Behaviour** at the sub-index corresponding to an Input Fault. Refer to section 3.2.4 and 3.2.13 for more information about objects 1003h and 1029h, including the complete list of EMCY messages.

Automatic Update of Objects

Object 5550h **Enable Automatic Updates** allows for the controller to automatically update the objects related to the output to defaults when it is changed. By default, this object is set to TRUE, in which case the objects are set to their default values depending on the type selected.

On the other hand, when this object is FALSE, the objects are not set to defaults and are left with the same values previous to changing the type. In this case, these are to be configured manually.

Startup

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

When using the CAN-4AOUT 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 INSTALLING INSTRUCTIONS

2.1 Dimensions and Pinout

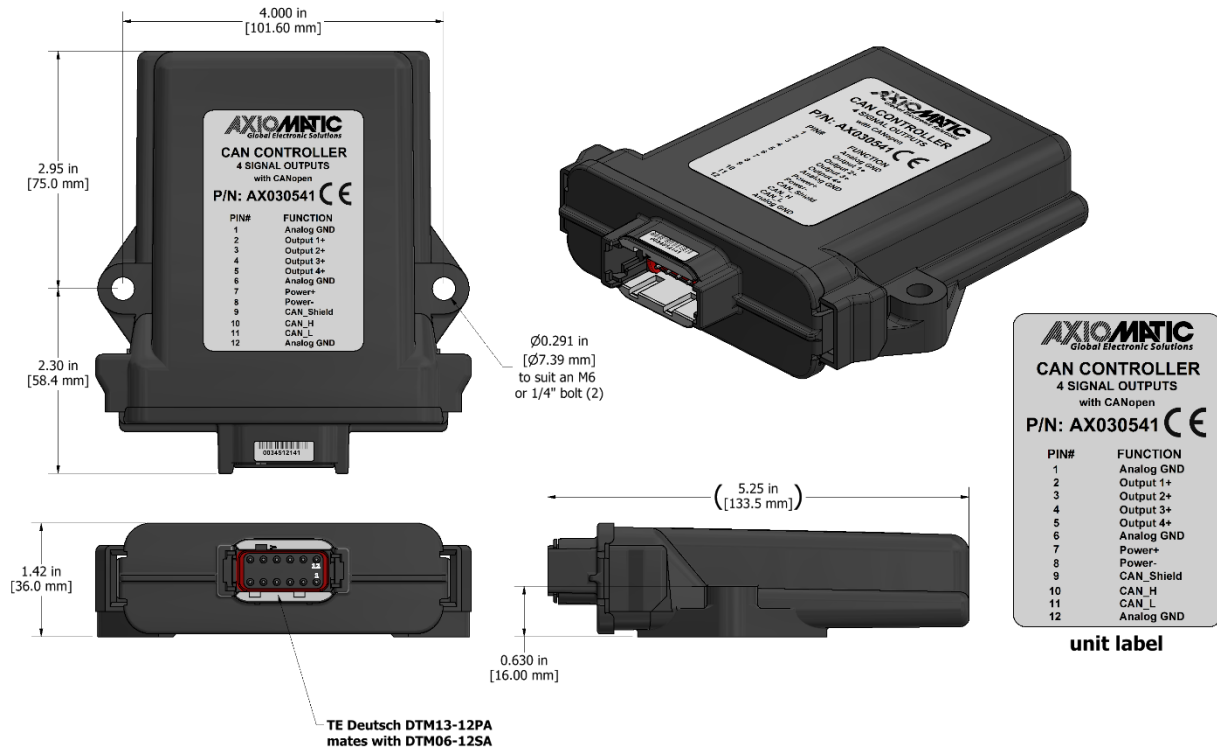


Figure 13 – Housing Dimensions

| PIN # | FUNCTION |
|-------|------------|
| 1 | Analog GND |
| 12 | Analog GND |
| 2 | Output 1+ |
| 11 | CAN_L |
| 3 | Output 2+ |
| 10 | CAN_H |
| 4 | Output 3+ |
| 9 | CAN_Shield |
| 5 | Output 4+ |
| 8 | Power - |
| 6 | Analog GND |
| 7 | Power + |

Note: CANopen® is a registered community trademark of CAN in Automation e.V.

Table 20 – Connector Pinout

2.2 Installation Instructions

NOTES & WARNINGS

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

MOUNTING

Mounting holes sized for ¼ inch or M6 bolts. The bolt length will be determined by the end-user's mounting plate thickness. The mounting flange of the controller is 0.63 inches (16 mm) thick.

If the module is mounted without an enclosure, it should be mounted vertically with connectors facing left and right to reduce likelihood of moisture entry.

The CAN wiring is considered intrinsically safe. The power wires are not considered intrinsically safe and so in hazardous locations, they need to be located in conduit or conduit trays at all times. The module must be mounted in an enclosure in hazardous locations for this purpose.

No wire or cable harness should exceed 30 meters in length. The power input wiring should be limited to 10 meters.

All field wiring should be suitable for the operating temperature range.

Install the unit with appropriate space available for servicing and for adequate wire harness access (6 inches or 15 cm) and strain relief (12 inches or 30 cm).

NETWORK TERMINATION

It is necessary to terminate the network with external termination resistors. The resistors are 120 Ohm, 0.25W minimum, metal film or similar type. They should be placed between CAN_H and CAN_L terminals at both ends of the network.

3 CANOPEN® OBJECT DICTIONARY

The CANopen® object dictionary of CAN-4AOUT is based on CiA device profile DS-404 V1.2 (device profile for measuring devices and closed-loop controllers). The object dictionary includes Communication Objects beyond the minimum requirements in the profile, as well as several manufacturer-specific objects for extended functionality.

3.1 NODE ID and BAUDRATE

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

3.1.1 LSS Protocol to Update

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

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

3.1.1.1 Setting Node-ID

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

| <i>Item</i> | <i>Value</i> |
|-------------|--|
| 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:

| <i>Item</i> | <i>Value</i> |
|-------------|---|
| 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).

| <i>Item</i> | <i>Value</i> |
|-------------|------------------------------------|
| 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:

| <i>Item</i> | <i>Value</i> |
|-------------|--------------------------------------|
| 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):

| <i>Item</i> | <i>Value</i> |
|-------------|--------------------------------------|
| 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)

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

3.1.1.2 Setting Baudrate

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

| <i>Item</i> | <i>Value</i> |
|-------------|--|
| 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:

| <i>Item</i> | <i>Value</i> |
|-------------|--|
| 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) |

| <i>Index</i> | <i>Bit Rate</i> |
|--------------|-----------------------|
| 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 Indices

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

| <i>Item</i> | <i>Value</i> |
|-------------|--|
| 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:

| <i>Item</i> | <i>Value</i> |
|-------------|---|
| 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):

| <i>Item</i> | <i>Value</i> |
|-------------|--------------------------------------|
| 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):

| <i>Item</i> | <i>Value</i> |
|-------------|--------------------------------------|
| 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)

| <i>Item</i> | <i>Value</i> |
|-------------|-------------------------------------|
| 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.

The left screenshot shows the CANscope interface. At the top, it says 'Net0 | CAN USB331 | 250 - CANscope'. Below that is a menu bar with 'File', 'Can', and 'Help'. There is a section for 'Add/Delete ID Area' with fields for 'from', 'to', and 'Add >' buttons, and a text box containing '0x000 <> 0x7FF'. Below this are checkboxes for 'IDs decimal' and '< 29 >'. A 'Net:' dropdown shows '0 - CAN_USB331' and a 'Baud rate:' dropdown shows '250'. A table of frames is visible below:

| Frame... | Absolute Time | RelTime | Id | Atr | L | d1 | d2 | d3 | d4 |
|----------|---------------|---------|------|-----|---|----|----|----|----|
| 95 | 11:42:45.248 | 6110 | 07E5 | | 2 | 04 | 01 | | |
| 96 | 11:42:54.468 | 9219 | 07E5 | | 3 | 13 | 00 | 03 | |
| 97 | 11:42:54.468 | 0 | 07E4 | | 3 | 13 | 00 | 00 | |
| 98 | 11:42:58.687 | 4218 | 07E5 | | 3 | 15 | 88 | 13 | |
| 99 | 11:43:16.579 | 17891 | 07E5 | | 1 | 17 | | | |
| 100 | 11:43:16.907 | 328 | 07E4 | | 3 | 17 | 00 | 00 | |
| 101 | 11:43:23.017 | 6109 | 07E5 | | 2 | 04 | 00 | | |
| 102 | 11:43:23.017 | 0 | 0750 | | 1 | 00 | | | |

At the bottom of the interface, there is a 'Send' button, an 'ID:' field, checkboxes for '29-bit', 'RTR', and 'Len:', and a 'Data\$:' field. The status bar at the bottom shows 'Fill:102(10.2%)', 'Bus:ok', and 'STARTED'.

The right screenshot shows a terminal window with a menu and status messages. The menu is as follows:

```

===== Main Menu =====
Choose one of the following:
U: View Object Dictionary
D: Default Object Dictionary
T: Toggle RS-232 Stream On/Off
S: Show/Stop Diagnostics
L: Load New Software
M: Main Menu (this)

```

The terminal output shows the following sequence of events:

```

->Node Id = 80
->Baudrate= 125 [kbps]
CO: PRE-OPERATIONAL
Activating new baud = 250 [kbps]
CO: STOP
Restarting CAN in 5000 [ms]
CO: PRE-OPERATIONAL
Storing ID
Storing Factory Parameters
Storing Baud
Storing Factory Parameters
Storing Communication Parameters
->Node Id = 80
->Baudrate= 250 [kbps]
CO: PRE-OPERATIONAL

```

3.2 COMMUNICATION OBJECTS (DS-301 and DS-404)

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

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

3.2.1 Object 1000h: Device Type

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

| | |
|--|---|
| MSB | LSB |
| Additional Information = 0xE00C | 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 | 0xE00C0194 |
| Default Value | 0xE00C0194 |

3.2.2 Object 1001h: Error Register

This object is an error register for the device. Any time there is an error detected by the CAN-4AOUT, the Generic Error Bit (bit 0) is set. Only if there is no error in the module, this bit will be cleared. No other bits in this register are used by the controller.

Object Description

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

Entry Description

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

3.2.3 Object 1002h: Manufacturer Status Register

This object is used for manufacturer debug purposes.

3.2.4 Object 1003h: Pre-Defined Error Field

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

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

The 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 input/thermocouple is not working as described in the previous sections, 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) | | | | | |
| 20003000h | 20h | Positive Overload (Vps Overvoltage) | 00h | Unspecified | 3000h | Generic Voltage |
| 40003000h | 40h | Negative Overload (Vps Undervoltage) | 00h | Unspecified | 3000h | Generic Voltage |
| 20004000h | 20h | Positive Overload (Over Temp) | 00h | Unspecified | 4000h | Device Temperature |
| 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 |
| 00008140h | 00h | Bus OFF Event | 00h | Unspecified | 8400h | Bus OFF Recovery |

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 5 |
| Default Value | 0 |

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

3.2.5 Object 100Ch: Guard Time

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

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

Object Description

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

Entry Description

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

3.2.6 Object 100Dh: Life Time Factor

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

Object Description

| | |
|-------------|------------------|
| Index | 100Dh |
| Name | Life Time Factor |
| Object Type | VAR |
| Data Type | UNSIGNED8 |

Entry Description

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

3.2.7 Object 1010h: Store Parameters

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

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 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 controller saves parameters on command. **This means that if power is removed before the Store object is written, changes to the Object Dictionary will NOT have been saved in the non-volatile memory and will be lost on the next power cycle.**

Object Description

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

Entry Description

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

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

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

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

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

3.2.8 Object 1011h: Restore Parameters

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

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 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 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 controller restores defaults on command.

Object Description

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

Entry Description

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

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

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

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

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

3.2.9 Object 1016h: Consumer Heartbeat Time

The CAN-4AOUT can be a consumer of heartbeat objects for a single module. This object defines the expected heartbeat cycle time for that module, and if set to zero, it is not used. When the object is 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 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 |
| Description | Consumer heartbeat time |
| Access | RW |
| PDO Mapping | No |
| Value Range | UNSIGNED32 |
| Default Value | 0 |

3.2.10 Object 1017h: Producer Heartbeat Time

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

Object Description

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

Entry Description

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

3.2.11 Object 1018h: Identity Object

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

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

| | | |
|---|-------------------|------------------|
| MSB | | LSB |
| Major revision number (object dictionary) | Hardware Revision | Software Version |

Object Description

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

Entry Description

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

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

| | |
|---------------|--------------|
| Sub-Index | 2h |
| Description | Product Code |
| Access | RO |
| PDO Mapping | No |
| Value Range | 0xAA030541 |
| Default Value | 0xAA030541 |

| | |
|---------------|-----------------|
| 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 |

3.2.12 Object 1020h: Verify Configuration

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

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

For example, a value of 0x30042014 would indicate that the software was compiled on April 30th, 2014. A time value of 0x00001842 would indicate it was compiled at 6:42pm.

Object Description

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

Entry Description

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

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

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

3.2.13 Object 1029h: Error Behaviour

This object controls the state that the CAN-4AOUT 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. And output faults are defined in Section 1.4.

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 (Not Used) |
| Access | RW |
| PDO Mapping | No |
| Value Range | See above |
| Default Value | 1 (No State Change) |

| | |
|---------------|-----------------------------------|
| Sub-Index | 4h |
| Description | Digital Output Fault (DO1 to DO4) |
| Access | RW |
| PDO Mapping | No |
| Value Range | See above |
| Default Value | 1 (No State Change) |

| | |
|---------------|-----------------------------------|
| Sub-Index | 5h |
| Description | Analog Output Fault (AO1 and AO4) |
| Access | RW |
| PDO Mapping | No |
| Value Range | See above |
| Default Value | 1 (No State Change) |

3.2.14 RPDO Behaviour

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

- a) Destroy the PDO by setting bit **exists** (most significant bit) of sub-index 01h of the according PDO communication parameter to 1b
- b) Disable mapping by setting sub-index 00h of the corresponding mapping object to 0
- c) Modify the mapping by changing the values of the corresponding sub-indices
- d) Enable mapping by setting sub-index 00h to the number of mapped objects

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

The CAN-4AOUT can support up to four RPDO messages. All RPDOs on the controller use the similar default communication parameters, with the PDO IDs set according to the pre-defined connection set described in DS-301. Some 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 | 4 | Number of mapped application objects in PDO |
| 1 | 0x73000110 | Analog Output 1 PV |
| 2 | 0x73000210 | Analog Output 2 PV |
| 3 | 0x73000310 | Analog Output 3 PV |
| 4 | 0x73000410 | Analog Output 4 PV |

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

| Sub-Index | Value | Object |
|------------------|--------------|---|
| 0 | 3 | Number of mapped application objects in PDO |
| 1 | 0x25000110 | Extra Received 1 PV |
| 2 | 0x25000210 | Extra Received 2 PV |
| 3 | 0x25000310 | Extra Received 3 PV |
| 4 | 0 | Not used by default |

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

| Sub-Index | Value | Object |
|------------------|--------------|---|
| 0 | 3 | Number of mapped application objects in PDO |
| 1 | 0x25000410 | Extra Received 4 PV |
| 2 | 0x25000510 | Extra Received 5 PV |
| 3 | 0x25000610 | Extra Received 6 PV |
| 4 | 0 | Not used by default |

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

| Sub-Index | Value | Object |
|------------------|--------------|---|
| 0 | 4 | Number of mapped application objects in PDO |
| 1 | 0x62200108 | Digital Output 1 Write State |
| 2 | 0x62200208 | Digital Output 2 Write State |
| 3 | 0x62200308 | Digital Output 3 Write State |
| 4 | 0x62200408 | Digital Output 4 Write State |

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

Object Description

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

Entry Description

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

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

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

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

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

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

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

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

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

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

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

3.2.15 TPDO Behaviour

The CAN-4AOUT can support up to four TPDO messages. All TPDOs on the controller use the similar default communication parameters, with the PDO IDs set according to the pre-defined connection set described in DS-301. Some 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 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

| <i>Sub-Index</i> | <i>Value</i> | <i>Object</i> |
|-------------------------|---------------------|---|
| 0 | 4 | Number of mapped application objects in PDO |
| 1 | 0x23700110 | Analog Output 1 Feedback Value |
| 2 | 0x23700210 | Analog Output 2 Feedback Value |
| 3 | 0x23700310 | Analog Output 3 Feedback Value |
| 4 | 0x23700410 | Analog Output 4 Feedback Value |

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

| <i>Sub-Index</i> | <i>Value</i> | <i>Object</i> |
|-------------------------|---------------------|---|
| 0 | 4 | Number of mapped application objects in PDO |
| 1 | 0x73300110 | Analog Output 1 Field Value |
| 2 | 0x73300210 | Analog Output 2 Field Value |
| 3 | 0x73300310 | Analog Output 3 Field Value |
| 4 | 0x73300410 | Analog Output 4 Field Value |

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

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

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

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

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

Object Description

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

Entry Description

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

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

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

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

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

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

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

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

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

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

3.3 APPLICATION OBJECTS (DS-404)

| <i>Index (hex)</i> | <i>Object</i> | <i>Object Type</i> | <i>Data Type</i> | <i>Access</i> | <i>PDO Mapping</i> |
|-------------------------------|------------------------------|-------------------------------|-------------------------|----------------------|-------------------------------|
| 6220 | DO Write State 1 Output Line | ARRAY | UNSIGNED8 | RW | Yes |
| 6250 | DO Fault Mode 1 Output Line | ARRAY | UNSIGNED8 | RW | No |
| 6260 | DO Fault State 1 Output Line | ARRAY | UNSIGNED8 | RW | No |
| 6302 | AO Decimal Digits PV | ARRAY | UNSIGNED8 | RW | No |
| 6310 | AO Output Type | ARRAY | UNSIGNED16 | RW | No |
| 6332 | AO Decimal Digits FV | ARRAY | UNSIGNED8 | RW | No |
| 6340 | AO Fault Mode | ARRAY | UNSIGNED8 | RW | No |
| 7300 | AO Output Process Value | ARRAY | INTEGER16 | RW | Yes |
| 7320 | AO Output Scaling 1 PV | ARRAY | INTEGER16 | RW | No |
| 7321 | AO Output Scaling 1 FV | ARRAY | INTEGER16 | RW | No |
| 7322 | AO Output Scaling 2 PV | ARRAY | INTEGER16 | RW | No |
| 7323 | AO Output Scaling 2 FV | ARRAY | INTEGER16 | RW | No |
| 7330 | AO Output Field Value | ARRAY | INTEGER16 | RO | Yes |
| 7341 | AO Fault Field Value | ARRAY | INTEGER16 | RW | No |

3.3.1 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 1.3)

Object Description

| | |
|-------------|------------------------------|
| Index | 6220h |
| Name | DO Write State 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | DOx Write State |
| Access | RW |
| PDO Mapping | Yes |
| Value Range | 0 (OFF) or 1 (ON) |
| Default Value | 0 (OFF) |

3.3.2 Object 6250h: DO Fault Mode 1 Output Line

This object defines how a single digital output shall respond when a fault condition is detected on any control input, as described in Table 3.

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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | DOx Fault Mode |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 3 |
| Default Value | 1 (Apply Pre-defined State) |

3.3.3 Object 6260h: DO Fault State 1 Output Line

This object defined 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 | UNSIGNED8 |

Entry Description

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

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | DOx Fault State |
| Access | RW |
| PDO Mapping | No |
| Value Range | 0 (OFF) or 1 (ON) |
| Default Value | 0 (OFF) |

3.3.4 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Decimal Digits PV |
| Access | RW |
| PDO Mapping | No |
| Value Range | 0 to 4 |
| Default Value | 3 [mV] |

3.3.5 Object 6310h: AO Output Type

This object specifies the type of analog output, as defined in Table 4.

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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Output Type |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 4 |
| Default Value | 10 (Voltage) |

3.3.6 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Decimal Digits FV |
| Access | RW |
| PDO Mapping | No |
| Value Range | 0 to 4 |
| Default Value | 3 [mv] |

3.3.7 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 11.

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 | 4 |
| Default Value | 4 |

| | |
|---------------|--------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Fault Mode |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 11 |
| Default Value | 1 (Apply Pre-defined FV) |

3.3.8 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 1.3).

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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Process Value |
| Access | RW |
| PDO Mapping | Yes |
| Value Range | Integer16 |
| Default Value | No |

3.3.9 Object 7320h: AO Output Scaling 1 PV

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

Object Description

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

Entry Description

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

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Scaling 1 PV |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 7 |
| Default Value | 0 [mV] |

3.3.10 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 4. It will be scaled in the physical unit of the output, dependent on range, 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 4. 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 | 4 |
| Default Value | 4 |

| | |
|---------------|----------------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Scaling 1 FV |
| Access | RW |
| PDO Mapping | No |
| Value Range | Dependent on range (see Table 4) |
| Default Value | 0 [mV] |

3.3.11 Object 7322h: AO Output Scaling 2 PV

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

Object Description

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

Entry Description

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

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Scaling 2 PV |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 7 |
| Default Value | 5000 [mV] |

3.3.12 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 9. It will be scaled in the physical unit of the output, dependent on range, 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 4. 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 | 4 |
| Default Value | 4 |

| | |
|---------------|----------------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Scaling 2 FV |
| Access | RW |
| PDO Mapping | No |
| Value Range | Dependent on range (see Table 4) |
| Default Value | 5000 [mV] |

3.3.13 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 1.3, and the scaling applied as shown in Figure 7. It is defined in the physical unit of the output dependent on range, as outlined in Table 4. 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Field Value |
| Access | RO |
| PDO Mapping | Yes |
| Value Range | Integer16 |
| Default Value | No |

3.3.14 Object 7341h: AO Fault Field Value

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 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 | 4 |
| Default Value | 4 |

| | |
|---------------|----------------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Fault Field Value |
| Access | RW |
| PDO Mapping | No |
| Value Range | Dependent on range (see Table 4) |
| Default Value | 0 [mV] |

3.4 MANUFACTURER OBJECTS

| Index (hex) | Object | Object Type | Data Type | Access | PDO Mapping |
|--------------------|-----------------------------------|--------------------|------------------|---------------|--------------------|
| 2223 | DO Blink Rate 1 Output Line | ARRAY | UNSIGNED16 | RW | No |
| 2240 | DO Digital Range | ARRAY | UNSIGNED8 | RW | No |
| 2241 | DO Polarity | ARRAY | UNSIGNED8 | RW | No |
| 2300 | AO Override Field Value | ARRAY | INTEGER16 | 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 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 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 Response | ARRAY | UNSIGNED8 | RW | No |
| 2370 | AO Feedback Field Value | ARRAY | INTEGER16 | RO | Yes |
| 2380 | AO Output Frequency | ARRAY | UNSIGNED16 | RW | No |
| 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 |
| 3yz0 | LTyz Input X-Axis Source | VAR | UNSIGNED8 | RW | No |
| 3yz1 | LTyz Input X-Axis Number | VAR | UNSIGNED8 | RW | No |
| 3yz2 | LTyz Auto Repeat | VAR | UNSIGNED8 | RW | No |
| 3yz3 | LTyz X-Axis Decimal Digits PV | VAR | UNSIGNED8 | RW | No |
| 3yz4 | LTyz Y-Axis Decimal Digits PV | VAR | UNSIGNED8 | RW | No |
| 3yz5 | LTyz Point Response | ARRAY | UNSIGNED8 | RW | No |
| 3yz6 | LTyz Point X-Axis PV | ARRAY | INTEGER32 | RW | No |
| 3yz7 | LTyz Point Y-Axis PV | ARRAY | INTEGER16 | RW | No |
| 3yz8 | LTyz Output Y-Axis PV | VAR | INTEGER16 | RO | Yes |
| 3300 | Logic Block Enable | ARRAY | BOOLEAN | RW | No |
| 3310 | Logic Block Selected Table | ARRAY | UNSIGNED8 | RO | Yes |
| 3320 | Logic Output Process Value | ARRAY | INTEGER16 | RO | Yes |
| 3x01 | LB(x-3) Lookup Table Number | ARRAY | UNSIGNED8 | RW | No |
| 3x02 | LB(x-3) Function Logical Operator | ARRAY | UNSIGNED8 | RW | No |
| 3x11 | LB(x-3) Function A Condition 1 | RECORD | UNSIGNED8 | RW | No |

| | | | | | |
|------|--|--------|-----------|----|-----|
| 3x12 | LB(x-3) Function A Condition 2 | RECORD | UNSIGNED8 | RW | No |
| 3x13 | LB(x-3) Function A Condition 3 | RECORD | UNSIGNED8 | RW | No |
| 3x21 | LB(x-3) Function B Condition 1 | RECORD | UNSIGNED8 | RW | No |
| 3x22 | LB(x-3) Function B Condition 2 | RECORD | UNSIGNED8 | RW | No |
| 3x23 | LB(x-3) Function B Condition 3 | RECORD | UNSIGNED8 | RW | No |
| 3x31 | LB(x-3) Function C Condition 1 | RECORD | UNSIGNED8 | RW | No |
| 3x32 | LB(x-3) Function C Condition 2 | RECORD | UNSIGNED8 | RW | No |
| 3x33 | LB(x-3) Function C Condition 3 | RECORD | UNSIGNED8 | RW | No |
| 4000 | Math Block Enable | ARRAY | BOOLEAN | RW | No |
| 4021 | Math Output Scaling 1 PV | ARRAY | INTEGER16 | RW | No |
| 4023 | Math Output Scaling 2 PV | ARRAY | INTEGER16 | RW | No |
| 4030 | Math Output Process Value | ARRAY | INTEGER16 | RO | Yes |
| 4032 | Math Output Decimal Digits PV | ARRAY | UNSIGNED8 | RW | No |
| 4y00 | Math Y Input Source | ARRAY | UNSIGNED8 | RW | No |
| 4y01 | Math Y Input Number | ARRAY | UNSIGNED8 | RW | No |
| 4y02 | Math Y Function Number | ARRAY | UNSIGNED8 | RW | No |
| 4y03 | Math Y Input Decimal Digits FV | ARRAY | UNSIGNED8 | RW | No |
| 4y20 | Math Y Input Scaling 1 FV | ARRAY | INTEGER16 | RW | No |
| 4y22 | Math Y Input Scaling 2 FV | ARRAY | INTEGER16 | RW | No |
| 4y40 | Math Y Input Gain | ARRAY | INTEGER8 | RW | No |
| 4y50 | Math Y Operator | ARRAY | UNSIGNED8 | 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 |
| 5025 | Power Supply Fault Shutdown | VAR | UNSIGNED8 | RW | No |
| 5030 | Processor Temperature Field Value | VAR | FLOAT32 | RO | Yes |
| 5031 | Enable Error Detection on Temperature | VAR | UNSIGNED8 | RW | No |
| 5032 | Over Temperature Threshold | VAR | UNSIGNED8 | RW | No |
| 5033 | Hysteresis to Clear Temperature Fault | VAR | UNSIGNED8 | RW | No |

| | | | | | |
|------|----------------------------|-----|-----------|----|----|
| 5034 | Temperature Fault Shutdown | VAR | UNSIGNED8 | RW | No |
| 5550 | Enable Auto Updates | 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 **yz** = 01 to 12 (LUT 1 to 12) and **x** = 4 to 7 (Logic 1 to 4) and **y** = 1 to 6 (Math 1 to 6)

3.4.1 Object 2223h: DO Blink Rate 1 Output Line

This object is used only when an ON/OFF digital output has been specified for a blinking response by object 2241h 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 Rate 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | DOx Blink Rate |
| Access | RW |
| PDO Mapping | No |
| Value Range | 0 to 60,000 |
| Default Value | 500 [ms] |

3.4.2 Object 2240h: DO Digital Range

This object determines if the output is at +5V or +12V when ON. It does not apply to other types.

Object Description

| | |
|-------------|------------------|
| Index | 2240h |
| Name | DO Digital Range |
| Object Type | ARRAY |
| Data Type | UNSIGNED8 |

Entry Description

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

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | DOx Digital Range |
| Access | RW |
| PDO Mapping | No |
| Value Range | 0 (+5V) to 1(+12V) |
| Default Value | 0 (+5V) |

3.4.3 Object 2241h: 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 | 2241h |
| 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | DOx Polarity |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 1 |
| Default Value | 0 (Normal ON/OFF) |

3.4.4 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 | 4 |
| Default Value | 4 |

| | |
|---------------|----------------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Override FV |
| Access | RW |
| PDO Mapping | No |
| Value Range | Dependent on range (see Table 4) |
| Default Value | 1000 [mV] |

3.4.5 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Ramp Up |
| Access | RW |
| PDO Mapping | Yes |
| Value Range | 0 to 60,000 |
| Default Value | 1000 [ms] |

3.4.6 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 | 2331h |
| 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Ramp Down |
| Access | RW |
| PDO Mapping | Yes |
| Value Range | 0 to 60,000 |
| Default Value | 1000 [ms] |

3.4.7 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 5. The available control sources on the CAN-4AOUT controller are listed in Table 5. 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 | 4 |
| Default Value | 4 |

| | |
|---------------|--------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Control Input Source |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 5 |
| Default Value | 1 (CANopen® RPDO) |

3.4.8 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 5. The available control numbers are dependent on the source selected, as shown in Table 6. Once selected, the control represents the process value (X-Axis input) in Figure 9. Objects 6302h, 7320h, 7322h should therefore be updated to match the scaling limits defined by the control source/number, as listed in Table 7.

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 | 4 |
| Default Value | 4 |

| | |
|---------------|--------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Control Input Number |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 6 |
| Default Value | x (CANopen® Message x) |

3.4.9 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 8.

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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Control Response |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 8 |
| Default Value | 1 (Output OFF below Scaling 1 PV) |

3.4.10 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 5. The available control sources on the CAN-4AOUT controller are listed in Table 5. 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Enable Input Source |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 5 |
| Default Value | 0 (control not used) |

3.4.11 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 5. The available control numbers are dependent on the source selected, as shown in Table 6.

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 | 4 |
| Default Value | 4 |

| | |
|---------------|-------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Enable Input Number |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 6 |
| Default Value | 0 (null control source) |

3.4.12 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 for analog output 1 to 2 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-------------------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Enable Response |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 9 |
| Default Value | 3 (Enable When Off, Else Shut Off) |

3.4.13 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 outputs as shown in the logic flowchart in Figure 5. The available control sources on the CAN-4AOUT controller are listed in Table 5. 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 | 4 |
| Default Value | 4 |

| | |
|---------------|---------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Override Input Source |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 5 |
| Default Value | 0 (control not used) |

3.4.14 Object 2361h: AO Override Input Number

This object defines the number of the source that will be used to override the analog outputs as shown in the logic flowchart in Figure 5. The available control numbers are dependent on the source selected, as shown in Table 6.

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 | 4 |
| Default Value | 4 |

| | |
|---------------|---------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Override Input Number |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 6 |
| Default Value | 0 (null control source) |

3.4.15 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 |

Entry Description

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

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Override Response |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 10 |
| Default Value | 0 (Override When On) |

3.4.16 Object 2370h: AO Feedback Field Value

This read-only object reflects the target Output FV based on PV vs. FV calculations (see Figure 3) 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 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 | 4 |
| Default Value | 4 |

| | |
|---------------|----------------------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Feedback Field Value |
| Access | RO |
| PDO Mapping | Yes |
| Value Range | Dependent on range (see Table 4) |
| Default Value | No |

3.4.17 Object 2380h: AO Output Frequency

This object is used to set the frequency of the outputs. When the output is under Frequency mode, it will be used to set duty cycle of the outputs.

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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (x = 1 to 4) |
| Description | AOx Output Frequency |
| Access | RW |
| PDO Mapping | No |
| Value Range | 1...25000 Hz |
| Default Value | 25000 |

3.4.18 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.

Object Description

| | |
|-------------|---------------------------------|
| Index | 2500h |
| Name | EC Extra Received 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 | 6 |
| Default Value | 6 |

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

3.4.19 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) |

3.4.20 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 4. 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 |

3.4.21 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 4. 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) |

3.4.22 Object 3yz0h: LTyz 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-4AOUT are listed in Table 5. 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 | 3yz0h (where yz = 01 to 10) |
| Name | LTyz Input X-Axis Source |
| Object Type | VARIABLE |
| Data Type | UNSIGNED8 |

Entry Description

| | |
|---------------|----------------------|
| Sub-Index | 0h |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 5 |
| Default Value | 0 (control not used) |

3.4.23 Object 3yz1h: LTyz 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 6. 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 16.

Object Description

| | |
|-------------|-----------------------------|
| Index | 3yz1h (where yz = 01 to 10) |
| Name | LTyz Input X-Axis Number |
| Object Type | VARIABLE |
| Data Type | UNSIGNED8 |

Entry Description

| | |
|---------------|-------------------------|
| Sub-Index | 0h |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 6 |
| Default Value | 0 (null control source) |

3.4.24 Object 3yz2h: LTyz Auto Repeat

This object determines whether the lookup table sequence will repeat automatically once the last point in the lookup table has been completed. This object is only taken into effect when the response is set to '*Time Response*'. For more details on the functionality of this object and its effect on the lookup table, please refer to section 1.4.4

Object Description

| | |
|-------------|-------------------------------|
| Index | 3yz2h (where yz = 01 to 10) |
| Name | LTyz X-Axis Decimal Digits PV |
| Object Type | VARIABLE |
| Data Type | UNSIGNED8 |

Entry Description

| | |
|---------------|-------------------|
| Sub-Index | 0h |
| Access | RW |
| PDO Mapping | No |
| Value Range | 0 (OFF) to 1 (ON) |
| Default Value | 0 [OFF] |

3.4.25 Object 3yz3h: LTyz 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.

Object Description

| | |
|-------------|-------------------------------|
| Index | 3yz3h (where yz = 01 to 10) |
| Name | LTyz 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 |
| Default Value | 0 |

3.4.26 Object 3yz4h: LTyz 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, 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 | 3yz4h (where yz = 01 to 10) |
| Name | LTyz 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 |

3.4.27 Object 3yz5h: LTyz 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 12. See Figure 7 for an example of the difference between a step and ramp response.

Object Description

| | |
|-------------|-----------------------------|
| Index | 3yz5h (where yz = 01 to 10) |
| Name | LTyz 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 12 (0 or 1) |
| Default Value | 0 (x-axis data response) |

| | |
|---------------|--------------------------|
| Sub-Index | 2h to 11h (x = 2 to 11) |
| Description | LTyz Point X Response |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 12 (0, 1 or 2) |
| Default Value | 1 (ramp to response) |

3.4.28 Object 3yz6h: LTyz 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 3yz5), 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 3yz3h, LTyz X-Axis Decimal Digits PV.

$$\text{MinInt16} \leq X_1 \leq X_2 \leq X_3 \leq X_4 \leq X_5 \leq X_6 \leq X_7 \leq X_8 \leq X_9 \leq X_{10} \leq X_{11} \leq \text{MaxInt16}$$

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 | 3yz6h (where yz = 01 to 10) |
| Name | LTyz 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 | LTyz Point X-Axis PVx | |
| Access | RW | |
| PDO Mapping | No | |
| Value Range | See above (data) | 1 to 86400000 (time) |
| Default Value | $10^{*(x-1)}$ | No |

3.4.29 Object 3yz7h: LTyz 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 3yz4h, LTyz Y-Axis Decimal Digits PV.

Object Description

| | |
|-------------|-----------------------------|
| Index | 3yz7h (where yz = 01 to 10) |
| Name | LTyz 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 | LTyz Point Y-Axis PVx |
| Access | RW |
| PDO Mapping | No |
| Value Range | Integer16 |
| Default Value | $10^{*(x-1)}$ [i.e. 0, 10, 20, 30, ... 100] |

3.4.30 Object 3yz8h: LTyz 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. The physical unit for this object is undefined, and it will use the resolution defined in object 3yz4h, LTyz Y-Axis Decimal Digits PV.

Object Description

| | |
|-------------|-----------------------------|
| Index | 3yz8h (where yz = 01 to 10) |
| Name | LTyz 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 |

3.4.31 Object 3300h: Logic Block Enable

This object defines whether or not the logic shown in Figure 10 will be evaluated.

Object Description

| | |
|-------------|--------------------|
| Index | 3300h |
| 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 | 3 |
| Default Value | 3 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 3h (x = 1 to 3) |
| Description | LBx Enable |
| Access | RW |
| PDO Mapping | No |
| Value Range | 0 (FALSE) or 1 (TRUE) |
| Default Value | 0 [FALSE] |

3.4.32 Object 3310h: 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 10 has been performed.

Object Description

| | |
|-------------|----------------------------|
| Index | 3310h |
| 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 | 3 |
| Default Value | 3 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 3h (x = 1 to 3) |
| Description | LBx Selected Table |
| Access | RO |
| PDO Mapping | Yes |
| Value Range | 1 to 10 |
| Default Value | No |

3.4.33 Object 3320h: 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 7. This value has a fixed decimal digit value of 1 giving a resolution of 0.1%.

Object Description

| | |
|-------------|-----------------------|
| Index | 3320h |
| 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 | 3 |
| Default Value | 3 |

| | |
|---------------|-----------------------------|
| Sub-Index | 1h to 3h (x = 1 to 3) |
| Description | LBx Output PV |
| Access | RO |
| PDO Mapping | Yes |
| Value Range | Dependent on Selected Table |
| Default Value | No |

3.4.34 Object 3x01h: LB(x-3) Lookup Table Numbers

This object determines which of the ten lookup tables supports on the controller 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 | 3x01h (where x = 4 to 6) |
| Name | LB(x-3) 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 | LB(x-3) Lookup Table Y Number |
| Access | RW |
| PDO Mapping | No |
| Value Range | 1 to 10 |
| Default Value | See Table 18 |

3.4.35 Object 3x02h: LB(x-3) 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 16. See Section 1.5 for more information about how this object is used.

Object Description

| | |
|-------------|-----------------------------------|
| Index | 3x02h (where x = 4 to 6) |
| Name | LB(x-3) 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 | LB(x-3) Function Y Logical Operator |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 16 |
| Default Value | Function A = 1 (and all) Function B = 1 (and all) Function C = 0 (default) |

3.4.36 Object 3x11h: LB(x-3) Function A Condition 1**3.4.37 Object 3x12h: LB(x-3) Function A Condition 2****3.4.38 Object 3x13h: LB(x-3) Function A Condition 3****3.4.39 Object 3x21h: LB(x-3) Function B Condition 1****3.4.40 Object 3x22h: LB(x-3) Function B Condition 2****3.4.41 Object 3x23h: LB(x-3) Function B Condition 3****3.4.42 Object 3x31h: LB(x-3) Function C Condition 1****3.4.43 Object 3x32h: LB(x-3) Function C Condition 2****3.4.44 Object 3x33h: LB(x-3) Function C Condition 3**

These objects, 3xyzh, represent Logic Block z, Function y, Condition z, where x = 4 to 6, y = 1 (A) to 3 (C), and z = 1 to 3. All of these objects are a special type of record, defined in Table 13. Information on how to use these objects is defined in Section 1.5.

Object Description

| | |
|-------------|--------------------------------|
| Index | 3xyzh |
| Name | LB(x-3) 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 5 |
| Default Value | 1 (CANopen® Message) |

| | |
|---------------|----------------------|
| Sub-Index | 2h |
| Description | Argument 1 Number |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 6 |
| Default Value | 2 (EC Received PV 1) |

| | |
|---------------|-------------------|
| Sub-Index | 3h |
| Description | Argument 2 Source |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 5 |
| Default Value | 3 (Constant PV) |

| | |
|---------------|-------------------|
| Sub-Index | 4h |
| Description | Argument 2 Number |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 6 |
| Default Value | 3 (Constant FV 1) |

| | |
|---------------|--------------|
| Sub-Index | 5h |
| Description | Operator |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 14 |
| Default Value | 0 (Equals) |

3.4.45 Object 4000h: Math Function Enable

The corresponding sub-index of object must be set TRUE in order for a math function block to be enabled. Otherwise, the output will always be at 0.

Object Description

| | |
|-------------|----------------------|
| Index | 4000h |
| Name | Math Function Enable |
| Object Type | ARRAY |
| Data Type | BOOLEAN |

Entry Description

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

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (Y = 1 to 4) |
| Description | Math Y Enable |
| Access | RW |
| PDO Mapping | No |
| Value Range | 0 (FALSE) or 1 (TRUE) |
| Default Value | 0 [FALSE] |

3.4.46 Object 4021h: Math Output Scaling 1 PV

This object defines the process value that would correspond to 0% output from the math calculation. The object would apply the resolution defined in object 4532h Math Output Decimal Digits PV. The physical unit is undefined.

Object Description

| | |
|-------------|--------------------------|
| Index | 4021h |
| Name | Math Output Scaling 1 PV |
| Object Type | ARRAY |
| Data Type | INTEGER16 |

Entry Description

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

| | |
|---------------|----------------------------|
| Sub-Index | 1h to 4h (Y = 1 to 4) |
| Description | Math Y Output Scaling 1 PV |
| Access | RW |
| PDO Mapping | No |
| Value Range | -32768 to 32767 |
| Default Value | 0 |

3.4.47 Object 4023h: Math Output Scaling 2 PV

This object defines the process value that would correspond to 100% output from the math calculation. The object would apply the resolution defined in object 4532h Math Output Decimal Digits PV. The physical unit is undefined.

Object Description

| | |
|-------------|--------------------------|
| Index | 4023h |
| Name | Math 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 | 4 |
| Default Value | 4 |

| | |
|---------------|----------------------------|
| Sub-Index | 1h to 4h (Y = 1 to 4) |
| Description | Math Y Output Scaling 2 PV |
| Access | RW |
| PDO Mapping | No |
| Value Range | -32768 to 32767 |
| Default Value | 10000 (100.00) |

3.4.48 Object 4030h: Math Output Process Value

This read-only object reflects the output from the math function block after it has been scaled by objects 4021h and 4023h. The object would apply the resolution defined in object 4032h Math Output Decimal Digits PV. The physical unit is undefined.

Object Description

| | |
|-------------|---------------------------|
| Index | 4030h |
| Name | Math 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------------|
| Sub-Index | 1h to 4h (Y = 1 to 4) |
| Description | Math Y Output Process Value |
| Access | RO |
| PDO Mapping | Yes |
| Value Range | -32768 to 32767 |
| Default Value | No |

3.4.49 Object 4032h: Math Output Decimal Digits PV

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 process value object.

Object Description

| | |
|-------------|-------------------------------|
| Index | 4032h |
| Name | Math Output 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 | 4 |
| Default Value | 4 |

| | |
|---------------|--------------------------|
| Sub-Index | 1h to 4h (Y = 1 to 4) |
| Description | Math Y Decimal Digits PV |
| Access | RW |
| PDO Mapping | No |
| Value Range | 0 to 4 |
| Default Value | 2 (0.01) |

3.4.50 Object 4y00h: Math Y Input Source

This object defines the input sources that will be used in the mathematical calculations. Here, y = 1 to 4 – representing Math Block 1 to Math Block 4. If a control source is not used, the associate mathematical calculation would be ignored. The available control sources on the controller are listed in Table 5.

Object Description

| | |
|-------------|---------------------|
| Index | 4y00h (y = 1 to 4) |
| Name | Math Y 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------------|
| Sub-Index | 1h to 4h (X = 1 to 4) |
| Description | Math Y Input X Source |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 5 |
| Default Value | 0 (control source not used) |

3.4.51 Object 4y01h: Math Y Input Number

This object defines the number of the input source that will be used in the math calculation. The available control numbers are dependent on the source selected, as shown in Table 6. Once selected, the input value will be used in the corresponding calculation as described in Section 1.6.

Object Description

| | |
|-------------|---------------------|
| Index | 4y01h (y = 1 to 4) |
| Name | Math Y 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 | 4 |
| Default Value | 4 |

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (X = 1 to 4) |
| Description | Math Y Input X Number |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 15 |
| Default Value | 0 (null input) |

3.4.52 Object 4y02h: Math Y Input Function Number

This object defines the number of the function within the Math Block will be used in the math calculation. This object is applicable when the Input Source together with the Input Number match the Math Block that is being configured. If Input Source and Input Number match the Math Block being configured and the Function Number is 0, this object is ignored. For more details, refer to Section 1.6.

Object Description

| | |
|-------------|---------------------|
| Index | 4y01h (y = 1 to 4) |
| Name | Math Y 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 | 4 |
| Default Value | 4 |

| | |
|---------------|--------------------------------|
| Sub-Index | 1h to 4h (X = 1 to 4) |
| Description | Math Y Input X Function Number |
| Access | RW |
| PDO Mapping | No |
| Value Range | 0 to 3 |
| Default Value | 0 (null input) |

3.4.53 Object 4y03h: Math Y Input Decimal Digits FV

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

Object Description

| | |
|-------------|--------------------------------|
| Index | 4y03h (y = 1 to 4) |
| Name | Math Y Input 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 | 4 |
| Default Value | 4 |

| | |
|---------------|----------------------------------|
| Sub-Index | 1h to 4h (X = 1 to 4) |
| Description | Math Y Input X Decimal Digits PV |
| Access | RW |
| PDO Mapping | No |
| Value Range | 0 to 4 |
| Default Value | 2 (0.01) |

3.4.54 Object 4y20h: Math Y Input Scaling 1 FV

This object defines the input field value that would correspond to 0% when scaling the input for use in the math calculation. All inputs are normalized to a percentage before being used by the math function block. The object would apply the resolution defined in object 4y03h Math Y Input Decimal Digits FV. The physical unit would match that of the input source.

Object Description

| | |
|-------------|---------------------------|
| Index | 4y20h (y = 1 to 4) |
| Name | Math Y Input Scaling 1 FV |
| Object Type | ARRAY |
| Data Type | INTEGER16 |

Entry Description

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

| | |
|---------------|-----------------------------|
| Sub-Index | 1h to 4h (X = 1 to 4) |
| Description | Math Y Input X Scaling 1 FV |
| Access | RW |
| PDO Mapping | No |
| Value Range | INTEGER16 |
| Default Value | 0 |

3.4.55 Object 4y22h: Math Y Input Scaling 2 FV

This object defines the input field value that would correspond to 100% when scaling the input for use in the math calculation. All inputs are normalized to a percentage before being used by the math function block. The object would apply the resolution defined in object 4y03h Math Y Input Decimal Digits FV. The physical unit would match that of the input source.

Object Description

| | |
|-------------|---------------------------|
| Index | 4y22h (y = 1 to 4) |
| Name | Math Y Input Scaling 2 FV |
| Object Type | ARRAY |
| Data Type | INTEGER16 |

Entry Description

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

| | |
|---------------|-----------------------------|
| Sub-Index | 1h to 4h (X = 1 to 4) |
| Description | Math Y Input X Scaling 2 FV |
| Access | RW |
| PDO Mapping | No |
| Value Range | INTEGER16 |
| Default Value | 10000 (100.00%) |

3.4.56 Object 4y40h: Math Y Input Gain

This object can be used to adjust the 'weight' of the input in the math calculation. It is a multiplier of the input after it has been converted into a percentage, before it is used in the math calculation. This object has a fixed resolution of 2 decimal digits.

Object Description

| | |
|-------------|--------------------|
| Index | 4y40h (y = 1 to 4) |
| Name | Math Y Input Gain |
| Object Type | ARRAY |
| Data Type | INTEGER8 |

Entry Description

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

| | |
|---------------|-----------------------|
| Sub-Index | 1h to 4h (X = 1 to 4) |
| Description | Math Y Input X Gain |
| Access | RW |
| PDO Mapping | No |
| Value Range | -100 to 100 |
| Default Value | 100 (1.0) |

3.4.57 Object 4y50h: Math Y Operator

This object defines the actual operators that will be used in each stage of a math calculation, as described in Section 1.6. The options for this object are listed in Table 19.

Object Description

| | |
|-------------|--------------------|
| Index | 4y50h (y = 1 to 4) |
| Name | Math Y 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 (X = 1 to 3) |
| Description | Math Y Function X Operator |
| Access | RW |
| PDO Mapping | No |
| Value Range | See Table 19 |
| Default Value | 12 (Plus) |

3.4.58 Object 5010h: Constant Field Value

This object is provided to allow the user to compare against a fixed value, i.e. 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 ten 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 | 0 |
| Description | Largest sub-index supported |
| Access | RO |
| PDO Mapping | No |
| Value Range | 15 |
| Default Value | 15 |

| | |
|---------------|----------------|
| Sub-Index | 1 |
| Description | Constant False |
| Access | RO |
| PDO Mapping | No |
| Value Range | 0 |
| Default Value | 0 (false) |

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

| | |
|---------------|---------------|
| Sub-Index | 3 |
| Description | Constant FV 3 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 3.141593 |

| | |
|---------------|---------------|
| Sub-Index | 4 |
| Description | Constant FV 4 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 2.718282 |

| | |
|---------------|---------------|
| Sub-Index | 5 |
| Description | Constant FV 5 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 1.414214 |

| | |
|---------------|---------------|
| Sub-Index | 6 |
| Description | Constant FV 6 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 1.732051 |

| | |
|---------------|---------------|
| Sub-Index | 7 |
| Description | Constant FV 7 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 2.236068 |

| | |
|---------------|---------------|
| Sub-Index | 8 |
| Description | Constant FV 8 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 2.50 |

| | |
|---------------|---------------|
| Sub-Index | 9 |
| Description | Constant FV 9 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 5.00 |

| | |
|---------------|----------------|
| Sub-Index | 10 |
| Description | Constant FV 10 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 10.00 |

| | |
|---------------|----------------|
| Sub-Index | 11 |
| Description | Constant FV 11 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 20.00 |

| | |
|---------------|----------------|
| Sub-Index | 12 |
| Description | Constant FV 12 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 40.00 |

| | |
|---------------|----------------|
| Sub-Index | 13 |
| Description | Constant FV 13 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 60.00 |

| | |
|---------------|----------------|
| Sub-Index | 14 |
| Description | Constant FV 14 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 80.00 |

| | |
|---------------|----------------|
| Sub-Index | 15 |
| Description | Constant FV 15 |
| Access | RW |
| PDO Mapping | No |
| Value Range | Float32 |
| Default Value | 100.00 |

3.4.59 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 70 [V] |
| Default Value | No |

3.4.60 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 1.7.

Object Description

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

Entry Description

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

3.4.61 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 1.7.

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) |

3.4.62 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 1.7.

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) |

3.4.63 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 1.7.

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 | 3 (V) |

3.4.64 Object 5025h: Enable Power Supply Fault Disables Outputs

This write-able object is available to enable/disable on all the outputs when there are faults on power supply measured in the system. For more information, please refer to Section 1.7.

Object Description

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

Entry Description

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

3.4.65 Object 5030h: Processor Temperature Field Value

This read-only object is available for diagnostic feedback purposes. It reflects the measured processor temperature of the controller. The physical unit for this object is 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 [DegC] |
| Default Value | No |

3.4.66 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 1.7.

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) |

3.4.67 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 1.7.

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) |

3.4.68 Object 5033h: 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 1.7.

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) |

3.4.69 Object 5034h: Enable Temperature Fault Shutdown

This write-able object is available to enable shutdown when there are faults on temperature measured in the system. For more information, please refer to Section 1.7.

Object Description

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

Entry Description

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

3.4.70 Object 5550h: Enable Automatic Updates

This object allows the controller to update objects to defaults automatically when an output type is changed. By default this object is TRUE.

Object Description

| | |
|-------------|---------------------|
| Index | 5550h |
| Name | Enable Auto Updates |
| Object Type | VARIABLE |
| Data Type | UNSIGNED8 |

Entry Description

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

3.4.71 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 controller as a stand-alone module. This should always be set FALSE whenever it is connected to a standard master/slave network.

Object Description

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

Entry Description

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

3.4.72 Object 5B50h: Change Baud Rate

The CAN-4AOUT 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) |

3.4.73 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/>.

Input

| | |
|-----------------------------|---|
| Power Supply Input | 12V, 24V, or 48Vdc nominal (9 to 60 Vdc power supply range) |
| Surge Protection | Provided |
| Reverse Polarity Protection | Provided |
| Undervoltage Protection | Provided |
| Overvoltage Protection | Provided (Hardware shutdown at 75V) |
| Input | CANopen® {SAE J1939 (model AX030540)} The CAN signal can be filtered to accept messages from a single address on the network permitting a link to a specific ECU. |

Outputs

| | |
|----------------------------------|---|
| CAN | The controller can send a single frame application specific CAN message to the network continuously or on request. |
| Signal Outputs | Up to 4 signal outputs are selectable by the user. Refer to Table 1.0. |
| Ground Connection | 3 Analog GND connections are provided. They are connected together internally. |
| Protection for Output + Terminal | Fully protected against short circuit to ground and short circuit to power supply rail. Unit will fail safe in the case of a short circuit condition, self-recovering when the short is removed. |

| | |
|---------------------|---|
| Table 1.0 - Outputs | |
| Output Types | Up to 4 signal outputs are available. Using the Axiomatic Electronic Assistant, the user selects the output mode (voltage, current, or digital): <ul style="list-style-type: none"> the minimum and maximum values for the output signal from the +/-10V or +/-20 mA range standard analog voltage signal ranges, including: 0-5V; 0-10V; +/-5V; +/-10V with maximum 25mA load analog current signal ranges, including: 0-20mA; 4-20 mA; and +/-20mA with maximum 500Ω load PWM outputs, including: PWM 0-100% D.C.; and Frequency 0.5-30 kHz (5V or 12V Amplitude, maximum 40mA load). PWM outputs are push-pull type. Maximum 40mA sourcing/sinking. <p>The outputs can be globally enabled or disabled.</p> |
| Output Accuracy | Voltage, Current: 0.2% preliminary PWM: 0.1% preliminary |
| Output Resolution | 0.015% (>16 bit) |

General Specifications

| | |
|--------------------------------|--|
| Microcontroller | STM32F405, 32-bit, 1 MByte flash program memory |
| Isolation | 300 Vrms Galvanic isolation between the power supply input and the analog signal outputs and the CAN circuit. |
| Control Logic | Standard embedded software is provided. (Application-specific control logic or factory programmed setpoints are available on request.) |
| Monitoring and Troubleshooting | The controller can also transmit a CAN application message carrying signals internally generated by the controller. This feature can be used for monitoring and debugging purposes. |
| CAN | 1 CAN port (CANopen®) |
| User Interface (PC-based) | EDS File (Download from product page.) |
| Software Reflashing | PC-based Axiomatic Electronic Assistant, P/Ns: AX070502 or AX070506K |
| Quiescent Current Draw | 107 mA @ 12V and full load 52 mA @ 24V and full load 32 mA @ 48V and full load |
| Response Time | <10 mSec. max. |
| Weight | 0.55 lb. (0.249 kg) |
| Operating Conditions | -40 to 85 °C (-40 to 185 °F) |
| Storage Temperature | -55 to 125 °C (-67 to 257°F) |
| Compliance | CE / UKCA marking |
| Protection | IP67, PCB is conformal coated and protected by the housing. |
| Vibration and Shock | MIL-STD-202G, Test 204D, 214A and 213B 7.68 Grms (Random), 10 g peak (Sine), 50 g (Shock) |
| Enclosure and Dimensions | High Temperature Nylon Enclosure – (TE Deutsch P/N: EEC-325X4B) 4.62 x 5.24 x 1.43 inches 117.42 x 133.09 x 36.36 mm (W x L x H excluding mating plugs) Refer to the dimensional drawing. |

| | |
|----------------------------|---|
| <p>Mounting</p> | <p>Mounting holes sized for ¼ inch or M6 bolts. The bolt length will be determined by the end-user's mounting plate thickness. The mounting flange of the controller is 0.63 inches (16 mm) thick.</p> <p>If the module is mounted without an enclosure, it should be mounted vertically with connectors facing left and right to reduce likelihood of moisture entry.</p> <p>The CAN wiring is considered intrinsically safe. The power wires are not considered intrinsically safe and so in hazardous locations, they need to be located in conduit or conduit trays at all times. The module must be mounted in an enclosure in hazardous locations for this purpose.</p> <p>No wire or cable harness should exceed 30 meters in length. The power input wiring should be limited to 10 meters.</p> <p>All field wiring should be suitable for the operating temperature range.</p> <p>Install the unit with appropriate space available for servicing and for adequate wire harness access (6 inches or 15 cm) and strain relief (12 inches or 30 cm).</p> |
| <p>Network Termination</p> | <p>It is necessary to terminate the network with external termination resistors. The resistors are 120 Ohm, 0.25W minimum, metal film or similar type. They should be placed between CAN_H and CAN_L terminals at both ends of the network.</p> |

5 VERSION HISTORY

| Version | Date | Author | Modifications |
|----------------|-------------------------------|----------------|---|
| 1 | March 5th, 2021 | Jessica Chen | Initial Draft |
| - | March 15 th , 2021 | Jessica Chen | Added Weight and Response time |
| - | April 8 th , 2021 | Jessica Chen | Modified Table of Contents |
| - | May 31st, 2021 | Jessica Chen | Updated Drawing |
| - | June 11, 2021 | Amanda Wilkins | Updated weight |
| 1.1 | July 13, 2023 | M Ejaz | Fixed legacy issues |
| - | August 3, 2023 | Kiril Mojsov | Fixed further legacy issues |
| 1.2 | January 26, 2024 | M Ejaz | Added some details about PWM output in Technical Specifications |

OUR PRODUCTS

AC/DC Power Supplies
Actuator Controls/Interfaces
Automotive Ethernet Interfaces
Battery Chargers
CAN Controls, Routers, Repeaters
CAN/WiFi, CAN/Bluetooth, Routers
Current/Voltage/PWM Converters
DC/DC Power Converters
Engine Temperature Scanners
Ethernet/CAN Converters,
Gateways, Switches
Fan Drive Controllers
Gateways, CAN/Modbus, RS-232
Gyroscopes, Inclinometers
Hydraulic Valve Controllers
Inclinometers, Triaxial
I/O Controls
LVDT Signal Converters
Machine Controls
Modbus, RS-422, RS-485 Controls
Motor Controls, Inverters
Power Supplies, DC/DC, AC/DC
PWM Signal Converters/Isolators
Resolver Signal Conditioners
Service Tools
Signal Conditioners, Converters
Strain Gauge CAN Controls
Surge Suppressors

OUR COMPANY

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

QUALITY DESIGN AND MANUFACTURING

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

WARRANTY, APPLICATION APPROVALS/LIMITATIONS

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

COMPLIANCE

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

SAFE USE

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



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

SERVICE

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