CAN to PWM
SIGNAL CONVERTER
With CANopen®

USER MANUAL

P/N: AX130701

ACRONYMS

SO	Signal 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
DO	Digital Output
EDS	Electronic Data Sheet
EMCY	Emergency
LSB	Least Significant Byte (or Bit)
LSS	Layer Settling Service
MSB	Most Significant Byte (or Bit)
NMT	Network Management
PID	Proportional-Integral-Derivative Control
RO	Read Only Object
RPDO	Received Process Data Object
RW	Read/Write
SDO	Service Data Object
TPDO	Transmitted Process Data Object
WO	Write Only Object

REFERENCES

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

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

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

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

Contents

1. OVERVIEW OF CONTROLLER

1.1. Description of CAN to PWM Signal Output Converter

The following user manual describes the architecture and firmware functionality of the CAN to single PWM signal converter with CANopen®.

The CAN to PWM Signal Converter (CAN-PWM) is designed for versatile control of a single PWM output as a control signal to other sensors or controllers via CANopen®. The converter allows its output signal to be controlled in a variety of ways using its internal functional blocks and algorithms for a wide range of applications.

The signal output can be set up as a proportional: PWM, Frequency, Mixed PWM/Frequency and Digital types.

Figure 1 below shows the hardware block diagram of the CAN-PWM converter. In all output types, the signal will be 5V or 12V in amplitude. The signal output can be used to drive a small LED lamp or any other small components as it is capable of sourcing 50mA at 5V and 30mA at 12V.
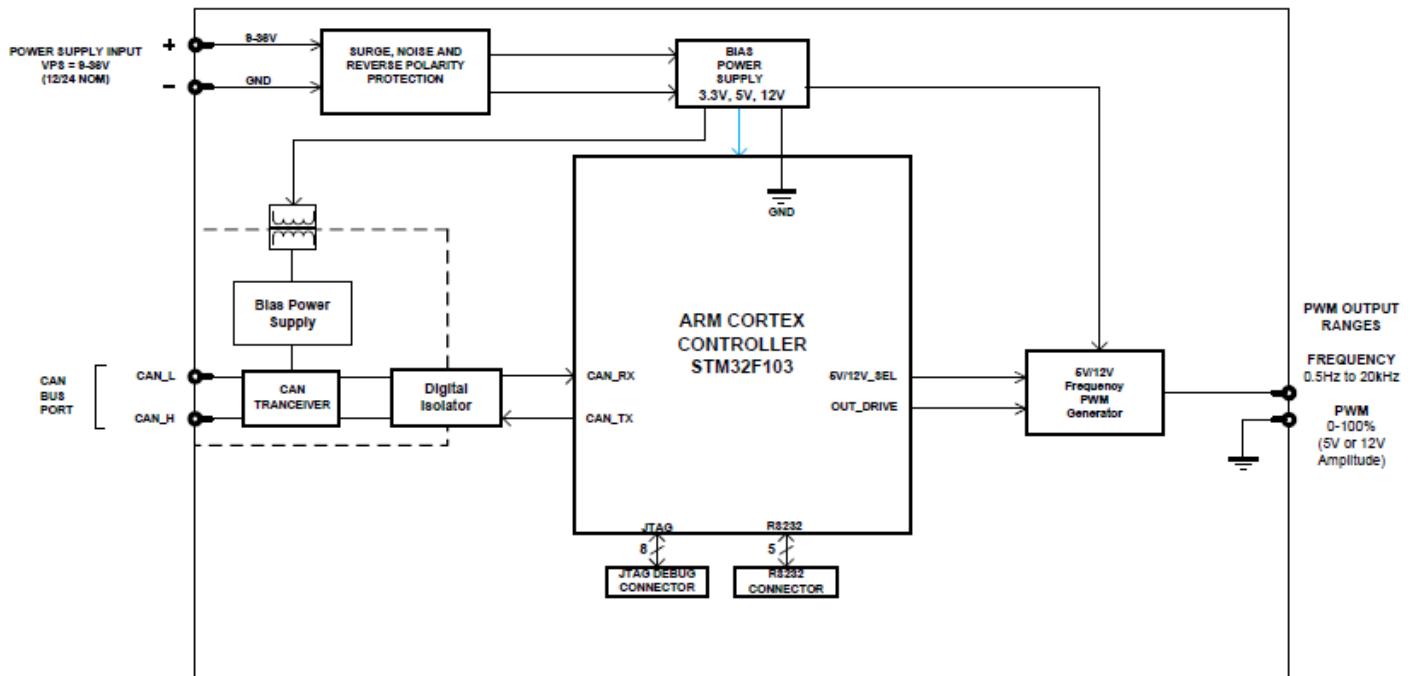
Figure 1: Hardware Functional Block Diagram

The CAN-PWM is a highly configurable controller which allows to fit in various applications. Its control algorithms allow for open or closed loop drive of the signal output. The controller can be operated as either a self-contained control system, driving the output directly from an internal function block and/or it can be integrated into a CANopen® network of controllers. The signal outputs and all logical function blocks in the controller are inherently independent from one another but can be configured to interact amongst them in a number of ways. Figure 2 the logical function blocks available in the CAN-PWM.
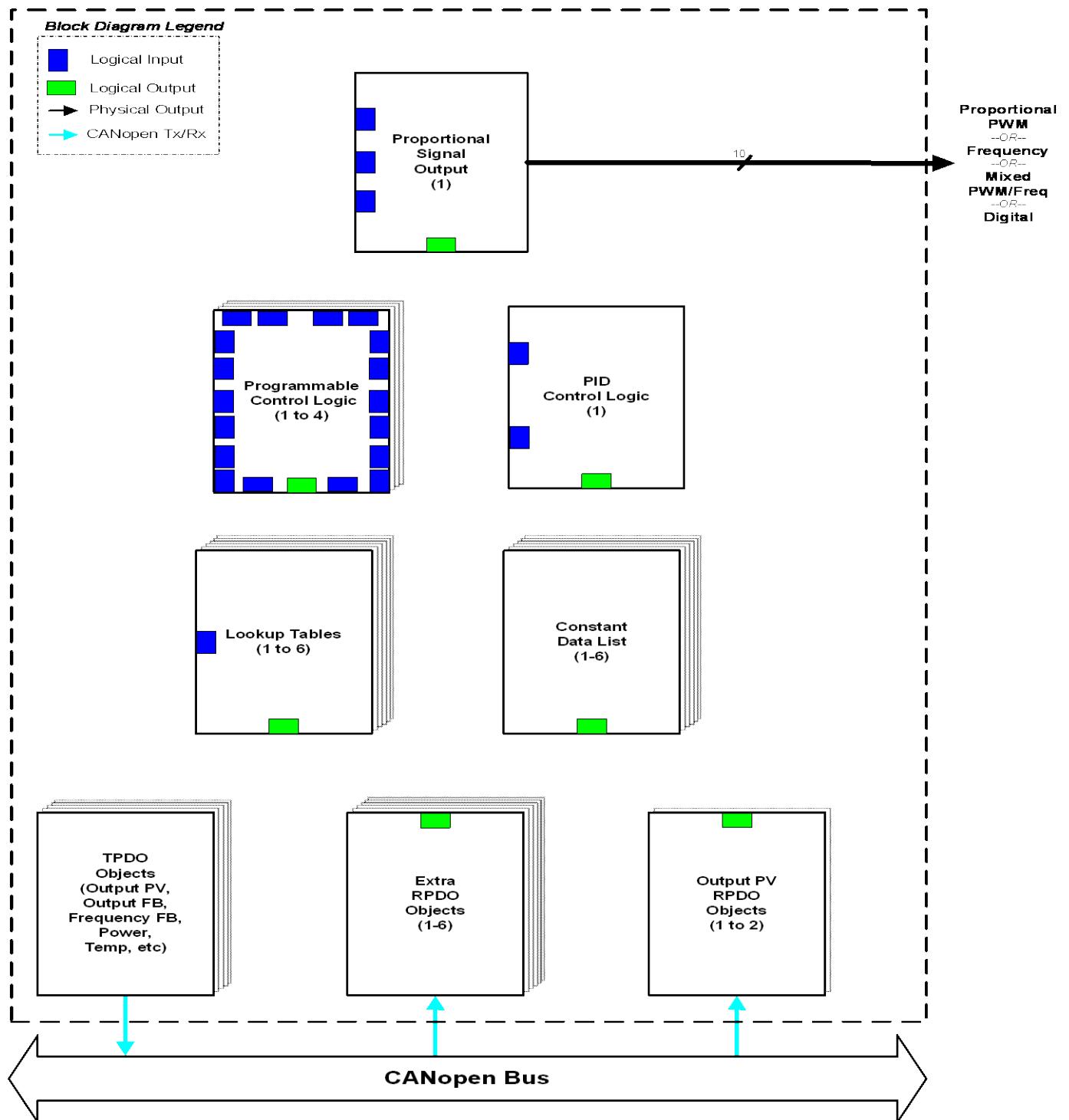
Figure 2: Logic Functional Block Diagram

The CAN-PWM has a number of built-in protection features that can shutoff the outputs in adverse conditions. These features are described in detail in subsequent, and they include hardware shutoffs to protect the circuits from being damaged as well as software shutdown features that can be enabled in safety critical systems when an input or CAN fault is detected.

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

1.2. Digital Output Function Block

The digital output (DO) function block only becomes applicable on the output when object 6130h, SO **Output Type**, is set to a digital output response (Type=1000 or 1020).
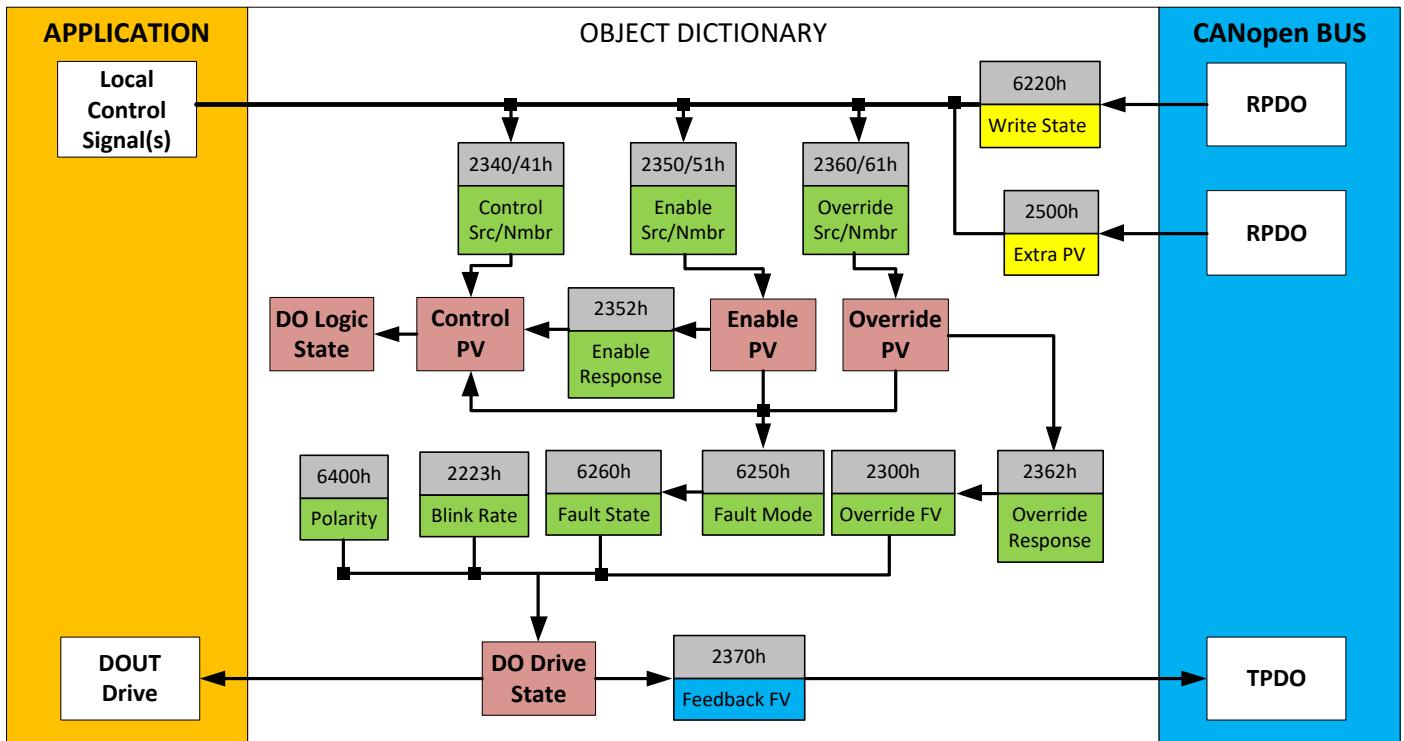
Figure 3: Digital Output Objects

Several of the objects shown in the above diagram are associated with the Signal Output function block, and are 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 **Signal Control Input Source** (see Table 4), then data from the appropriate sub-index from write-mappable object 6220h **DO Write State** will be used as the control signal.

The Enable and Override Inputs and Responses for a digital output are the same as for an Analog Output, and are evaluated in the same order. Therefore, what is described in section 1.3 for these also applied for the DO function block.

As with the SO function, the output will respond to the Control Input if and only if the following conditions have been met:

  a) No fault is detected for any of the control signals
  b) The override command is either ignored or false (Override Input)
  c) The output has not been disabled by a secondary signal (Enable Input)

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

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

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

Table 1: DO Polarity Options (Object 6240h)

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

In digital output mode, the output signal switches between GND and the amplitude selection in Object 2381h. The amplitude is further explained in Section 1.3 and Table 4.

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

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

Table 2: DO Fault Mode Options (Object 6260h)

1.3.   Signal Output Function Block

The Signal Output (SO) function block is the default logic associate with the signal output.
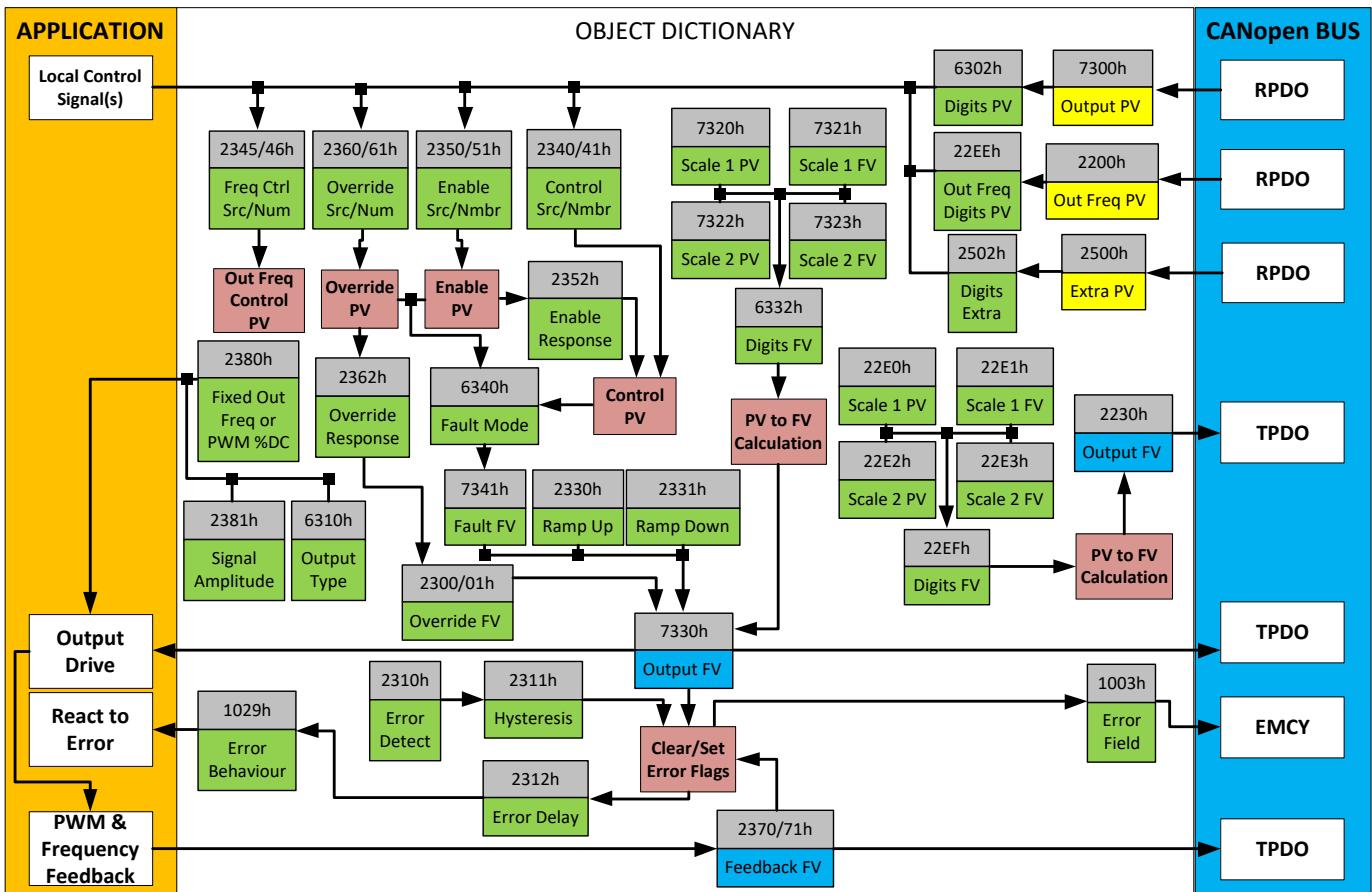
Figure 4: Signal Output Objects

There are many objects associated with the Signal Output function block, but not all of them apply to all output types or control conditions. To start with, object 6310h SO **Output Type** defines what type of signal will be seen at the output of the controller. The output types are highlighted in Table 3below. This table also shows the output unit and range for each type.

Value	Meaning	Range [Unit]
40	**PWM**	**0 to 100 [%]**
60	Frequency	1 to 20000 [Hz]
1000	Mixed PWM/Frequency	0 (OFF) or 1 (ON)
1020	Digital On/Off	0 (OFF) or 1 (ON)

Table 3: SO Output Type Options (Object 6310h)

1.3.1. PWM Output Type

By default, the output is set to PWM mode. In this mode, the command signal (7300h FV) will adjust the duty cycle of the output signal which will run at a fixed output frequency, object 2380h. The output frequency can be adjusted from 1Hz to 20kHz.

1.3.2. Frequency Output Type

In Frequency output, the 7300h FV will adjust the frequency of the signal while maintaining a fixed duty cycle throughout. The fixed duty cycle can be adjusted via object 2380h. This object is also used in PWM output type to adjust the fixed frequency.

1.3.3. Mixed PWM/Frequency Output Type

This type allows the output signal to change its PWM duty cycle as well as its frequency. The main command signal (7300h FV) will command the PWM duty cycle while 2200h FV will command the signal frequency. In this mode, object 2380h is ignored.

1.3.4. Digital ON/OFF Output Type

The digital output types have been covered in section 1.2.

In all signal output types (not digital), the Signal Output Feedback FV will be calculated based on Decimal Digits, object 6332h while the Signal Output Frequency Feedback FV, object 2371h, will be calculated based on Digits FV, object 22EFh.

The signal amplitude in all output modes can be configured via object 2381h. Table 4 below shows the configurable values of the signal amplitude.

Value	Meaning
0	**5V Amplitude**
1	12V Amplitude

Table 4: Signal Amplitude (Object 2381h)

The relationship between the Process Value (input) and the Field Value (output) is a linear one, as shown in Figure 5. However, the output will actually use the SO Scaling FV objects as limits to the drive, such that the output will hold at the minimum and maximum FV points, as shown in the figure.
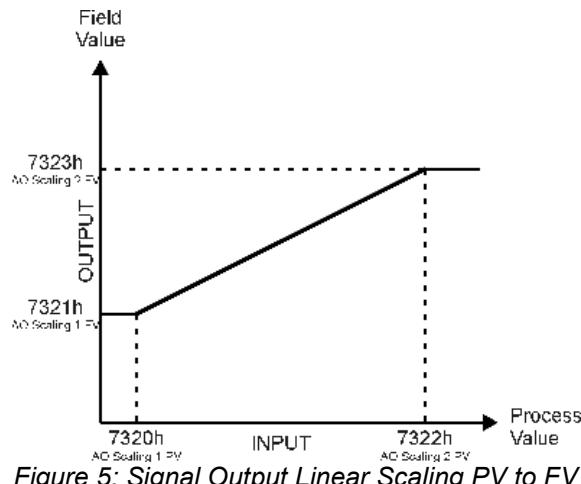
Figure 5: Signal Output Linear Scaling PV to FV

1.3.5. Control Sources

An interesting feature of the CAN-PWM is that the source for the PV input can be selected from the list of the logical function blocks supported by the controller as shown in Figure 2. Any output from one function block can be selected as the control source for another. Not all options make sense in all cases, but the complete list of control sources is shown in Table 5. By default, the signal output is setup to respond to CANopen® Message RPDO1.

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

Table 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 6220h sub-index 1*
	2	2200h sub-index 1
	3	2500h sub-index 1 (Extra Received PV 1)
	4	2500h sub-index 2 (Extra Received PV 2)
	5	2500h sub-index 3 (Extra Received PV 3)
	6	2500h sub-index 4 (Extra Received PV 4)
	7	2500h sub-index 5 (Extra Received PV 5)
	8	2500h sub-index 6 (Extra Received PV 6)
Constant Function Block	1	5010h sub-index 1 (always FALSE)
	2	5010h sub-index 2 (always TRUE)
	3	5010h sub-index 3 (Constant FV 3)
	4	5010h sub-index 4 (Constant FV 4)
	5	5010h sub-index 5 (Constant FV 5)
	6	5010h sub-index 6 (Constant FV 6)
PID Control Function Block	1	2460h sub-index 1 (PID Output FV 1)
Lookup Table Function Block	1	3017h (Lookup Table 1 Output Y-Axis PV)
	2	3027h (Lookup Table 2 Output Y-Axis PV)
	3	3037h (Lookup Table 3 Output Y-Axis PV)
	4	3047h (Lookup Table 4 Output Y-Axis PV)
	5	3057h (Lookup Table 5 Output Y-Axis PV)
	6	3067h (Lookup Table 6 Output Y-Axis PV)
Programmable Logic Function Block	1	30z7 (Lookup Table Selected by Logic 1)
	2	30z7 (Lookup Table Selected by Logic 2)
	3	30z7 (Lookup Table Selected by Logic 3)
	4	30z7 (Lookup Table Selected by Logic 4)
NOTE: The following options are meant more for diagnostic feedback, and should not be selected as a control source for logic inputs (i.e. output control or lookup table X-Axis)		
Output Commanded Field Value	1	7330h sub-index 1 or "DO1 Logic State"
Output Frequency Commanded FV	1	2230h sub-index 1 **
Output Feedback Field Value	1	2370h sub-index 1 (SO FB or DO1 State)
Power Supply Measured	0 or 1	5020h (Power Supply FV)
Processor Temperature Measured	0 or 1	5030h (Processor Temperature FV)
Logic Selected Table Feedback	1	4140h (Logic Block 1 Selected Table)
	2	4240h (Logic Block 2 Selected Table)
	3	4340h (Logic Block 3 Selected Table)
	4	4440h (Logic Block 4 Selected Table)

Table 6: Control Number According to Control Source

* Depending on SO Output Type selected, either the SO Output PV or DO Write State will be used
** Data will be valid if Mixed PWM/Frequency output type enabled

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

for the override function, objects 2360h SO **Override Input Source** and 2361h SO **Override Input Number** are used.

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.

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

Control Source	Scaling 1	Scaling 2	Dec Digits
CANopen® Message – Num 1	7320h	7322h	6302h
CANopen® Message – Num 2	22E0h	22E2h	22EEh
CANopen® Message – Num. 3 to 8	2520h	2522h	2502h
Constant Function Block	N/A	N/A	N/A (float)
PID Control Function Block	0%	100%	1 (fixed)
Lookup Table Z Function Block (where Z = 1 to 6)	0 or lowest from 30z6h[1]	100 or highest from 30z6h[2]	30z3h
Programmable Logic Function	0%	100%	1 (fixed)
Output Commanded Field Value	7320h	7322h	6302h
Output Feedback Field Value	7320h	7322h	6302h
Power Supply Measured	0V	35V	N/A (float)
Processor Temperature Measured	-50.0°C	150°C	N/A (float)
Logic Selected Table Feedback	N/A	N/A	N/A

Table 7: Scaling Limits per Control Source
(1) Whichever value is smaller, (2) Whichever value is larger

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 Mixed Frequency/PWM Output type, the scaling objects 22E0h-22E2h behave the same way as objects 7320h-7322h for the Mixed Frequency command.

In general, the profile in Figure 5 holds true. In some cases, it may be desired that the minimum offset not be applied when the value is out of range, i.e. when using a profile with a dead-band. For this reason, object 2342h SO **Control Response** has the options shown in Table 8.

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

Table 8: SO Control Response Options (Object 2342h)

The default configuration for the CAN-PWM signal converter is that each current output is responding to changes from a CANopen® message. The objects defaults listed in Table 9.

Object (Meaning)	Signal Output
7300h (SO Output PV)	Not Used
6302h (SO Decimal Digits PV)	0
6310h (SO Output Type)	40 (PWM)
7320h (SO Scaling 1 PV)	10
7321h (SO Scaling 1 FV)	100 [0.1%DC resolution]
7322h (SO Scaling 2 PV)	90
7323h (SO Scaling 2 FV)	900 [0.1%DC resolution]
6332h (SO Decimal Digits FV)	1 [0.1%DC resolution]
2340h (SO Control Input Source)	1 (CANopen® Message)
2341h (SO Control Input Number)	1 (Message 1)
2342h (SO Control Response)	1 (OFF below Scaling 1 PV)
6340h (SO Fault Mode)	1 (Apply Pre-Defined FV)
7341h (SO Fault FV)	50 [%DC]
2200h (Mixed Freq Output PV)	Not Used
22EEh (Mixed Freq Decimal Digits PV)	0
22E0h (Mixed Freq Scaling 1 PV)	50
22E1h Mixed Freq Scaling 1 FV)	50 [Hz]
22E2h (Mixed Freq Scaling 2 PV)	1050
22E3h (Mixed Freq Scaling 2 FV)	1050 [Hz]
22EFh (Mixed Freq Decimal Digits FV)	0 [Hz]
2345h (Mixed Freq Control Input Source)	1 (CANopen® Message)
2346h (Mixed Freq Control Input Number)	2 (Message 2)
2241h (Mixed Freq Fault FV)	50 [Hz]

Table 9: SO Default Object Values

By default, neither inputs are used (control sources are set to 0=Ignore), but they can be activated for safety interlocks or other more complex applications. Table 10 and Table 11 show the options for object 2352h SO **Enable Response**, and 2362h SO **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, SO **Override FV.**

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

Table 10: SO Enable Response Options (Object 2352h)

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

Table 11: SO Override Response Options (Object 2362h)

The output can be setup to react to a fault detected on any of the inputs to the function block (control, enable or override.) Should any one of these inputs be showing an error condition, object 6340h SO **Fault Mode** determines how the output will respond, per Table 12. By default, the output will be driven to the value defined in object 7341h SO **Fault FV**. If the output type is Mixed

Frequency/PWM, object 7341h will apply to the duty cycle of the signal while object 2241h will apply to the frequency when there is a fault.

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

Table 12: SO Fault Mode Options (Object 6340h)

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

Object 2380h, SO **Output Frequency** can and should be adjusted to the desired frequency in all output types with the exception of Digital ON/OFF.

Amplitude adjustments on the signal can be made via Object 2381, **SO Amplitude** which can set the amplitude of the signal to 5V or 12V.
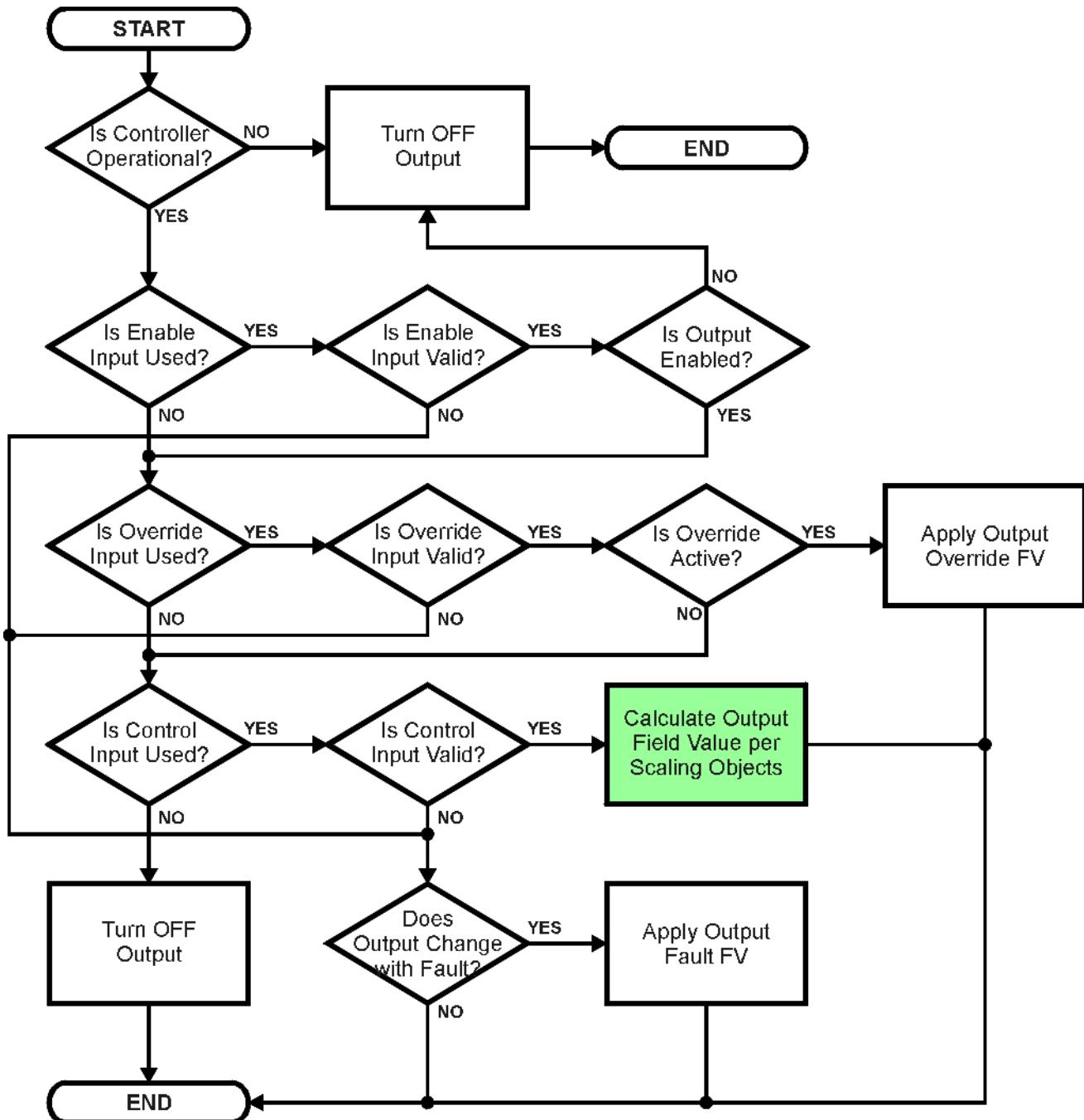
Figure 6: Signal Output Logic Flowchart

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

If object 2310h SO **Error Detect Enable** is set to TRUE, then the absolute value between the desired output FV (7330h) and the measured feedback (2370h) is compared to 2311h SO **Error Clear Hysteresis**. If the difference between the target and the actual exceeds the hysteresis value, then a fault is present. If a flag stays active for the 2312h SO **Error Reaction Delay** time, then an appropriate EMCY message will be added to object 1003h **Pre-Defined Error Field**. The application will react to the EMCY message as defined by object 1029h **Error Behaviour** at the

sub-index corresponding to an Input Fault. Refer to section 3.2.4 and 3.2.13 for more information about objects 1003h and 1029h, including the complete list of EMCY messages.

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

1.4. PID Control Function Block

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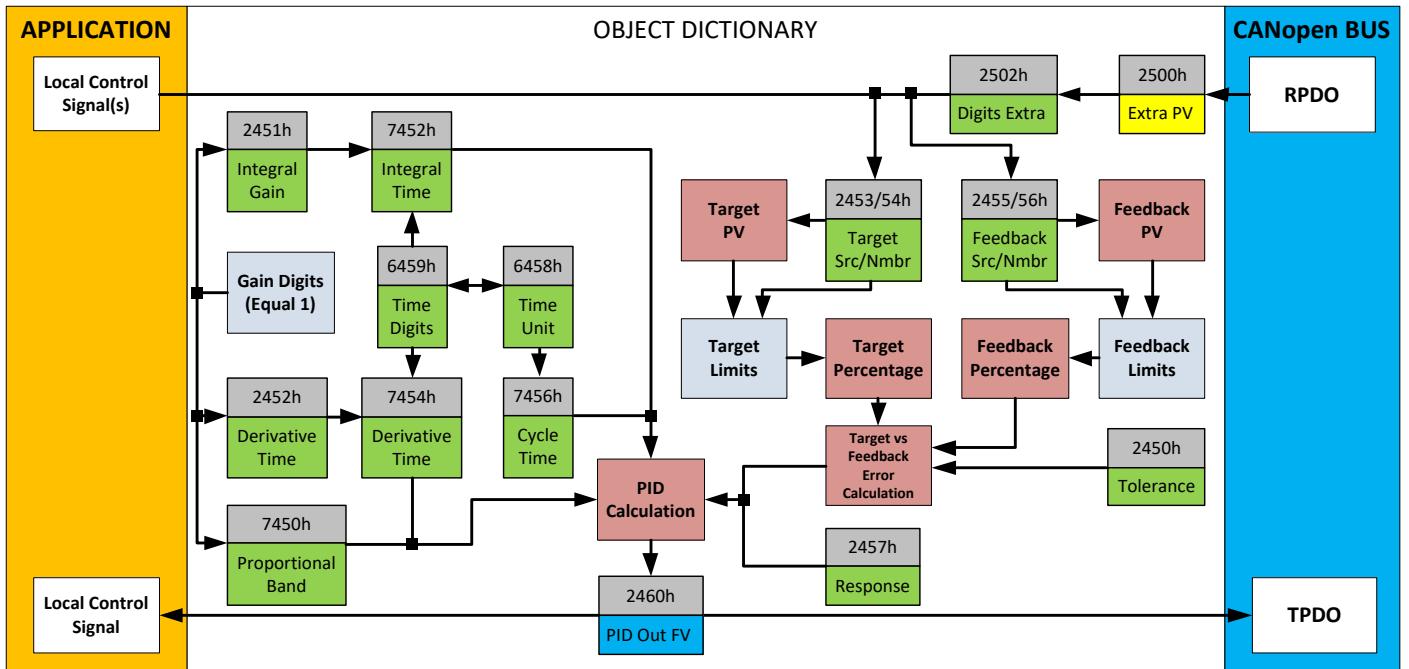
Figure 7: PID Control Objects

As with the Signal Output block, the PID control function has control inputs associate with it that can be mapped to the output from any other function block. Objects 2453h **PID Target Source** and 2454h **PID Target Number** define what value the PID loop will attempt to maintain. For example, in the case of a setpoint (fixed) control application, this input can be mapped to one of object 5010h, a Constant FV. In this case, since there is no pre-defined range associate with a constant (see Table 7), the scaling limits will be set equal to those of the feedback input. Otherwise, the target input units do not have to match the feedback units, so long as they are scaled relative to one another.

Objects 2355h **PID Feedback Source** and 2356h **PID Feedback Number** define the close-loop input. Both the target and feedback use Table 5 and Table 13 as the available options. Both inputs are normalized to a percentage based on the associated scaling limits as defined in Table 7.

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

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

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

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

By default, the PID loop is assumed to be controlling a single output which will increase/decrease as the feedback over/undershoots the target. However, some systems may require a push-pull response where one output comes on when over target, and the other when under. Object 2457h **PID Control Response** allows the user to select the response profile as needed from Table 13.

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

Table 13: PID Control Response Options (Object 2457h)

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

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

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

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

$$P_k = Error_k * P\_Gain$$

$$I_k = ErrorSum_k * I\_Gain$$

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

$$PIDOutput_k = P_k + I_k + D_k$$

Figure 8 – PID Control Algorithm

Each system will have to be tuned for the optimum output response. Response times, overshoots and other variables will have to be decided by the customer using an appropriate PID tuning strategy.

1.5. Lookup Table Function Block

The lookup table (LTz) function blocks are not used by default.
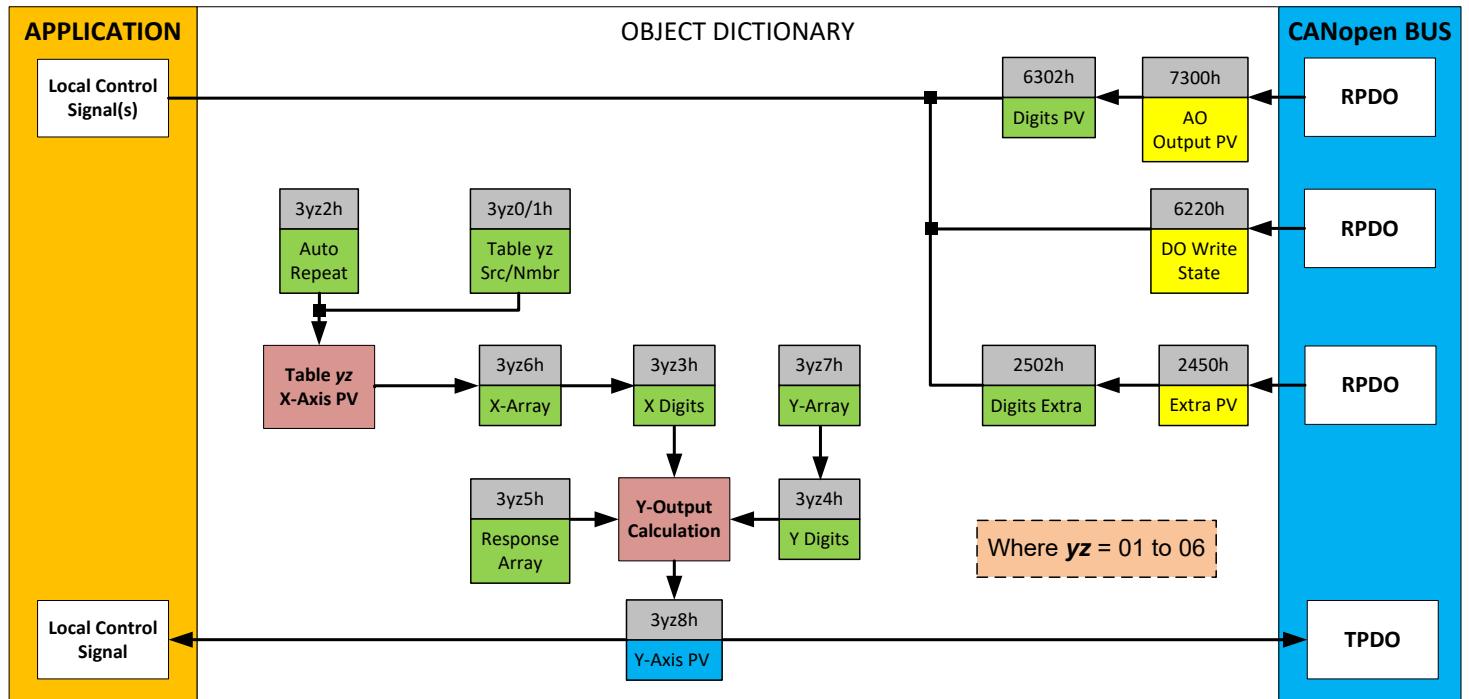
Figure 8: Lookup Table Objects

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 1.6.

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

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 need to be updated with new defaults based on the X-Axis source selected as described in Table 5 and Table 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 1.5.4.

1.5.1. 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 -40ºC to 210ºC, then the "**LTz Point X-Axis PV sub-index 1**" will be set to the minimum instead, in this case -40ºC.

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

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

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 6.

1.5.2. Y-Axis, Lookup Table Output

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

In fact, so long as all the data in the Y-Axis is $0 <= Y[i] <= 100$ (where i = 1 to 11) then other function blocks using the lookup table as a control source will have 0 and 100 as the Scaling 1 and Scaling 2 values used in linear calculations shown in Table 7.

However, the Y-Axis has no constraints on the data that it represents. This means that inverse, or increasing/decreasing or other responses can be easily established. **The Y-Axis does not have to be a percentage output, but could represent full scale process values instead.**

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

Even if some of the data points are *'Ignored'* as described in Section 1.5.3, they are still used in the Y-Axis range determination. If not all the data points are going to be used, it is recommended that Y10 be set to the minimum end of the range, and Y11 to the maximum first. This way, the user can get predictable results when using the table to drive another function block, such as an analog output.

1.5.3. Point To Point Response

By default, all six lookup tables have a simple linear response from 0 to 100 in steps of 10 for both the X and Y axes. For a smooth linear response, each point in the 30z5h **LTz Point Response** array is setup for a *'Ramp To'* output.

Alternatively, the user could select a *'Step To'* response for 30z4h, where N = 2 to 11. In this case, any input value between X_{N-1} to X_N will result in an output from the lookup table function block of Y_N. *(Recall: LTz Point Response sub-index 1 defines the X-Axis type)*

Figure 10 shows the difference between these two response profiles with the default settings.
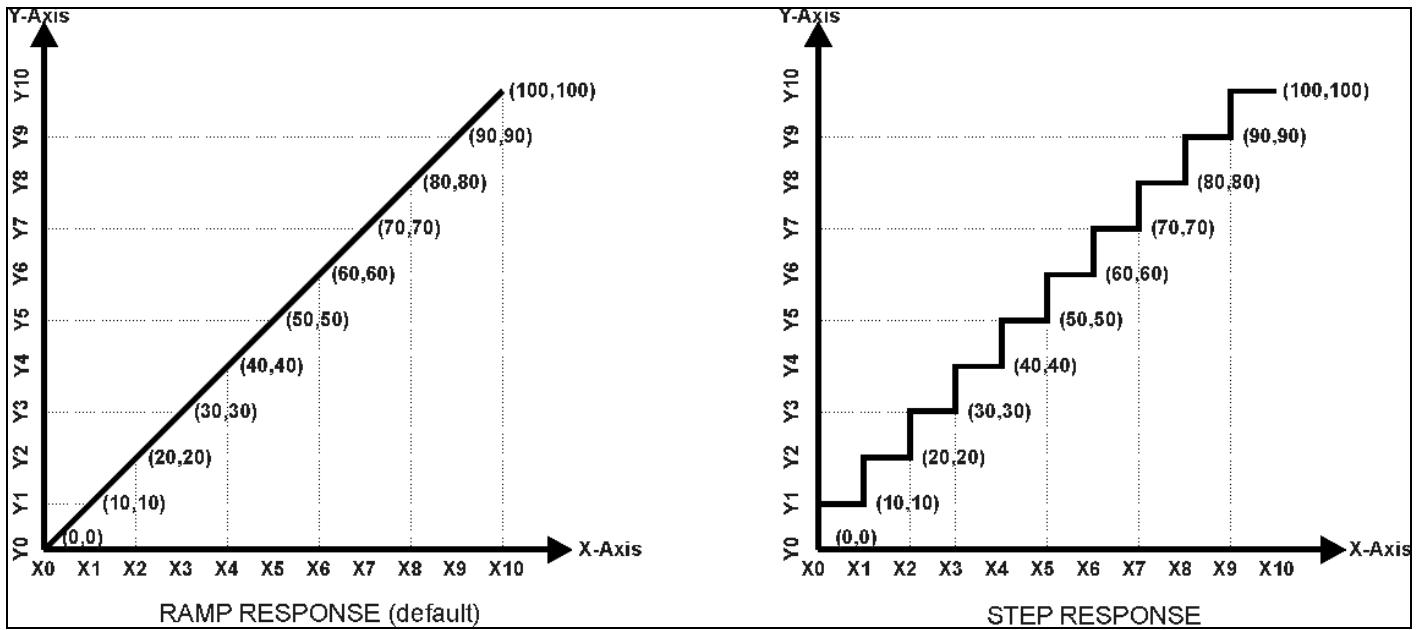
Figure 10 – Lookup Table Defaults with Ramp and Step Responses

Lastly, any point except (1,1) can be selected for an *'Ignore'* response. If **LTz Point Response sub-index N** is set to ignore, then all points from (X_N, Y_N) to (X_{11}, Y_{11}) will also be ignored. For all data greater than X_{N-1}, the output from the lookup table function block will be Y_{N-1}.

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

To summarize, Table 14 outlines the different responses that can be selected for object 30z4h, both for the X-Axis type and for each point in the table.

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

Table 14: LTyz Point Response Options (Objects 30z4h)

1.5.4. X-Axis, Time Response

As mentioned in Section 1.3, 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 (X_1, Y_1) which is 0 output for 0ms.

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

In a time response, the data in object 30z6h **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]

1.6.   Programmable Logic Function Block

The programmable logic block (LBx) functions are not used by default.
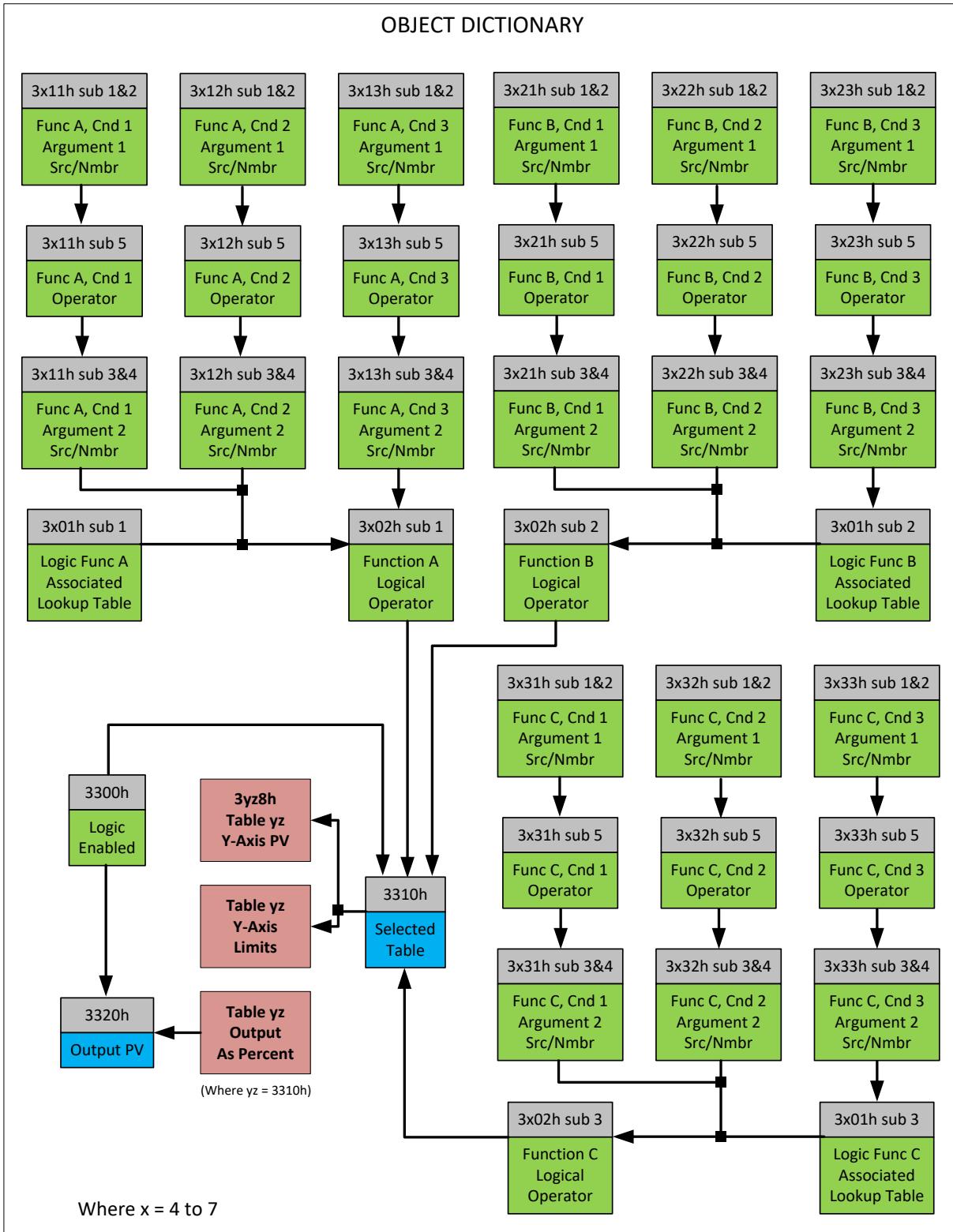
Figure 9: Logic Block Objects

This function block is obviously the most complicated of them all, but very powerful. Any LBx (where X= 4 to 7) 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 12) can be associated with the logic, and which ones are used is fully configurable on object 3x01 **LB(3-x) Lookup Table Number**.

Should the conditions be such that a particular table (A, B or C) has been selected as described in Section 1.6.2, then the output from the selected table, at any given time, will be passed directly to LB(3-x)'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(3-x)* refers to Logic Blocks 1 to 4. Due to the CANopen® Object indices, Logic Block 1 begins at 3401h where x, in this case, is 4.

Therefore, an LBx allows up to three different responses to the same input, or three different responses to different inputs, to become the control for another function block, such as an analog output. Here, the "**Control Source**" for the reactive block would be selected to be the *'Programmable Logic Function Block,'* as described in Section 1.3.

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 9. 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.**
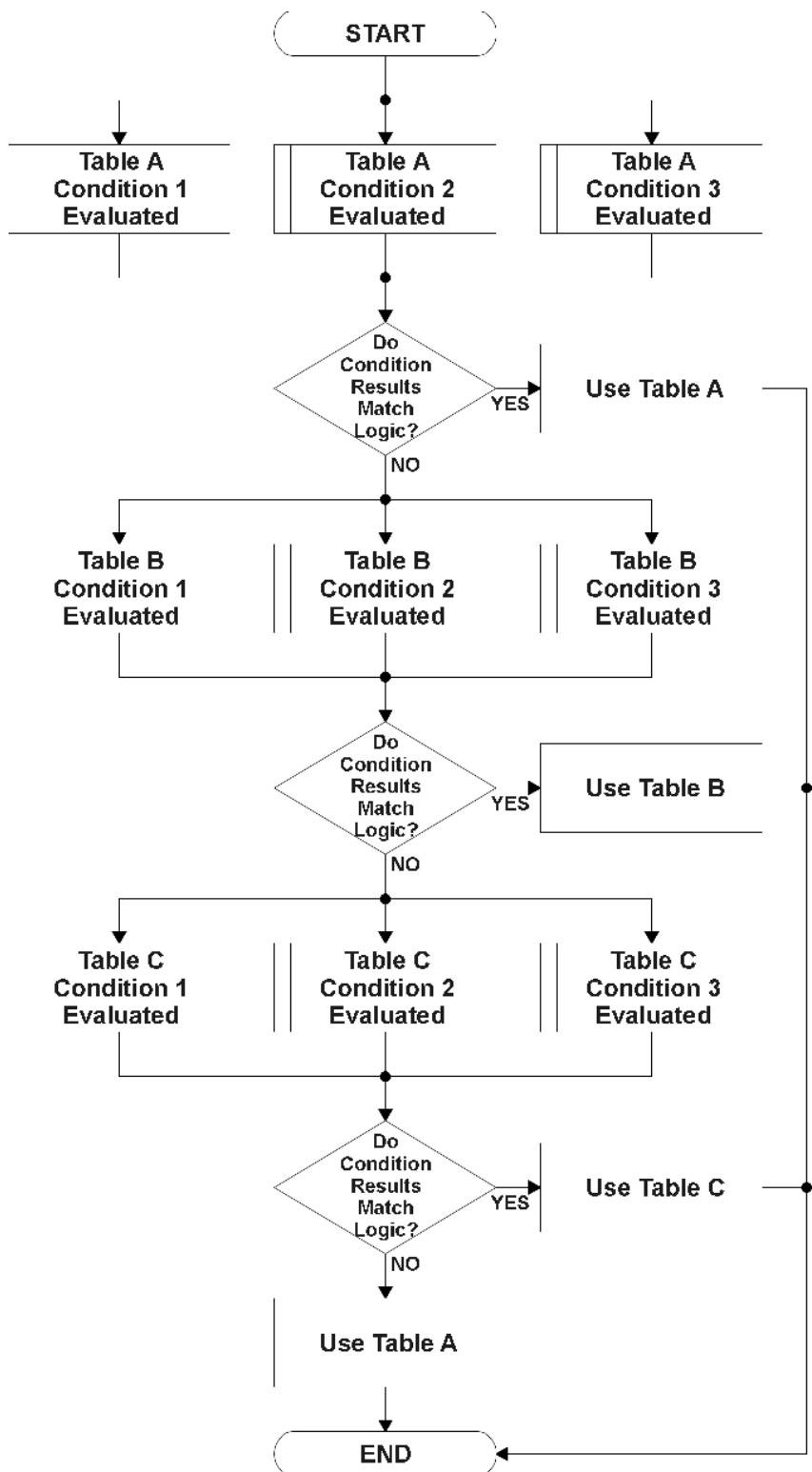
Figure 10: Logic Block Flowchart

1.6.1. 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 15.

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 7, Y = A, B or C, and Z = 1 to 3
Table 15: LB(3-x) 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 4. As always, the input is a combination of the functional block objects 3xyzh 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 16, 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 16: LB(3-x) 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 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 17.

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

Table 17: LB(3-x) Condition Evaluation Results

1.6.2. 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 1.6.1. There are several logical combinations that can be selected, as listed in Table 18. The default value for object 3x02h **LB(3-x) 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 18: LB(3-x) Function Logical Operator Options

Not every evaluation is going to need all three conditions. The case given in the earlier section, for example, only has one condition listed, i.e. that the Engine RPM be below a certain value. Therefore, it is important to understand how the logical operators would evaluate an Error or N/A result for a condition, as outlined in Table 19.

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

(Cnd1 And Cnd2) Or Cnd3	**To be used only when all three conditions are relevant.** If both Condition 1 and Condition 2 are True, OR Condition 3 is True, the table is selected. Error or N/A results are treated as False If(((Cnd1==True)&&(Cnd2==True)) || (Cnd3==True)) Then Use Table
(Cnd1 Or Cnd2) And Cnd3	**To be used only when all three conditions are relevant.** If Condition 1 And Condition 3 are True, OR Condition 2 And Condition 3 are True, the table is selected. Error or N/A results are treated as False If(((Cnd1==True)||(Cnd2==True)) && (Cnd3==True)) Then Use Table

Table 19: LB(3-x) Conditions Evaluation Based on Selected Logical Operator

If the result of the function logic is TRUE, then the associated lookup table (see object 4x01h) is immediately selected as the source for the logic output. No further conditions for other tables are evaluated. For this reason, the *'Default Table'* should always be setup as the highest letter table being used (A, B or C) If no default response has been setup, the Table A automatically becomes the default when no conditions are true for any table to be selected. This scenario should be avoided whenever possible 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 4010h **Logic Block Selected Table.** This will change as different conditions result in different tables being used.

1.6.3. Logic Block Output

Recall that Table Y, where Y = A, B or C in the LB(3-x) function block does NOT mean lookup table 1 to 3. Each table has object 3x01h LB(3-x) **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 20.

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
4	10	11	12

Table 20: LB(3-x) 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(3-x) 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(3-x) function block so long as that table is selected.

The LB(3-x) output is always setup as a percentage, based on the range of the Y-Axis for the associated table (see Section 1.5.2) It is written to sub-index X of read-only object 3320h **Logic Block Output PV** with a resolution of 1 decimal place.

1.7. 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.
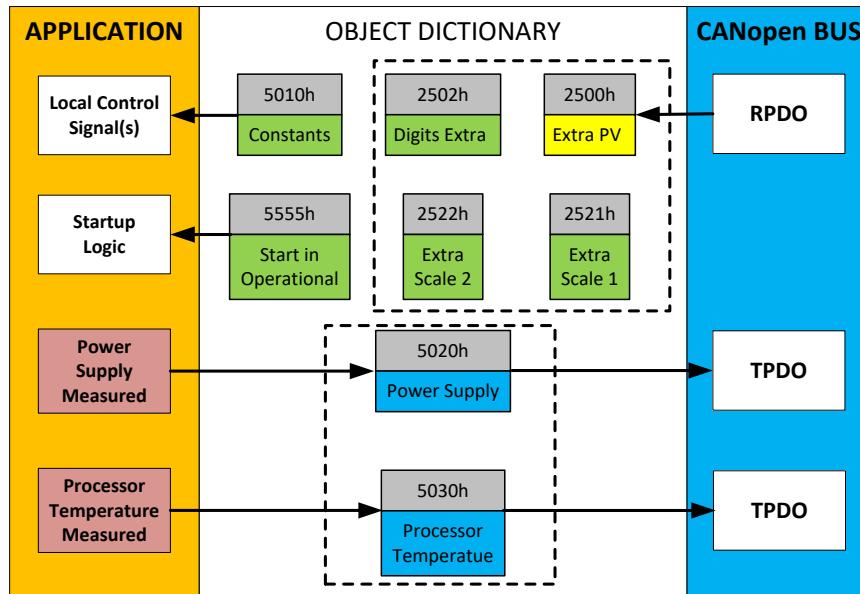
Figure 11: Miscellaneous Objects

1.7.1. Extra RPDO Messages

Objects 2500h **Extra Control Received PV**, 2502h **EC Decimal Digits PV**, 2502h **EC Scaling 1 PV** and **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. For example, a PID loop must have two inputs (target and feedback), so one of them has to come from the CAN bus. The scaling objects are provided to define the limits of the data when it is used by another function block, as shown in Table 9.

1.7.2. 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 4 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, and they can also be used as a setpoint target for a PID control block.

1.7.3. 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.

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

2. INSTALLATION INSTRUCTIONS

2.1. Dimensions and Pinout
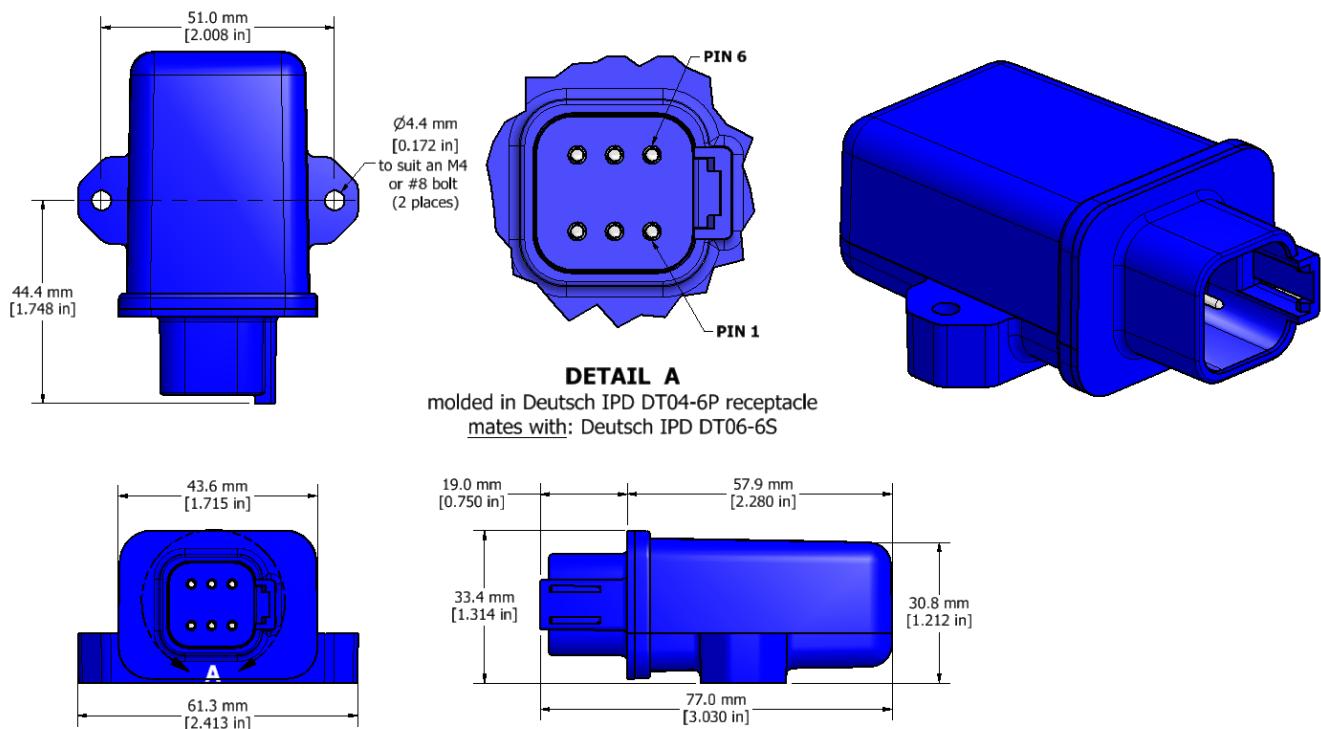
6-pin Connector	
Pin #	**Description**
1	BATT+
2	Output +
3	CAN H
4	CAN L
5	Output -
6	BATT -

2.2. Installation Instructions

2.2.1. Connections & Mounting

6-pin Integral Connector (equivalent TE Deutsch P/N: DT04-6P), which mates to TE Deutsch P/N: DT06-6S.

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

2.2.2. Noise – Electrical Connections and Shielding

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

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

All wires used must be 16 or 18 AWG.

2.2.3. CAN Network Construction

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

2.2.4. CAN Termination

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

3. CANOPEN® OBJECT DICTIONARY

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

3.1. Node ID & Baud Rate

By default, the CAN-PWM 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 baud rate can be changed is to use Layer Settling Services (LSS) and protocols as defined by CANopen® standard DS-305.

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

3.1.1.1. Setting Node-ID

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

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

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

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

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

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

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

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

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

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

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

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

3.1.1.2.   Setting Baudrate

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

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

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

Item	Value
COB-ID	0x7E5
Length	3
Data 0	0x13 (cs=19 for configure bit timing parameters)
Data 1	0x00 (switches to waiting state)
Data 2	Index (select baudrate index per table 20)

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

Table 20 – LSS Baudrate Indexes

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Index (hex)	Object	Object Type	Data Type	Access	PDO Mapping
1000	Device Type	VAR	UNSIGNED32	RO	No
1001	Error Register	VAR	UNSIGNED8	RO	No
1002	Manufacturer Status Register	VAR	UNSIGNED32	RO	No
1003	Pre-Defined Error Field	ARRAY	UNSIGNED32	RO	No
100C	Guard Time	VAR	UNSIGNED16	RW	No
100D	Life Time Factor	VAR	UNSIGNED8	RW	No
1010	Store Parameters	ARRAY	UNSIGNED32	RW	No
1011	Restore Default Parameters	ARRAY	UNSIGNED32	RW	No
1016	Consumer Heartbeat Time	ARRAY	UNSIGNED32	RW	No
1017	Producer Heartbeat Time	VAR	UNSIGNED16	RW	No
1018	Identity Object	RECORD		RO	No
1020	Verify Configuration	ARRAY	UNSIGNED32	RW	No
1029	Error Behaviour	ARRAY	UNSIGNED8	RW	No
1400	RPDO1 Communication Parameter	RECORD		RW	No
1401	RPDO2 Communication Parameter	RECORD		RW	No
1402	RPDO3 Communication Parameter	RECORD		RW	No
1403	RPDO4 Communication Parameter	RECORD		RW	No
1600	RPDO1 Mapping Parameter	RECORD		RO	No
1601	RPDO2 Mapping Parameter	RECORD		RO	No
1602	RPDO3 Mapping Parameter	RECORD		RO	No
1603	RPDO4 Mapping Parameter	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 = 0x201C	**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 = Signal Output block
0010h = controller block (aka PID)
0020h = alarm block
0040h … 0800h = reserved
1000h = reserved
2000h = lookup table block (manufacturer-specific)
4000h = programmable logic block (manufacturer-specific)
8000h = miscellaneous block (manufacturer-specific)

Object Description

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

Entry Description

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

3.2.2. Object 1001h: Error Register

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

Object Description

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

Entry Description

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

3.2.3. Object 1002h: Manufacturer Status Register

This object is used for manufacturer debug purposes.

3.2.4. Object 1003h: Pre-Defined Error Field

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

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

The CAN-PWM 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 a Signal Output is not working as described in Section 1.3, 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 21 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)					
0001F002h	10h	Signal Out-of-Range	01h	Signal Output	F002h	Output Overload
00008100h	00h	RPDO Timeout	00h	Unspecified	8100h	Communication - generic
10008130h	10h	Lifeguard Event	00h	Unspecified	8130h	Lifeguard/Heartbeat Error
80nn8130h	80h	Heartbeat Timeout	nn	Node-ID	8130h	Lifeguard/Heartbeat Error

Table 21: Pre-Defined Error Field Codes

Object Description

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

Entry Description

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

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

3.2.5. Object 100Ch: Guard Time

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

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

Object Description

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

Entry Description

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

3.2.6. Object 100Dh: Lifetime Factor

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

Object Description

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

Entry Description

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

3.2.7. Object 1010h: Store Parameters

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

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

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

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

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

Object Description

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

Entry Description

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

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

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

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

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

3.2.8. Object 1011h: Restore Parameters

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

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

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

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

By read access, the object provides information about the module's default parameter restoring capabilities. For all sub-indexes, this value is 1h, indicating that the CAN-PWM 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-PWM Controller can be a consumer of heartbeat objects for up to four modules. This object defines the expected heartbeat cycle time for those modules, and if set to zero, it is not used. When non-zero, the time is a multiple of 1ms and monitoring will start after the reception of the first heartbeat from the module. If the CAN-PWM Controller fails to receive a heartbeat from a node in the expected timeframe, it will indicate a communication error, and respond as per object 1029h.

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

Object Description

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

Entry Description

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

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

3.2.10. Object 1017h: Producer Heartbeat Time

The CAN-PWM 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 CAN-PWM 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)	Software Major Rev	Software Minor Rev

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	0xAA130701
Default Value	0xAA130701

Sub-Index	3h
Description	Revision Number
Access	RO
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	0x01000100

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

Object Description

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

Entry Description

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

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

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

3.2.13. Object 1029h: Error Behaviour

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

A network fault is flagged when an RPDO is not received within the expected time period defined in the "Event Timer" of the associated communication objects, (see Section 3.2.14 for more information) or if a lifeguard or heartbeat message is not received as expected. Input faults are defined in Section 1.3, and output faults are defined in Section 1.5.

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

Object Description

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

Entry Description

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

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

Sub-Index	5h
Description	Signal Output Fault (SO)
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-PWM Controller can support up to four RPDO messages. All RPDOs on the CAN-PWM Controller use the similar default communication parameters, with the PDO IDs set according to the pre-defined connection set described in DS-301. Most RPDOs do not exist, there is no RTR allowed, they use 11-bit CAN-IDs (base frame valid) and they are all event-driven. While all four have valid default mappings defined (see below) only RPDO1 is enabled by default (i.e. RPDO exists).

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

Sub-Index	*Value*	*Object*
0	3	Number of mapped application objects in PDO
1	0x73000110	Signal Output Process Value
2	0x22000110	Mixed Frequency Signal Output Process Value
3	0x62200108	Digital Write State 1
4	0	Not used by default

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

Sub-Index	*Value*	*Object*
0	4	Number of mapped application objects in PDO
1	0x25000110	Extra Received 1 PV (i.e. PID Control Feedback 1 PV)
2	0x25000210	Extra Received 2 PV (i.e. PID Control Feedback 2 PV)
3	0x25000310	Extra Received 3 PV (i.e. Lookup Table 1 X-Axis)
4	0x25000410	Extra Received 4 PV (i.e. Lookup Table 2 X-Axis)

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

Sub-Index	*Value*	*Object*
0	2	Number of mapped application objects in PDO
1	0x25000510	Extra Received 5 PV (i.e. Lookup Table 3 X-Axis)
2	0x25000610	Extra Received 6 PV (i.e. Lookup Table 4 X-Axis)
3	0	Not used by default
4	0	Not used by default

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

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

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

Object Description

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

Entry Description

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

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

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

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

Sub-Index	Value	Object
0	3	Number of mapped application objects in PDO
1	0x73300110	Signal Output 1 Field Value
2	0x23700110	Signal Output Feedback Field Value
3	0x23710110	Signal Output Frequency Feedback Field Value
4	0	Not used by default

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

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

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

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

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

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

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

Object Description

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

Entry Description

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

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

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

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

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

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

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

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

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

3.3. APPLICATION OBJECTS (DS-404)

Index (hex)	Object	Object Type	Data Type	Access	PDO Mapping
6220	DO Write State 1 Output Line	ARRAY	BOOLEAN	RW	Yes
6240	DO Polarity 1 Output Line	ARRAY	UNSIGNED8	RW	No
6250	DO Fault Mode 1 Output Line	ARRAY	UNSIGNED8	RW	No
6260	DO Fault State 1 Output Line	ARRAY	BOOLEAN	RW	No
7300	SO Output Process Value	ARRAY	INTEGER16	RW	Yes
6302	SO Decimal Digits PV	ARRAY	UNSIGNED8	RW	No
6310	SO Output Type	ARRAY	UNSIGNED16	RW	No
7320	SO Output Scaling 1 PV	ARRAY	INTEGER16	RW	No
7321	SO Output Scaling 1 FV	ARRAY	INTEGER16	RW	No
7322	SO Output Scaling 2 PV	ARRAY	INTEGER16	RW	No
7323	SO Output Scaling 2 FV	ARRAY	INTEGER16	RW	No
7330	SO Output Field Value	ARRAY	INTEGER16	RO	Yes
6332	SO Decimal Digits FV	ARRAY	UNSIGNED8	RW	No
6340	SO Fault Mode	ARRAY	UNSIGNED8	RW	No
7341	SO Fault Field Value	ARRAY	INTEGER16	RW	No
7450	PID Proportional Band	ARRAY	INTEGER16	RW	No
7452	PID Integral Action Time	ARRAY	INTEGER16	RW	No
7454	PID Derivative Action Time	ARRAY	INTEGER16	RW	No
7456	PID Cycle Time	ARRAY	INTEGER16	RW	No
7458	PID Physical Unit Timing	ARRAY	UNSIGNED32	RO	No
7459	PID Decimal Digits Timing	ARRAY	UNSIGNED8	RW	No

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

This object shall set a single digital output logic state when the 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	BOOLEAN

Entry Description

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

Sub-Index	1h
Description	DO1 Write State
Access	RW
PDO Mapping	Yes
Value Range	0 (OFF) or 1 (ON)
Default Value	0 (OFF)

3.3.2. Object 6240h: DO Polarity 1 Output Line

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

Object Description

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

Entry Description

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

Sub-Index	1h
Description	DO1 Polarity
Access	RW
PDO Mapping	No
Value Range	See Table 1
Default Value	0 (normal on/off)

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

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

Object Description

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

Entry Description

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

Sub-Index	1h
Description	DO1 Fault Mode
Access	RW
PDO Mapping	No
Value Range	See Table 2
Default Value	1 (apply pre-defined state)

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

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

Object Description

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

Entry Description

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

Sub-Index	1h
Description	DO1 Fault State
Access	RW
PDO Mapping	No
Value Range	0 (OFF) or 1 (ON)
Default Value	1 (ON)

3.3.5. Object 7300h: SO Output Process Value

This object represents the process value of the output. It can be used as an input to the Signal Output function block when the input has been selected as controlled by a CANopen® Message.

Object Description

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

Entry Description

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

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

3.3.6. Object 6302h: SO 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	SO Decimal Digits PV
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	SO Decimal Digits PV
Access	RW
PDO Mapping	No
Value Range	0 to 4
Default Value	0 [%DC]

3.3.7.   Object 6310h: SO Output Type

This object specifies the type of analog output, as defined in Table 14.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	SO Type
Access	RW
PDO Mapping	No
Value Range	See Table 3
Default Value	40 (PWM)

3.3.8.   Object 7320h: SO Output Scaling 1 PV

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

Object Description

Index	7320h
Name	SO 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	1
Default Value	1

Sub-Index	1h
Description	SO Scaling 1 PV
Access	RW
PDO Mapping	No
Value Range	See Table 7
Default Value	10

3.3.9. Object 7321h: SO Output Scaling 1 FV

This object defines the output field value when the input data is at or below the SO Output Scaling 1 PV value as shown in Figure 11. It will be scaled in the physical unit of the output, dependent on type, with the resolution defined in object 6332h SO Decimal Digits FV. The value can be set anywhere within the allowable output range as outlined in Table 14. This value can be set higher than object 7323h SO Output Scaling 2 FV for an inverse response (i.e. decreasing) to an increasing input.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	SO Scaling 1 FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 3)
Default Value	100 [0.1 %DC]

3.3.10. Object 7322h: SO 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 SO Decimal Digits PV, even when the output is not being controlled directly by the SO Output PV object 7300h. This object must always be larger than object 7322h SO Output Scaling 2 PV.

Object Description

Index	7322h
Name	SO Output Scaling 2 PV
Object Type	ARRAY

Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	SO Scaling 2 PV
Access	RW
PDO Mapping	No
Value Range	See Table 7
Default Value	90

3.3.11. Object 7323h: SO Output Scaling 2 FV

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

Object Description

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

Entry Description

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

Sub-Index	1h
Description	SO Scaling 2 FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 3)
Default Value	900 [0.1%DC]

3.3.12. Object 7330h: SO 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 5. It is defined in the physical unit of the output dependent on type, as outlined in Table 3. The resolution of the object is defined in object 6332h SO Decimal Digits FV.

Object Description

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

Entry Description

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

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

3.3.13. Object 6332h: SO 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	SO Decimal Digits FV
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	SO Decimal Digits FV
Access	RW

PDO Mapping	No
Value Range	0 to 4
Default Value	1 [0.1%DC resolution]

3.3.14. Object 6340h: SO Fault Mode

This object defines how a Signal Output shall response when a fault condition is detected on any control input, as described in Table 12.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	SO Fault Mode
Access	RW
PDO Mapping	No
Value Range	See Table 12
Default Value	1 (apply pre-defined FV)

3.3.15. Object 7341h: SO Fault FV

This object contains the pre-defined field value of a Signal 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 SO Decimal Digits FV.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	SO Fault FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 3)
Default Value	50 [%DC]

3.3.16. Object 7450h: PID Proportional Band

This object describes the proportional band gain (G in Figure 15) of the PID algorithm. The value is always interpreted as having a resolution of one digit after the decimal place.

Object Description

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

Entry Description

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

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

3.3.17. Object 7452h: PID Integral Action Time

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

Object Description

Index	7452h
Name	PID Integral Action Time
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

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

3.3.18. Object 7454h: PID Derivative Action Time

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

Object Description

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

Entry Description

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

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

3.3.19. Object 7456h: PID Cycle Time

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

Object Description

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

Entry Description

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

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

3.3.20. Object 6458h: PID Physical Unit Timing

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

Object Description

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

Entry Description

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

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

3.3.21. Object 6459h: PID Decimal Digits Timing

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

Object Description

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

Entry Description

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

Default Value	1

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

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
2200	Mixed Frequency Command PV	ARRAY	INTEGER16	RW	Yes
2230	Mixed Frequency Commanded FV	ARRAY	INTEGER16	RW	Yes
2241	Mixed Frequency Fault FV	ARRAY	INTEGER16	RW	No
22E0	Mixed Frequency Scaling 1 PV	ARRAY	INTEGER16	RW	No
22E1	Mixed Frequency Scaling 1 FV	ARRAY	INTEGER16	RW	No
22E2	Mixed Frequency Scaling 2 PV	ARRAY	INTEGER16	RW	No
22E3	Mixed Frequency Scaling 2 FV	ARRAY	INTEGER16	RW	No
22EE	Mixed Frequency Decimal Digits PV	ARRAY	UNSIGNED8	RW	No
22EF	Mixed Frequency Decimal Digits FV	ARRAY	UNSIGNED8	RW	No
2300	SO Override Field Value	ARRAY	INTEGER16	RW	No
2301	SO Mixed Frequency Override Field Value	ARRAY	INTEGER16	RW	No
2310	SO Error Detect Enable	ARRAY	BOOLEAN	RW	No
2311	SO Error Clear Hysteresis	ARRAY	INTEGER16	RW	No
2312	SO Error Reaction Delay	ARRAY	UNSIGNED16	RW	No
2320	SO Dither Frequency	ARRAY	UNSIGNED16	RW	No
2321	SO Dither Amplitude	ARRAY	UNSIGNED16	RW	No
2330	SO Ramp Up	ARRAY	UNSIGNED16	RW	No
2331	SO Ramp Down	ARRAY	UNSIGNED16	RW	No
2340	SO Control Input Source	ARRAY	UNSIGNED8	RW	No
2341	SO Control Input Number	ARRAY	UNSIGNED8	RW	No
2342	SO Control Input Response	ARRAY	UNSIGNED8	RW	No
2345	SO Mixed Frequency Control Input Source	ARRAY	UNSIGNED8	RW	No
2346	SO Mixed Frequency Control Input Number	ARRAY	UNSIGNED8	RW	No
2350	SO Enable Input Source	ARRAY	UNSIGNED8	RW	No
2351	SO Enable Input Number	ARRAY	UNSIGNED8	RW	No
2352	SO Enable Input Response	ARRAY	UNSIGNED8	RW	No
2360	SO Override Input Source	ARRAY	UNSIGNED8	RW	No
2361	SO Override Input Number	ARRAY	UNSIGNED8	RW	No
2362	SO Override Input Response	ARRAY	UNSIGNED8	RW	No
2370	SO Feedback Field Value	ARRAY	INTEGER16	RO	Yes
2371	SO Frequency Feedback Field Value	ARRAY	INTEGER16	RO	Yes
2380	SO Output Frequency	ARRAY	UNSIGNED16	RW	No
2381	SO Signal Amplitude	ARRAY	UNSIGNED8	RW	No

2450	PID Tolerance	ARRAY	INTEGER16	RW	No
2451	PID Integral Gain	ARRAY	INTEGER16	RW	No
2452	PID Derivative Gain	ARRAY	INTEGER16	RW	No
2453	PID Target Source	ARRAY	UNSIGNED8	RW	No
2454	PID Target Number	ARRAY	UNSIGNED8	RW	No
2455	PID Feedback Source	ARRAY	UNSIGNED8	RW	No
2456	PID Feedback Number	ARRAY	UNSIGNED8	RW	No
2457	PID Control Response	ARRAY	UNSIGNED8	RW	No
2460	PID Output Field Value	ARRAY	INTEGER16	RO	Yes
2500	EC Extra Received Process Value	ARRAY	INTEGER16	RW	Yes
2502	EC Decimal Digits PV	ARRAY	UNSIGNED8	RW	No
2520	EC Scaling 1 PV	ARRAY	INTEGER16	RW	No
2522	EC Scaling 2 PV	ARRAY	INTEGER16	RW	No
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(3-x) Lookup Table Number	ARRAY	UNSIGNED8	RW	No
3x02	LB(3-x) Function Logical Operator	ARRAY	UNSIGNED8	RW	No
3x11	LB(3-x) Function A Condition 1	RECORD	UNSIGNED8	RW	No
3x12	LB(3-x) Function A Condition 2	RECORD	UNSIGNED8	RW	No
3x13	LB(3-x) Function A Condition 3	RECORD	UNSIGNED8	RW	No
3x21	LB(3-x) Function B Condition 1	RECORD	UNSIGNED8	RW	No
3x22	LB(3-x) Function B Condition 2	RECORD	UNSIGNED8	RW	No
3x23	LB(3-x) Function B Condition 3	RECORD	UNSIGNED8	RW	No
3x31	LB(3-x) Function C Condition 1	RECORD	UNSIGNED8	RW	No
3x32	LB(3-x) Function C Condition 2	RECORD	UNSIGNED8	RW	No
3x33	LB(3-x) Function C Condition 3	RECORD	UNSIGNED8	RW	No
30z0	LTz Input X-Axis Source	VAR	UNSIGNED8	RW	No
30z1	LTz Input X-Axis Number	VAR	UNSIGNED8	RW	No
30z2	LTz X-Axis Decimal Digits PV	VAR	UNSIGNED8	RW	No
30z3	LTz Y-Axis Decimal Digits PV	VAR	UNSIGNED8	RW	No
30z4	LTz Point Response	ARRAY	UNSIGNED8	RW	No
30z5	LTz Point X-Axis PV	ARRAY	INTEGER16	RW	No
30z6	LTz Point Y-Axis PV	ARRAY	INTEGER16	RW	No
30z7	LTz Output Y-Axis PV	ARRAY	INTEGER16	RO	Yes
4000	Logic Block Enable	ARRAY	UNSIGNED8	RW	No
4010	Logic Block Selected Table	ARRAY	UNSIGNED8	RW	No
4020	Logic Output Process Value	ARRAY	INTEGER16	RO	Yes
4x01	LBx Lookup Table Number	ARRAY	UNSIGNED8	RW	No
4x02	LBx Function Logical Operator	ARRAY	UNSIGNED8	RW	No
4x11	Logic Block A Function A Condition 1	ARRAY	RECORD	RW	No
4x12	Logic Block A Function A Condition 2	ARRAY	RECORD	RW	No

4x13	Logic Block A Function A Condition 3	ARRAY	RECORD	RW	No
4x21	Logic Block A Function B Condition 1	ARRAY	RECORD	RW	No
4x22	Logic Block A Function B Condition 2	ARRAY	RECORD	RW	No
4x23	Logic Block A Function B Condition 3	ARRAY	RECORD	RW	No
4x31	Logic Block A Function C Condition 1	ARRAY	RECORD	RW	No
4x32	Logic Block A Function C Condition 2	ARRAY	RECORD	RW	No
4x33	Logic Block A Function C Condition 3	ARRAY	RECORD	RW	No
5010	Constant Field Value	ARRAY	FLOAT32	RW	No
5020	Power Supply Field Value	VAR	FLOAT32	RO	Yes
5030	Processor Temperature Field Value	VAR	FLOAT32	RO	Yes
5555	Start in Operational Mode	VAR	BOOLEAN	RW	No

*Where **yz** = 01 to 06 (LUT 1 to 6) and **x** = 4 to 7 (Logic 1 to 4)*

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

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

Object Description

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

Entry Description

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

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

3.4.2. Object 2200h: SO Mixed Frequency Output Process Value

This object represents the process value of the frequency output when output is configured as Mixed PWM/Frequency type.

Object Description

Index	2200h
Name	Signal Mixed Frequency Output Process Value
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	SO Mixed Frequency Process Value

Access	RW
PDO Mapping	Yes
Value Range	Integer16
Default Value	No

3.4.3. Object 2230h: SO Mixed Frequency Output Field Value

This object represents the target frequency output field value as a result of the output logic described in Section 1.3, and the scaling applied as shown in Figure 5. It is defined in the physical unit of the output dependent on type, as outlined in Table 3. The resolution of the object is defined in object 22EFh SO Decimal Digits FV.

Object Description

Index	2230h
Name	Signal Mixed Frequency Output Field Value
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

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

3.4.4. Object 2341h: SO Mixed Frequency Fault FV

This object contains the pre-defined field value of a Signal Frequency 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 22EFh SO Mixed Frequency Decimal Digits FV. This object is only valid/used when the output type is selected as Mixed PWM/Frequency output type

Object Description

Index	2241h
Name	SO Mixed Frequency Fault FV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	SO Mixed Frequency Fault FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 3)
Default Value	50 [Hz]

3.4.5. Object 22E0h: SO Mixed Frequency Output Scaling 1 PV

This object defines the minimum value of the input if output type is Mixed PWM/Frequency, 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 22EEh SO Mixed Frequency Decimal Digits PV, even when the output is not being controlled directly by the SO Mixed Frequency Output PV object 2200h. This object must always be smaller than object 22E2h SO Mixed Frequency Output Scaling 2 PV.

Object Description

Index	22E0h
Name	SO Mixed Frequency 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	1
Default Value	1

Sub-Index	1h
Description	SO Mixed Frequency Scaling 1 PV
Access	RW
PDO Mapping	No
Value Range	See Table 7
Default Value	50 [Hz]

3.4.6. Object 22E1h: SO Mixed Frequency Output Scaling 1 FV

This object defines the output field value when the input data is at or below the SO Mixed Frequency Output Scaling 1 PV value as shown in Figure 5. It will be scaled in the physical unit of the output, dependent on type, with the resolution defined in object 22EFh SO Mixed Frequency Decimal Digits FV. The value can be set anywhere within the allowable output range as outlined in

Table 3. This value can be set higher than object 22E3h SO Mixed Frequency Output Scaling 2 FV for an inverse response (i.e. decreasing) to an increasing input.

Object Description

Index	22E1h
Name	SO Mixed Frequency Output Scaling 1 FV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	SO Mixed Frequency Scaling 1 FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 3)
Default Value	500 [0.1Hz]

3.4.7. Object 22E2h: SO Mixed Frequency Output Scaling 2 PV

This object defines the maximum value of the input, and should be specified to equal the corresponding scaling object of the control source, as outlined in Table 6. It will be scaled in the physical unit of the control source. The resolution will always be dependent on object 22EEh SO Mixed Frequency Decimal Digits PV, even when the output is not being controlled directly by the SO Mixed Frequency Output PV object 2200h. This object must always be larger than object 22E2h SO Mixed Frequency Output Scaling 2 PV.

Object Description

Index	22E2h
Name	SO Mixed Frequency Output Scaling 2 PV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h

Description	SO Mixed Frequency Scaling 2 PV
Access	RW
PDO Mapping	No
Value Range	See Table 7
Default Value	1050 [Hz]

3.4.8. Object 22E3h: SO Mixed Frequency Output Scaling 2 FV

This object defines the output field value when the input data is at or above the SO Mixed Frequency Output Scaling 2 PV value as shown in Figure 5. It will be scaled in the physical unit of the output, dependent on type, with the resolution defined in object 22EFh SO Mixed Frequency Decimal Digits FV. The value can be set anywhere within the allowable output range as outlined in Table 3. This value can be set lower than object 22E1h SO Mixed Frequency Output Scaling 1 FV for an inverse response (i.e. decreasing) to an increasing input.

Object Description

Index	22E3h
Name	SO 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	10
Default Value	10

Sub-Index	1h
Description	SO Scaling 2 FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 3)
Default Value	10500 [0.1Hz]

3.4.9. Object 22EEh: SO Mixed Frequency 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	22EEh
Name	SO Mixed Frequency Decimal Digits PV
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported

Access	RO
PDO Mapping	No
Value Range	1
Default Value	1

Sub-Index	1h
Description	SO Mixed Frequency Decimal Digits PV
Access	RW
PDO Mapping	No
Value Range	0 to 4
Default Value	0 [Hz]

3.4.10. Object 22EFh: SO Mixed Frequency 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	22EFh
Name	SO Mixed Frequency Decimal Digits FV
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	SO Mixed Frequency Decimal Digits FV
Access	RW
PDO Mapping	No
Value Range	0 to 4
Default Value	1 [0.1Hz]

3.4.11. Object 2300h: SO Override Field Value

This object contains the pre-defined field value of a Signal 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 SO Decimal Digits FV.

Object Description

Index	2300h
Name	SO Override FV

Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	SO Override FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 11)
Default Value	50 [%DC]

3.4.12. Object 2301h: SO Mixed Frequency Override Field Value

This object contains the pre-defined field value of a Signal 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 22EFh SO Decimal Digits FV. This object is only valid/used when the output is configured as Mixed PWM/Frequency type.

Object Description

Index	2301h
Name	SO Mixed Frequency Override FV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	SO Mixed Frequency Override FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type (see Table 11)
Default Value	250 [Hz]

3.4.13. Object 2310h: SO Error Detect Enable

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

Object Description

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

Entry Description

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

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

3.4.14. Object 2311h: SO Error Clear Hysteresis

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

Object Description

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

Entry Description

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

Sub-Index	1h

Description	SO Error Clear Hysteresis
Access	RW
PDO Mapping	No
Value Range	0 to 10% of 7321h or 7323h, whichever is larger
Default Value	0.5 [%DC]

3.4.15. Object 2312h: SO Error Reaction Delay

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

Object Description

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

Entry Description

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

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

3.4.16. Object 2330h: SO 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	SO 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	2
Default Value	2

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

3.4.17. Object 2331h: SO Ramp Down

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

Object Description

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

Entry Description

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

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

3.4.18. Object 2340h: SO Control Input Source

This object defines the type of input that will be used to control the signal (or digital) output as shown in the logic flowchart in Figure 6. The available control sources on the CAN-PWM controller are listed in Table 5. Not all sources would make sense to control the SO, and it is the user's responsibility to select a source that makes sense for the application.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	SO Control Input Source
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	1 (CANopen® Message)

3.4.19. Object 2341h: SO Control Input Number

This object defines the number of the source that will be used to control the analog (or digital) output as shown in the logic flowchart in Figure 6: Signal Output Logic Flowchart. 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 5: Signal Output Linear Scaling PV to FV. 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	SO Control Input Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	SO Control Input Number
Access	RW
PDO Mapping	No
Value Range	See Table 6

Default Value	1 (RPDO 1)

3.4.20. Object 2342h: SO Control Response

This object defines the response profile of the Signal 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	SO Control Response
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	SO Control Response
Access	RW
PDO Mapping	No
Value Range	See Table 8
Default Value	1 (off below scaling 1 PV)

3.4.21. Object 2345h: SO Mixed Frequency Control Input Source

This object defines the type of input that will be used to control the frequency signal output if the output is configured as Mixed PWM/Frequency type. The available control sources on the CAN-PWM controller are listed in Table 5. Not all sources would make sense to control the SO, and it is the user's responsibility to select a source that makes sense for the application.

Object Description

Index	2345h
Name	SO Mixed Frequency Control Input Source
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Value Range	1
Default Value	1

Sub-Index	1h
Description	SO Mixed Frequency Control Input Source
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	1 (CANopen® Message)

3.4.22. Object 2346h: SO Mixed Frequency Control Input Number

This object defines the number of the source that will be used to control the frequency signal output if the output type selected is Mixed PWM/Frequency. The 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 5: Signal Output Linear Scaling PV to FV. Objects 22EEh, 22E0h, 22E2h should therefore be updated to match the scaling limits defined by the control source/number, as listed in Table 7.

Object Description

Index	2346h
Name	SO Mixed Frequency Control Input Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	SO Mixed Frequency Control Input Number
Access	RW
PDO Mapping	No
Value Range	See Table 6
Default Value	2 (RPDO 2)

3.4.23. Object 2350h: SO Enable Input Source

This object defines the type of input that will be used to enable/disable the analog (or digital) output as shown in the logic flowchart in Figure 6. The available control sources on the CAN-PWM controller are listed in Table 5. Not all sources would make sense to enable the SO, and it is the user's responsibility to select a source that makes sense for the application.

Object Description

Index	2350h
Name	SO Enable Input Source
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	SO Enable Input Source
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 (control not used)

3.4.24. Object 2351h: SO Enable Input Number

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

Object Description

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

Entry Description

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

Sub-Index	1h
Description	SO Enable Input Number
Access	RW
PDO Mapping	No
Value Range	See Table 6

Default Value	0 (null source selected)

3.4.25. Object 2352h: SO Enable Response

This object determines if the input will act as an enable or safety interlock (i.e. input must be ON to engage the output) or a disable signal (i.e. the output will shutoff when the input is ON.) The options for this object are listed in Table 10.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	SO Enable Response
Access	RW
PDO Mapping	No
Value Range	See Table 10
Default Value	1 (disable when input on)

3.4.26. Object 2360h: SO Override Input Source

This object defines the type of input that will be used to active the override value for the analog (or digital) output as shown in the logic flowchart in Figure 6. The available control sources on the CAN-PWM controller are listed in Table 5. Not all sources would make sense to enable the SO, and it is the user's responsibility to select a source that makes sense for the application.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	SO Override Input Source
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 (control not used)

3.4.27. Object 2361h: SO Override Input Number

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

Object Description

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

Entry Description

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

Sub-Index	1h
Description	SO Override Input Number
Access	RW
PDO Mapping	No
Value Range	See Table 6
Default Value	0 (null source selected)

3.4.28. Object 2362h: SO 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	SO Override Response
Object Type	ARRAY
Data Type	UNSIGNED8

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

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

3.4.29. Object 2370h: SO Feedback Field Value

This read-only object reflects the actual measured signal feedback of the output. If the output type is configured as Frequency Output Type, this object along with object 2371h will consist of the same data.

Object Description

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

Entry Description

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

Sub-Index	1h
Description	SO Feedback FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type
Default Value	No

3.4.30. Object 2371h: SO Frequency Feedback Field Value

This read-only object reflects the frequency feedback of the output. If the output type is configured as Frequency Output Type, this object along with object 2370h will consist of the same data.

Object Description

Index	2371h

Name	SO Frequency Feedback FV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h
Description	SO Frequency Feedback FV
Access	RW
PDO Mapping	No
Value Range	Dependent on type
Default Value	No

3.4.31. Object 2380h: SO Fixed PWM/Frequency

It defines the fixed output PWM duty cycle or frequency that will be used in Frequency Output Type or PWM Output Type, respectively. The range of this object is 0-100%DC and 1Hz to 20kHz. However, this object is ignored when the output is configured as Mixed PWM/Frequency.

Object Description

Index	2380h
Name	SO Fixed PWM/Frequency
Object Type	ARRAY
Data Type	UNSIGNED16

Entry Description

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

Sub-Index	1h
Description	SO Fixed PWM/Frequency
Access	RW
PDO Mapping	No
Value Range	0 to 100; 1 to 20,000
Default Value	500 [Hz] (Default Output Type: PWM)

3.4.32. Object 2381h: SO Signal Amplitude

This object defines the amplitude of the output signal.

Object Description

Index	2381h
Name	SO Signal Amplitude
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h
Description	SO Signal Amplitude
Access	RW
PDO Mapping	No
Value Range	Refer to Table 4
Default Value	0 (5V Amplitude)

3.4.33. Object 2450h: PID Tolerance

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

Object Description

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

Entry Description

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

Sub-Index	1h or 2h (x = 1 or 2)
Description	PIDx Tolerance
Access	RW
PDO Mapping	No
Value Range	0 to 100 (0% to 10%)
Default Value	10 [1%]

3.4.34. Object 2451h: PID Integral Gain

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

Object Description

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

Entry Description

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

Sub-Index	1h or 2h (x = 1 or 2)
Description	PIDx Integral Gain
Access	RW
PDO Mapping	No
Value Range	0 to 100
Default Value	10 [1.0]

3.4.35. Object 2452h: PID Derivative Gain

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

Object Description

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

Entry Description

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

Sub-Index	1h or 2h (x = 1 or 2)
Description	PIDx Derivative Gain
Access	RW
PDO Mapping	No

Value Range	0 to 100
Default Value	10 [1.0]

3.4.36. Object 2453h: PID Target Source

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

Object Description

Index	2453h
Name	PID Target Source
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

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

Sub-Index	1h or 2h (x = 1 or 2)
Description	PIDx Target Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (control not used, PID disabled)

3.4.37. Object 2454h: PID Target Number

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

Object Description

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

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO

PDO Mapping	No
Value Range	2
Default Value	2

Sub-Index	1h or 2h (x = 1 or 2)
Description	PIDx Target Number
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 (null source selected)

3.4.38. Object 2455h: PID Feedback Source

This object defines the type of input that will be used to determine the feedback process value for the PID control loop. The available control sources on the CAN-PWM controller are listed in Table 15. Not all sources would make sense to use as a PID feedback source, and it is the user's responsibility to select a source that makes sense for the application. A selection of "Control Source Not Used" disables the associated PID control function block.

Object Description

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

Entry Description

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

Sub-Index	1h or 2h (x = 1 or 2)
Description	PIDx Feedback Source
Access	RW
PDO Mapping	No
Value Range	See Table 4
Default Value	0 (control not used, PID disabled)

3.4.39. Object 2456h: PID Feedback Number

This object defines the number of the source that will be used as the feedback PV for the PID control loop. The available control numbers are dependent on the source selected, as shown in Table 16. Once selected, the control will convert the measured/received feedback into a percentage value using the scaling limits of the control source/number as defined in Table 6.

Object Description

Index	2456h

Name	PID Feedback Number
Object Type	ARRAY
Data Type	UNSIGNED8

Entry Description

Sub-Index	0h
Description	Largest sub-index supported
Access	RO
PDO Mapping	No
Value Range	2
Default Value	2
Sub-Index	1h or 2h (x = 1 or 2)
Description	PIDx Feedback Number
Access	RW
PDO Mapping	No
Value Range	See Table 5
Default Value	0 (null source selected)

3.4.40. Object 2457h: PID Control Response

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

Object Description

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

Entry Description

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

Sub-Index	1h or 2h (x = 1 or 2)
Description	PIDx Control Response
Access	RW
PDO Mapping	No
Value Range	See Table 12
Default Value	0 (single output)

3.4.41. Object 2460h: PID Output Field Value

This read-only output contains the PID control function block FV (as a percentage) that can be used as the input source for another function block (i.e. analog output.) It will be a value between 0

to 100% as per the algorithm defined in Figure 4. The physical unit for this object is percentage, and the value is always interpreted as having a resolution of one digit after the decimal place.

Object Description

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

Entry Description

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

Sub-Index	1h or 2h (x = 1 or 2)
Description	PIDx Output FV
Access	RO
PDO Mapping	Yes
Value Range	0 to 1000 (0 to 100%)
Default Value	No

3.4.42. Object 2500h: EC Extra Received Process Value

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

Object Description

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

Entry Description

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

Sub-Index	1h to 6h (x = 1 to 6)
Description	ECx Received PV
Access	RW
PDO Mapping	Yes
Value Range	Integer16

Default Value	No

3.4.43. 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)

3.4.44. Object 2520h: EC Scaling 1 PV

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

Object Description

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

Entry Description

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

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

3.4.45. Object 2522h: EC Scaling 2 PV

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

Object Description

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

Entry Description

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

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

3.4.46. 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-PWM controller 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 06)
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)

3.4.47. 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 7.

Object Description

Index	3yz1h (where yz = 01 to 06)
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)

3.4.48. 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 1.5.4

Object Description

Index	3yz2h (where yz = 01 to 06)
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]

3.4.49. 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 as defined in Table 7.

Object Description

Index	3yz3h (where yz = 01 to 06)
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 (see Table 7)
Default Value	0

3.4.50. 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 (i.e. a signal output), it is recommended that this value be set equal to the decimal digits used by the block that is using the lookup table as the control source/number.

Object Description

Index	3yz4h (where yz = 01 to 06)
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

3.4.51. 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 14.

Object Description

Index	3yz5h (where yz = 01 to 06)
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 14 (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 14 (0, 1 or 2)
Default Value	1 (ramp to response)

3.4.52. 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, LTz X-Axis Decimal Digits PV.

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

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 06)
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

3.4.53. 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 06)
Name	LTz Point Y-Axis PV
Object Type	ARRAY
Data Type	INTEGER16

Entry Description

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

Sub-Index	1h to 11h (x = 1 to 11)
Description	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]

3.4.54. 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 (i.e. signal output.) The physical unit for this object is undefined, and it will use the resolution defined in object 3yz4h, LTz Y-Axis Decimal Digits PV.

Object Description

Index	3yz8h (where yz = 01 to 06)
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

3.4.55. 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	4
Default Value	4

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

3.4.56. 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	4
Default Value	4

Sub-Index	1h to 4h (x = 1 to 4)
Description	LBx Selected Table
Access	RO
PDO Mapping	Yes
Value Range	1 to 6
Default Value	No

3.4.57.   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 6. 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	4
Default Value	4

Sub-Index	1h to 4h (x = 1 to 4)
Description	LBx Output PV
Access	RO
PDO Mapping	Yes
Value Range	Dependent on Selected Table
Default Value	No

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

This object determines which of the six lookup tables supports on the CAN-PWM 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 7)
Name	LB(3-x) 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	4
Default Value	4

Sub-Index	1h to 4h (y = A to C)
Description	LB(3-x) Lookup Table Y Number
Access	RW
PDO Mapping	No
Value Range	1 to 6
Default Value	See Table 20

3.4.59. Object 3x02h: LB(3-x) 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 18. See Section 1.6 for more information about how this object is used.

Object Description

Index	3x02h (where x = 4 to 7)
Name	LB(3-x) 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	4
Default Value	4

Sub-Index	1h to 4h (y = A to C)
Description	LB(3-x) Function Y Logical Operator
Access	RW
PDO Mapping	No
Value Range	See Table 18
Default Value	Function A = 1 (and all) Function B = 1 (and all) Function C = 0 (default)

3.4.60. Object 3x11h: LB(3-x) Function A Condition 1
3.4.61. Object 3x12h: LB(3-x) Function A Condition 2
3.4.62. Object 3x13h: LB(3-x) Function A Condition 3
3.4.63. Object 3x21h: LB(3-x) Function B Condition 1
3.4.64. Object 3x22h: LB(3-x) Function B Condition 2
3.4.65. Object 3x23h: LB(3-x) Function B Condition 3
3.4.66. Object 3x31h: LB(3-x) Function C Condition 1
3.4.67. Object 3x32h: LB(3-x) Function C Condition 2
3.4.68. Object 3x33h: LB(3-x) Function C Condition 3

These objects, 3xyzh, represent Logic Block z, Function y, Condition z, where x = 4 to 7, y = 1 (A) to 3 (C), and z = 1 to 3. All of these objects are a special type of record, defined in Table 15. Information on how to use these objects is defined in Section 1.6.

Object Description

Index	3xyzh
Name	LB(3-x) 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	11 (EC Received PV 1)

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

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

Sub-Index	5h
Description	Operator
Access	RW
PDO Mapping	No
Value Range	See Table 16
Default Value	0 (Equals)

3.4.69. Object 5010h: Constant Field Value

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

Object Description

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

Entry Description

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

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

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

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

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

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

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

3.4.70. Object 5020h: Power Supply Field Value

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

Object Description

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

Entry Description

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

3.4.71. Object 5030h: Processor Temperature Field Value

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

Object Description

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

Entry Description

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

3.4.72. Object 5555h: Start in Operational Mode

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

Object Description

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

Entry Description

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

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/.

4.1.   Power Supply

Power Supply Input	12 V or 24 Vdc nominal; 9…36 Vdc The minimum allowable supply voltage for the power pin is 7 Vdc.
Supply Current	16 mA @ 24Vdc Typical
Surge Protection	Meets the surge requirements of SAE J1445
Protection	Provided

4.2.   Outputs

Signal Output Functions	PWM [%], Frequency [Hz], Mixed PWM/Frequency [%/Hz], Digital On/Off
Output Type	1 Output configurable as PWM/Frequency or Digital PWM Signal, Frequency Signal or Mixed Output • 1 Hz to 20 kHz • 0-100% D.C. (User configurable) • 5V or 12V amplitude • Push pull output • Maximum load is 50 mA (at 5V) or 30 mA (at 12V). • Over-current protection (50 mA) Digital Level • Digital On/Off • 5V or 12V Amplitude Maximum load is 50 mA (at 5V) or 30 mA (at 12V). Output feedback data available 2370h Output frequency (only) data available 2371h
Error Detection/Reaction	EMCY code generation (object 1003h) and fault reaction possible (1029h) when an out-of-range is flagged
Output Accuracy	PWM Signal: 0.5% Frequency Signal: 0.1%
Output Feedback Accuracy	PWM Signal: 0.5% Frequency Signal: 0.5%
Response Time	10 mSec.

4.3.   Communication

CAN	1 CAN 2.0B port, protocol CiA CANopen® CiA DS-404 V1.2 – CANopen® profile for Measurement Devices and Closed Loop Controllers. CAN in Automation 2002
Network Termination	According to the CAN standard, 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.
Isolation	300 Vrms isolation for CAN port

4.4.   General Specifications

Microprocessor	STM32F103CBT7; 32-bit, 128 Kbytes Flash Program Memory
Control Logic	User programmable functionality using SDO object access, per CiA DS-301
User Interface	.EDS provided to interface to standard CANopen® tools
Operating Conditions	-40 to 85 °C (-40 to 185 °F)
Storage	-50 to 105 °C (-58 to 221 °F)
Vibration	MIL-STD-202G, Test 204D and 214A (Sine and Random) 10 g peak (Sine); 7.86 Grms peak (Random)
Shock	MIL-STD-202G, Test 213B, 50 g
Packaging and Dimensions	Plastic Enclosure, Nylon 6-6 with 30% glass fill Integral connector (equivalent to TE Deutsch P/N: DT04-6P) Refer to Figure 1.0, dimensional drawing.
Protection	IP67
Vibration	Random Vibration for vibration isolated cab mount components 16 hours/axis, 4.41 - 6.79 Grms, 5 Hz – 2000 Hz, Modified Kurtosis 9.3 Parts of SAE J1445, MIL-STD-202, IEC 60068-2-64
Weight	0.15 lbs, 0.068kg

5. VERSION HISTORY

User Manual Version	Date	Author	Modifications
1.00	December 14, 2017	Gustavo Del Valle	Initial Draft
1.01	July 27, 2023	Kiril Mojsov	Performed Legacy Updates

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

OUR PRODUCTS

AC/DC Power Supplies

Actuator Controls/Interfaces

Automotive Ethernet Interfaces

Battery Chargers

CAN Controls, Routers, Repeaters

CAN/WiFi, CAN/Bluetooth, Routers

Current/Voltage/PWM Converters

DC/DC Power Converters

Engine Temperature Scanners

Ethernet/CAN Converters,
Gateways, Switches

Fan Drive Controllers

Gateways, CAN/Modbus, RS-232

Gyroscopes, Inclinometers

Hydraulic Valve Controllers

Inclinometers, Triaxial

I/O Controls

LVDT Signal Converters

Machine Controls

Modbus, RS-422, RS-485 Controls

Motor Controls, Inverters

Power Supplies, DC/DC, AC/DC

PWM Signal Converters/Isolators

Resolver Signal Conditioners

Service Tools

Signal Conditioners, Converters

Strain Gauge CAN Controls

Surge Suppressors

OUR COMPANY

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

QUALITY DESIGN AND MANUFACTURING

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

WARRANTY, APPLICATION APPROVALS/LIMITATIONS

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

COMPLIANCE

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

SAFE USE

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

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

SERVICE

All products to be returned to Axiomatic require a Return Materials Authorization Number (RMA#) from sales@axiomatic.com. Please provide the following information when requesting an RMA number:
- Serial number, part number
- Runtime hours, description of problem
- Wiring set up diagram, application and other comments as needed

DISPOSAL

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

CONTACTS

Axiomatic Technologies Corporation
1445 Courtneypark Drive E.
Mississauga, ON
CANADA L5T 2E3
TEL: +1 905 602 9270
FAX: +1 905 602 9279
www.axiomatic.com
sales@axiomatic.com

Axiomatic Technologies Oy
Höytämöntie 6
33880 Lempäälä
FINLAND
TEL: +358 103 375 750

www.axiomatic.com
salesfinland@axiomatic.com