USER MANUAL UMAX1307x0
Version V2B

CAN TO
1 RELAY AND
2 ANALOG OUTPUTS
CONVERTER

USER MANUAL

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ACCRONYMS

ACK	Positive Acknowledgement	(from SAE J1939 standard)
DM	Diagnostic Message	(from SAE J1939 standard)
DOUT	Digital Output, sourcing (high-side) output up to 3A current	
DTC	Diagnostic Trouble Code	(from SAE J1939 standard)
EA	Electronic Assistant, p/n AX070502 (A Service Tool for Axiomatic ECUs)	
ECU	Electronic Control Unit	(from SAE J1939 standard)
NAK	Negative Acknowledgement	(from SAE J1939 standard)
PDU1	A format for messages that are to be sent to a destination address, either specific or global	(from SAE J1939 standard)
PDU2	A format used to send information that has been labeled using the Group Extension technique and does not contain a destination address.	
PGN	Parameter Group Number	(from SAE J1939 standard)
PropA	Message that uses the Proprietary A PGN for peer-to-peer communication	
PropB	Message that uses a Proprietary B PGN for broadcast communication	
PWM	Pulse Width Modulation	
RPM	Rotations per Minute	
SPN	Suspect Parameter Number	(from SAE J1939 standard)
AOUT	Analog Output: Current, Voltage, Digital, PWM or frequency type	

REFERENCES

J1939	Recommended Practice for a Serial Control and Communications Vehicle Network, SAE, April 2011
J1939/21	Data Link Layer, SAE, December 2010
J1939/71	Vehicle Application Layer, SAE, March 2011
J1939/73	Application Layer-Diagnostics, SAE, February 2010
J1939/81	Network Management, SAE, May 2003
TDAX130770	Technical Datasheet, CAN to 2 Analog/Digital Isolated Signals and 1 Relay Output Converter
UMAX07050x	User Manual, Electronic Assistant and USB-CAN, Axiomatic Technologies

This document assumes the reader is familiar with the SAE J1939 standard. Terminology from the standard is used but is not described in this document.

NOTE: When a description is in "**double-quotes**" and bolded, this refers to the name of a user configurable setpoint (variable). If it is in '*single-quotes*' and italicized, it refers to an option for the associated setpoint.

For example: "**Output Type**" set to *'Analog Current'*

This product uses the Axiomatic Electronic Assistant to program the setpoints for application specific requirements. After configuration, the setpoints can be saved in a file which could then be flashed into other AX1307x0 controllers over the CAN network.

1. OVERVIEW OF CONTROLLER

1.1. Description of CAN to 2 Analog/Digital Signals and 1 Relay Output Converter

This User Manual describes the architecture and functionality of the CAN to 1 Relay and 2 Analog Outputs Converter (CAN-1RLY-2AOUT). It accepts power supply voltages from 9 to 36 VDC. All logical function blocks on the unit are inherently independent from one another but can be configured to interact with each other. All parameters are configurable using Electronic Assistant.

This controller is designed for versatile control of CAN bus to 2 analog/digital outputs and a relay output. The hardware design allows for the controller to have a wide range of output types. The control algorithms/function blocks allow the user to configure the controller for a wide range of applications without the need for custom firmware. The various function blocks supported by this controller are outlined in the following sections.

The normally open/normally closed relay output can be configured to respond in different types: *Normal Logic, Inverse Logic, Latched Logic, Inverse Latched Logic and Toggle Logic*. The relay outputs are described in more details in section 1.2.

Similarly, the analog output can be configured to different types: *Analog Current, Analog Voltage, Digital PWM, Digital Frequency and Digital ON/OFF.* The analog output is described in more details in section 1.3.

1.2. Relay Output Function Block

The following sub-sections will explain in more detail the functionalities and available setpoints/parameters.

1.2.1. Relay Output Functionality

The relay output has 2 states: Normally Open and Normally Closed. It has 3 pins associated with it: Normally Closed (NC), Normally Open (NO), and Common (C). The **"Relay Output Type"** parameter allows for flexibility in the response of the output. Table 1 shows the options available for this parameter.

Value	Meaning
0	*Output Not Used*
1	*Normal Logic*
1	*Inverse Logic*
2	*Latched Logic*
3	*Inverse Latched Logic*
4	*Toggle Logic*

Table 1: Relay Output Types

By default, *'Normal Logic'* response is used for the relay outputs. In *'Normal Logic'* response, the Common pin is connected to the Normally Closed pin if the source of the respective relay output is triggered ON, the Common pin is connected to the Normally Open pin.

In the case of *'Inverse Logic'* response, the Common pin is connected to the Normally Open pin when the source of the respective relay output is triggered ON. When the source of the respective relay output is triggered OFF, the Common pin is connected to the Normally Closed pin.

In the case of *'Latched Logic'* response, the Common pin is toggled between Normally Closed and Normally Open pins every time the source of the respective relay output goes from OFF to ON. The *'Inverse Latched Logic'* response will respond the opposite way.

The *'Toggle Logic'* lets the relay output toggle between Normally closed and Normally Open pins for a configured frequency. The time for switching from one state to the other state results the **"Relay Blink Rate"** which is in milliseconds and by default 500ms.

1.2.2. Relay Output Control / Enable Sources / Override Source

The relay output can be configured to be commanded and/or enabled by the control sources listed in Table 2. This table also displays the number associated to the control sources which can be selected. The default control source is highlighted while the default Enable Source and Override Source is configured to *'Control Not Used'.*

Value	Meaning	Source Range
0	*Control Not Used*	[1]
1	*Relay Output*	[1]
2	*Power Supply State*	[1]
3	*Temperature State*	[1]
4	*CAN Receive Messages*	[1…10]
5	*Power Supply Measured*	[1]
6	*Processor Temperature Measured*	[1]
7	*Math Function*	[1…4]
8	*Lookup Table*	[1…10]
9	*Programmable Logic*	[1…3]
10	*Conditional Logic*	[1…10]
11	*Set Reset Lactch*	[1…5]

Table 2: Control Sources

The selected control source in the **"Relay Control Source"** parameter is the main commanding source of the relay output based on "**Relay Output Type"** parameter. A delay can be set for both output states when **"Relay Enable Response Delay"** is set to be *'TRUE'.* In case the output state should turn low after a certain amount of time, the parameter **"Relay Delay OFF Time"** can be set. Whereas the **"Relay Delay ON Time"** can be configured to set a delay before switching from the OFF-state to ON-state. Both delays are configurable in milliseconds.

1.2.3. Relay Output Enable

The **"Relay Enable Source"** will determine whether or not the relay output will be commanded by the **"Relay Control Source"**. There are six different **"Relay Enable Response"** in which the enable signal can be used. These responses are listed in Table 3.

Value	Meaning
0	*Enable When ON*
1	*Enable When OFF*
2	*Disable When ON*
3	*Disable When OFF*
4	*Enable When ON Else Keep State*
5	*Enable When OFF Else Keep State*

Table 3: Relay Enable Response

When the **"Relay Enable Response"** is set to *'Enable When ON'* or *'Disable When OFF'***,** the relay output will be commanded according to the combined signal of the **"Relay Control Source"** and **"Relay Control Number"** only when the signal of the **"Relay Enable Source"** and **"Relay Enable Number"** is ON. Otherwise, the relay output is commanded to the OFF state.

Similarly, when the **"Relay Enable Response"** is set to *'Enable When OFF'* or *'Disable When ON'*, the relay output will be commanded according to the **"Relay Control Source"** and **"Relay Control Number"** only when the signal of the **"Relay Enable Source"** and **"Relay Enable Number"** is OFF. Otherwise, the relay output is commanded to the OFF state.

In case the **“Relay Enable Response”** is *‘Enable When ON Else Keep State’*, the relay output will be commanded according to the signal of the **“Relay Control Source”** and **“Relay Control Number”** only when the signal of the **“Relay Enable Source”** and **“Relay Enable Number”** is ON. If the Enable Signal is OFF, the relay output will keep the previous state.

Likewise, when the **“Relay Enable Response”** is configured to *‘Enable When OFF Else Keep State’*, the relay output will be commanded according to the **“Relay Control Source”** and **“Relay Control Number”** only when the combined signal of **“Relay Enable Source”** and **“Relay Enable Number”** is OFF. Otherwise, the relay output holds the previous state.

1.2.4. Relay Output Override

The **“Relay Override Source”** will determine whether or not the relay output will be commanded by the **“Relay Control Source”**. This Source has a higher priority than the Enable Source.

There are two different **“Relay Override Response”** in which the Override signal can be used. These responses are listed in Table 4.

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

Table 4: Relay Override Response Options

When the **“Relay Override Response”** is configured to *‘Override When ON’*, the relay output will be commanded according to the signal of the **“Relay Control Source”** and **“Relay Control Number”** by the **“Relay Override State”** only when the override signal is ON. If the **“Relay Override Response”** is set to *‘Override When OFF’*, the relay output will be commanded only according to the signal of the Control Source/Number by the **“Relay Override State”** only when the override signal is OFF. Table 5 shows the two possible states for the **“Relay Override State”**.

In case of *‘Override State OFF’*, the relay output switches to Normally Open. If *‘Override State ON’* is configured, the relay output changes to Normally closed.

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

Table 5: Relay Override State Options

1.2.5. Unlatch Source

This Source can only be configured if the **“Relay Output Type”** is set to *‘Latched Logic* or *‘Inverse Latched Logic*’ and it can be enabled/disabled by the parameter **“Relay Enable Unlatch Source”**. If the signal of the **“Relay Unlatch Source”** is ON, it turns the output OFF when the **“Relay Output Type”** is set to *‘Latched Logic*’. If the Unlatch Source state turns OFF afterwards, the output state stays OFF independent of the output state before. The reverse behavior is applied to the *Inverse Latched Logic*.

1.3. Analog Output Function Block

The controller has 2 analog/digital outputs can be configured and they are inherently independent of each other. The **Analog Output Type** parameter determines what kind of signal the output produces. Changing this parameter will update other parameters in the group to match the selected type. For this reason, it should be the first parameter to be changed. The supported output types by the controller are listed in Table 5 below:

Value	Meaning
0	*Output Not Used*
1	*Analog Current*
2	*Analog Voltage*
3	*Digital PWM*
4	*Digital Frequency*
5	*Digital ON/OFF*

Table 6: Analog Output Type Options

The control signal of the outputs will have associated with it a minimum and maximum values. Besides type *Digital ON/OFF*, all the other output types are always responding in a linear fashion to changes in the control source per the calculation in Figure 1.

$$y = mx + a$$

$$m = \frac{Y\max - Y\min}{X\max - X\min}$$

$$a = Y\min - m * X\min$$

Figure 1 - Linear Slope Calculations

X and Y are defined as:

Xmin = Control Input Minimum Ymin = **"Output At Minimum Command"**
Xmax = Control Input Maximum Ymax = **"Output At Maximum Command"**

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

The **"Fixed Frequency/Duty Cycle"** is set to *500.0* [Hz] by default for all the output types except for *'Digital Frequency'*, the value is set to a default value as *50.0* [%Duty Cycle]. Since both outputs are connected to independent timers, this parameter can be changed at any time for each output without affecting the other.

1.3.1 Analog Current/Analog Voltage

Current Outputs can be configured to different ranges as 0-20mA, 4-20mA and 0-24mA and Voltage Outputs can be configured to be bipolar or unipolar, 0-5V, 0-10V, -10V to 10V and -5V to 5V. To drive the output to different ranges, simply setting the **"Output at Minimum Command"** and **"Output at Maximum Command"** to corresponding value in each range. The unit of measurement for current output variables is milliamps [mA] and volts [V] for voltage outputs.

1.3.2 Digital PWM/Digital Frequency

Pulse width modulated outputs use a fixed frequency determined by the value in the **"Fixed Frequency/Duty Cycle"** setpoint and frequency outputs use a fixed duty cycle as selected by this setpoint. The **"Digital Type VPS range"** setpoint determines if the signal will toggle between 0V and *+5V* or *+12V*. The unit of measurement for PWM output variables is percentage [%] and Hertz [Hz] for the frequency outputs.

1.3.3 Digital ON/OFF

The **"Digital Type VPS range"** setpoint determines if the output is at *+5V* or *+12V* when ON. If a non-digital control is selected for this type, the command state will be OFF at or below the minimum input, ON at or above the maximum input, and it will not change in between those points. In other words, the input will have built in hysteresis, as shown in Figure 2. This relationship is true for any function block that has a non-digital input mapped to a digital control.

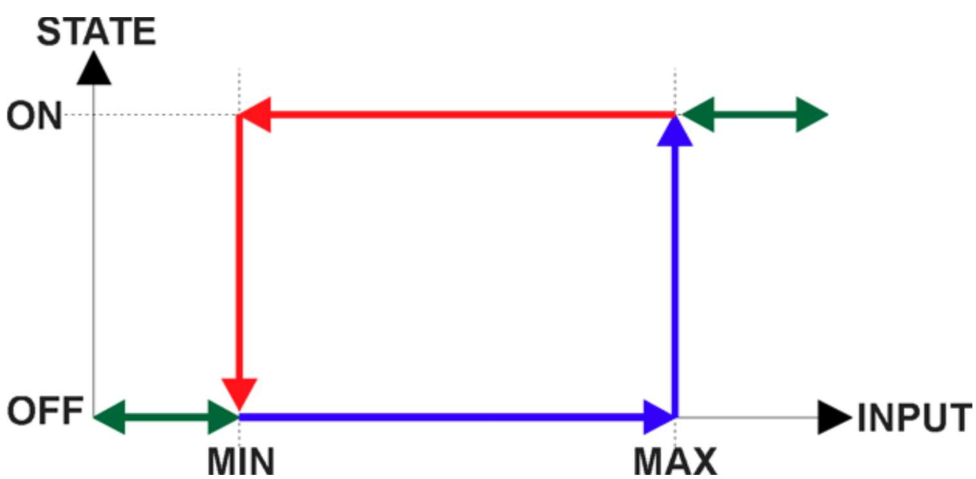


Figure 2 - Analog to Digital Input

Only when a *'Digital ON/OFF'* type has been selected will the **"Digital Control Response"** setpoint be enabled as shown in Table 7.

Value	Meaning
0	*Normal Logic*
1	*Inverse Logic*
2	*Latched Logic*
3	*Blink Logic*

Table 7: Digital Control Response Options

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

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

If a *'Blink Logic'* response is selected, then while the input command the output ON, it will blink at the rate set by **"Digital Blink Rate"** parameter. When commanded OFF, the output will stay off.

In order to prevent abrupt changes at the output due to sudden changes in the command input, the user can choose to use the independent up or down ramps to smooth out the response. The **Ramp Up (Min to Max)** and **Ramp Down (Max to Min)** parameters are in milliseconds, and the step size of the output change will be determined by taking the absolute value of the output range and dividing it by the ramp time. However, these setpoints are set to zero by default since in most signal conversion applications, fast response times are desired.

By default, the **"Control Source"** is setup to be *'CAN Receive Messages.'* In other words, all the outputs will response in a linear fashion to the corresponding CAN received command data.

The **"Control Source"** together with **"Control Number"** parameter determine which signal is used to drive the output. For example, setting **"Control Source"** to *'CAN Receive Messages'* and **"Control Number"** to '*1'* will connect signal measured from CAN Receive Message 1 to the output in question. The options for **"Control Sources"** and available **"Control Number"** are listed in Table 2.

In addition to the Control input, the function block also supports an enable input which can be setup as either an enable or disable signal.

When an Enable input is used, the output will be shutoff as per the **"Enable Response"** in Table 8. If the response is selected as a disable signal (2 or 3), when the input is ON, the output will be shut off.

Value	Meaning
0	*Enable When On, Else Shutoff*
1	*Enable When On, Else Rampoff*
2	*Enable When Off, Else Shutoff*
3	*Enable When Off, Else Rampoff*
4	*Enable When On, Else Ramp To Min*
5	*Enable When On, Else Ramp To Max*

Table 8: Enable Response Options

The Override option allows the user to choose whether or not to drive the output with the override input being engaged/disengaged, depending on the logic selected in **"Override Response."** The options for **"Override Response"** are the same as the relay output which are listed in Table 4.

The options for both **"Enable Source"** and **"Override Source"** are same as sources listed in Table 2.

1.4. Lookup Table Function Block

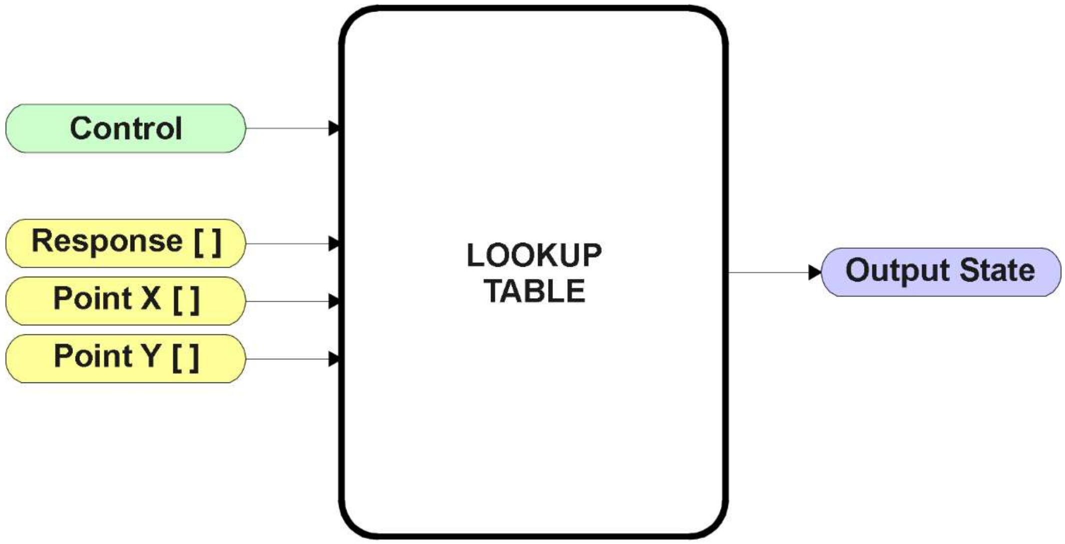


Figure 3 – Lookup Table Function Block

Lookup Tables are used to give an output response of up to 10 slopes per input. The array size of the Response [ ], Point X [ ] and Point Y [ ] setpoints shown in the block diagram above is therefore 11.

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

There are two key setpoints that will affect this function block. The first is the "**X-Axis Source**" and **"X-Axis Number"** which together define the Control Source for the function block. When it is changed, the table is automatically updated with new defaults based on the X-Axis source selected.

Initialize the Control Source of a Lookup Table BEFORE changing the table values, as the new settings WILL get erased when the control is updated.

The second setpoint that will affect the function block (i.e. reset to defaults), is the "**X-Axis Type**". By default, the tables have a *'Data Response'* output. Alternatively, it can be selected as a *'Time Response',* which is described later in Section 1.4.5.

1.4.1. X-Axis, Input Data Response

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

For example, if the control source is a CAN Receive message, setup as a 0-5V type, with an operating range of 0.5V to 4.5V, the X-Axis will be setup to have a default "**Point 1 – X Value**" of 0.5V, and setpoint "**Point 10 – X Value**" will be set to 4.5V. The "**Point 0 – X Value**" will be set to the default value of 0.0V.

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

However, should the minimum input be less than zero, for example a CAN message that is reflecting temperature in the range of -40ºC to 210ºC, then the "**Point 0 – X Value**" 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_{10} is changed first, then lower indexes in descending order.

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

As stated earlier, MinInputRange and MaxInputRange will be determined by the X-Axis Source that has been selected.

If some of the data points are *'Ignored'* as described in Section 1.4.4, they will not be used in the X-Axis calculation shown above. For example, if points X_4 and higher are ignored, the formula becomes MinInputRange <= X_0 <= X_1 <= X_2<= X_3<= MaxInputRange instead.

1.4.2. Y-Axis, Lookup Table Output

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

For example, should the X-Axis of a table be a resistive value (as read from another controller), the output of the table could be temperature from an NTC sensor in the range Y_0=125ºC to Y_{10}= -20ºC. If this table is used as the control source for another function block (i.e. transmitted over CAN), then Xmin would be -20 and Xmax would be 125 when used the linear formula.

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

However, if some of the data points are *'Ignored'* as described in Section 1.4.4, they will not be used in the Y-Axis range determination. Only the Y-Axis values shown on EA will be considered when establishing the limits of the table when it is used to drive another function block, such as an Analog Output.

1.4.3. Default Configuration, Data Response

By default, all Lookup Tables in the ECU are disabled (**"X-Axis Source"** equals *'Control Source Not Used'.*) If they were to use the default settings for Inputs 1 and 2 instead as the X-Axis and output current (in mA) they could be used to control the Analog Output 1. If a non-linear response for one or more of the outputs is required, the user can easily use the table(s) to create the desired response profiles.

Recall, any controlled function block which uses the Lookup Table as an input source (not only the Analog Output 1) will also apply a linearization to the data. Therefore, for a 1:1 control response, ensure that the minimum and maximum values of the output (Ymin and Ymax in Figure 3) correspond to the minimum and maximum values of the table's Y-Axis (Xmin and Xmax in Figure 3).

To control "Analog Output 1" by "CAN Received Message 1" modified by "Lookup Table 1", it is recommended to do so in the following order:

a) Change Analog Output 1 **"Output at Minimum Command"** and **"Output at Maximum Command"** to the desired limits.
b) Configure the desired Control Source (i.e. CAN Receive Message) and set the appropriate limits.
c) Change the Lookup Table 1 **"X-Axis Source"** setpoints. (If applicable)
   At this point, the X-Axis limits will match the control source, and the Y-Axis limits and the Y-Axis limits would correspond to the Analog Output 1 range, as a percentage.
d) Update the X and Y setpoints for the application

Note: Order (b) to (d) holds true for all configuration done using any Lookup Table function block.

All tables (1 to 10) are disabled by default (no control source selected). However, should an **"X-Axis Source"** be selected, the Y-Axis defaults will be in the range of 0 to 100% as described in the "Y-Axis, Lookup Table Output" section above. X-Axis minimum and maximum defaults will be set as described in the "X-Axis, Data Response" section above.

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

For example, with a 0.5 to 4.5V input (X-Axis) driving a 0 to 1500mA output (Y-Axis), the default points would be setup as per figure (a) below. However, a 100Ω to 54kΩ input (X-Axis) representing 120ºC to -30ºC (Y-Axis) would be setup as per figure (b) below. In each case, the user would have to adjust the table for the desired response.

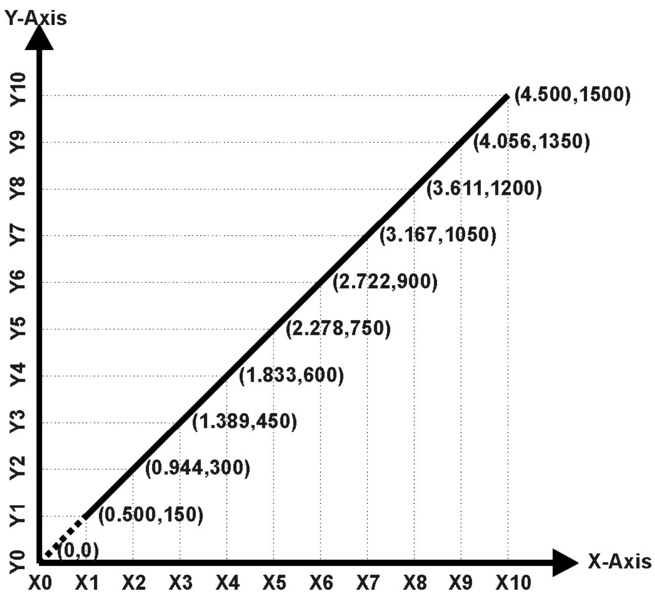


Figure A - 0.5 to 4.5V Input, 0 to 1500mA Output

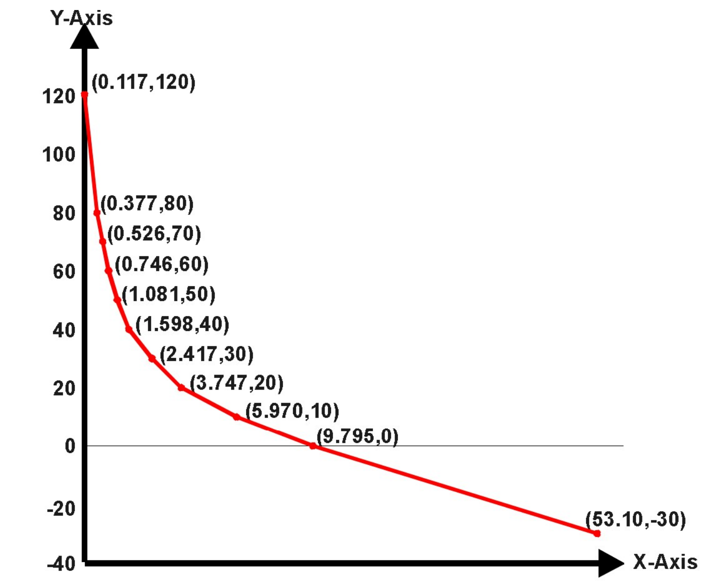


Figure B - 0.1 to 54kOhm Input, 120 to -30ºC Output

Figure 4 – Lookup Table Initialization Examples

1.4.4. Point To Point Response

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

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

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

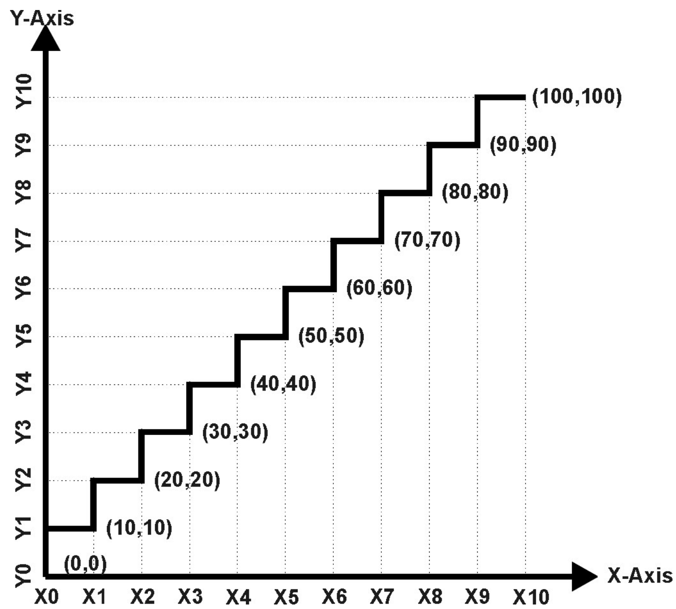


Figure 5 – Lookup Table "Jump To" Data Response

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

A combination of *'Ramp To'*, *'Jump To'* and *'Ignore'* responses can be used to create an application specific output profile. An example of where the same input (i.e. a CAN Message) is used as the X-Axis for two tables, but where the output profiles 'mirror' each other for a deadband joystick response is shown in . The example shows a dual slope output response for each side of the deadband, but additional slopes can be easily added as needed.

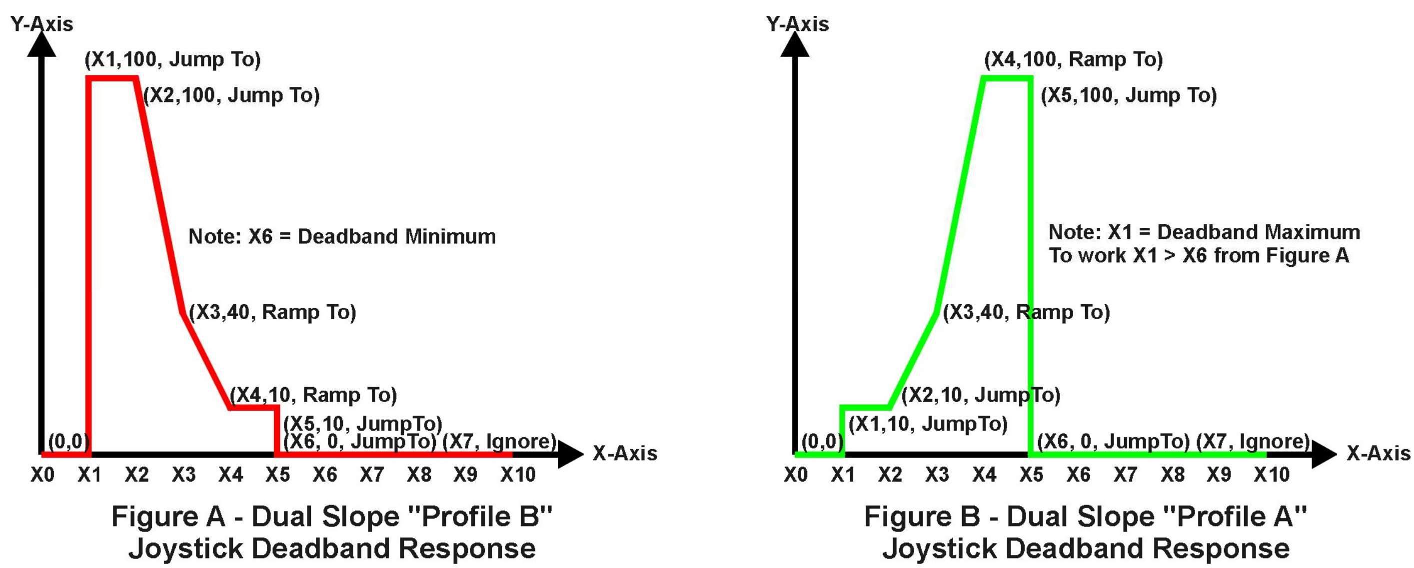


Figure 6 – Lookup Table Examples to Setup for Joystick Deadband Response

1.4.5. X-Axis, Time Response

As mentioned in Section 1.4, 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.

In this case, the **"X-Axis Source"** is treated as a digital input. If the signal is actually an analog input, it is interpreted like a digital input per Figure 2. 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. index 10, or *'Ignored'* response), the output will remain at the last output at the end of the profile until the control input turns OFF.

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

When using the Lookup Table to drive an output based on **time**, it is mandatory that setpoints **"Ramp Up (min to max)"** and **"Ramp Down (max to min)"** in the Analog Output 1 function block be set to **zero**. Otherwise, the output result will not match the profile as expected. Recall, also, that the Y-Axis range of the table should be set to match the Analog Output 1 range in order to get a 1:1 response of table output versus drive output.

An application where this feature would be useful is filling a clutch when a transmission is engaged. An example of some fill profiles is shown in Figure 7.

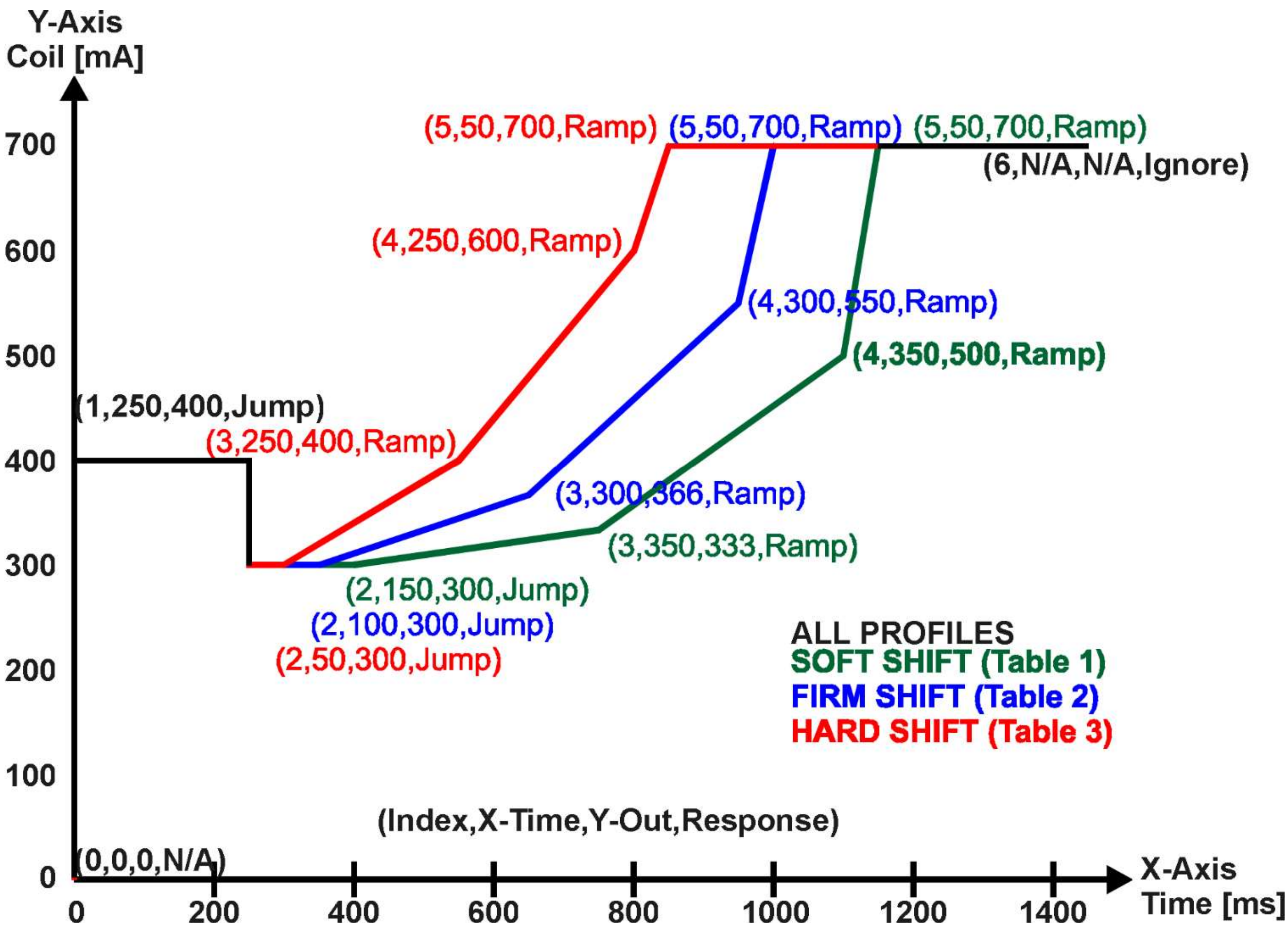


Figure 7 – Lookup Table Time Response Clutch Fill Profiles

In a time response, the interval time between each point on the X-axis can be set anywhere from 1ms to 24 hours. [86,400,000 ms]

One final note about the Lookup Tables is that if a digital input is selected as the control source for the X-Axis, only a 0 (Off) or 1 (On) will be measured. Ensure that the data range for the X-Axis on the table is updated appropriately in this condition.

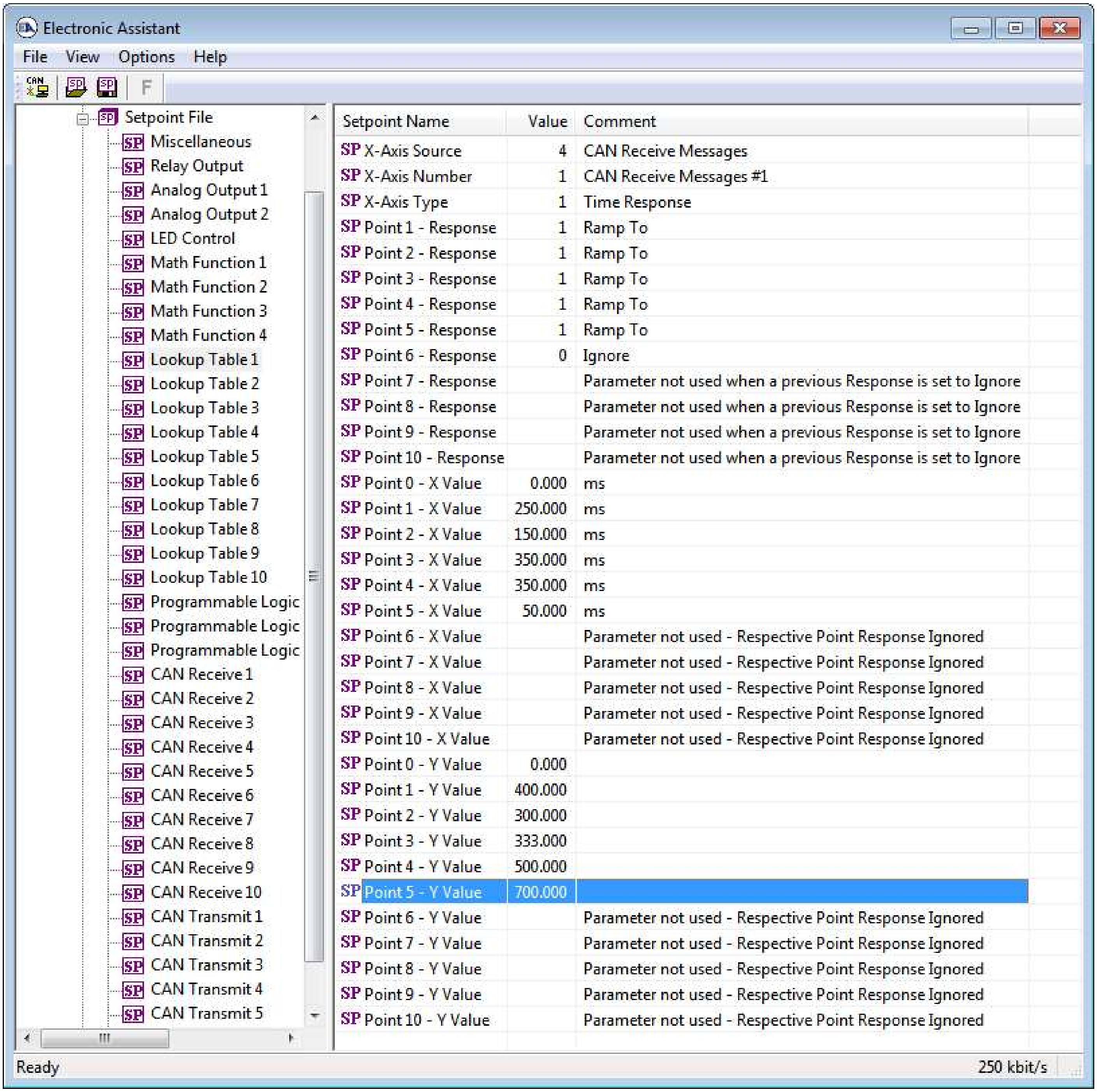


Figure 8 – Lookup Table "Soft Shift" EA Configuration

1.5. Programmable Logic Function Block

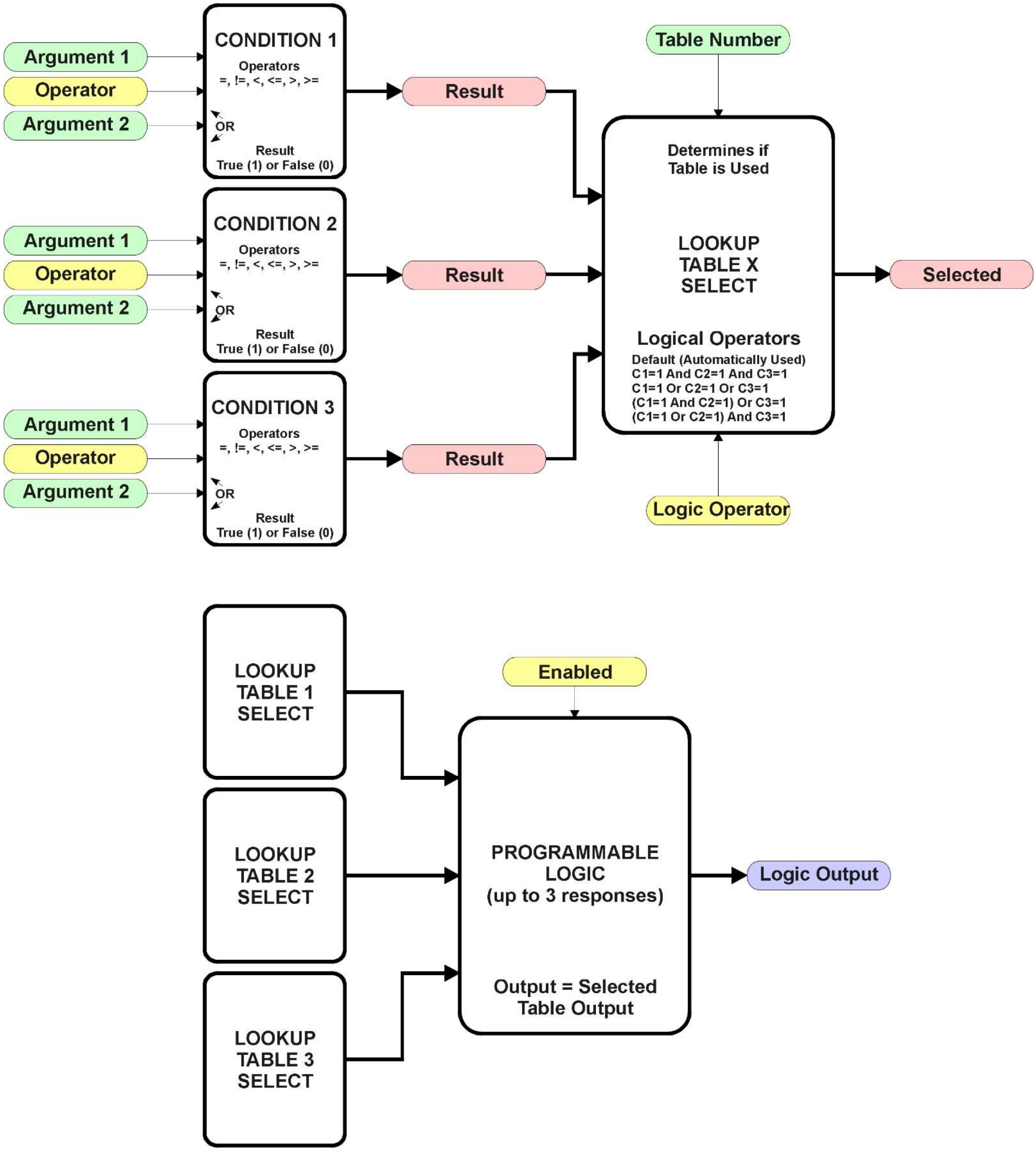


Figure 9 – Programmable Logic Function Block

This function block is obviously the most complicated of them all, but very powerful. The Programmable Logic can be linked to up to three tables, any one of which would be selected only under given conditions. Any three tables (of the available 10) can be associated with the logic, and which ones are used is fully configurable.

Should the conditions be such that a particular table (1, 2 or 3) has been selected as described in Section 1.5.2, then the output from the selected table, at any given time, will be passed directly to the Logic Output.

Therefore, up to three different responses to the same input, or three different responses to different inputs, can become the input to another function block, such as Analog Output 1. To do this, the "**Control Source**" for the reactive block would be selected to be the *'Programmable Logic Function Block.'*

In order to enable any one of Programmable Logic blocks, the "**Programmable Logic Block Enabled**" setpoint must be set to *'True'*. They are all disabled by default.

Logic is evaluated in the order shown in Figure 10. Only if a lower number table 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 number in any configuration.**

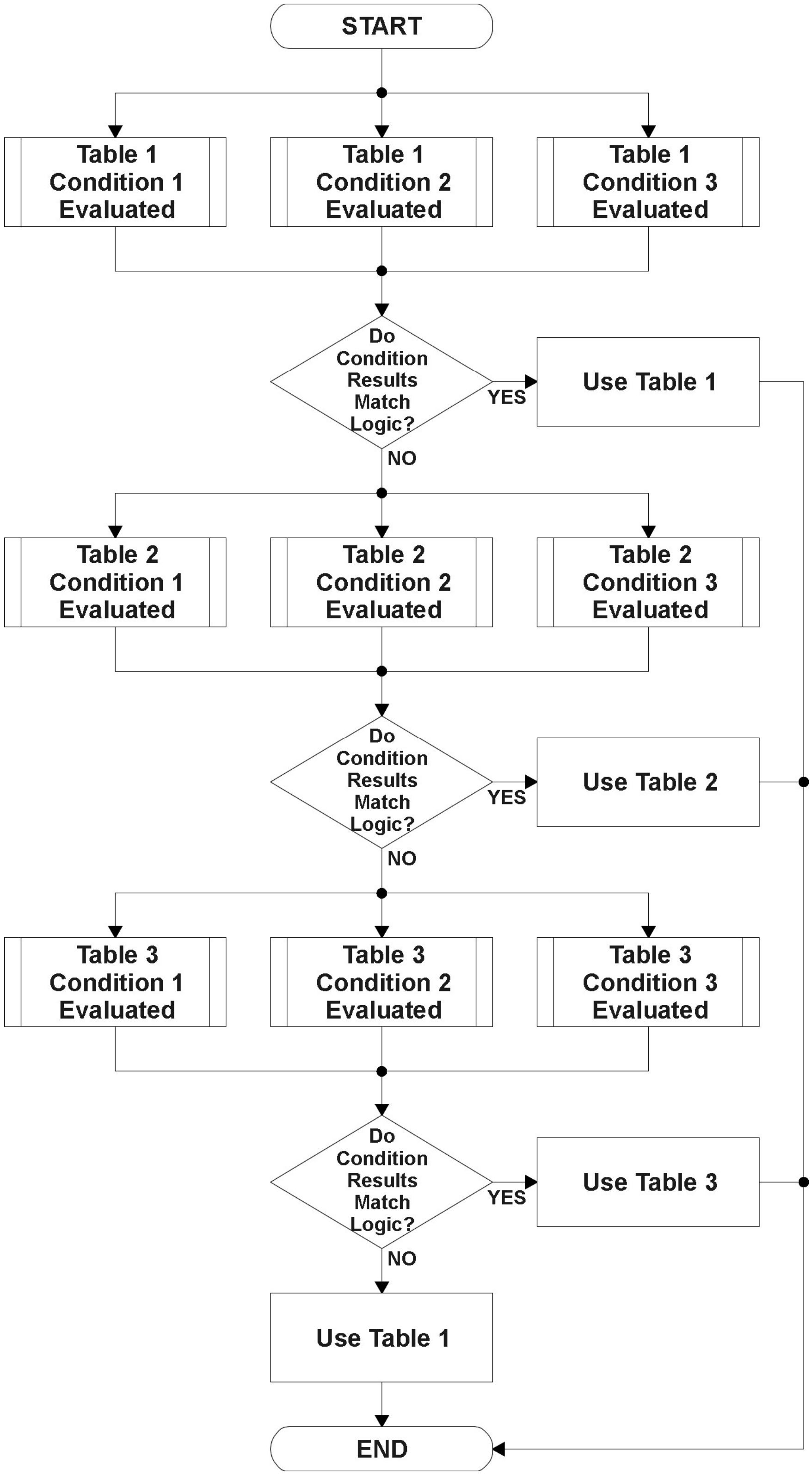


Figure 10 – Programmable Logic Flowchart

1.5.1. Conditions Evaluation

The first step in determining which table will be selected as the active table is to first evaluate the conditions associated with a given table. Each table has associated with it up to three conditions that can be evaluated.

Argument Z is always a logical output from another function block. As always, the source is a combination of the functional block type and number, setpoints **"Table X - Condition Y, Argument 1 Source"** and **"Table X, Condition Y, Argument 1 Number"**, where both X = 1 to 3 and Y = 1 to 3.

The condition is evaluated based on the **"Table X, Condition Y Operator"** selected by the user. It is always *'=, Equal'* by default. The only way to change this is to have two valid arguments selected for any given condition. Options for the operator are listed in Table 9.

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

Table 9: Condition Operator Options

For example, a condition for a transmission control shift selection, as shown in Figure 8 in the previous section, could be that the Engine RPM received on CAN message 3 be less than a certain value to select a Soft Fill profile. In this case, **"…Argument 1 Source"** would be set to *'Received CAN J1939 Message 3',* **"…Argument 2 Source"** to *'Control Constant Data'*, and the **"…Operator"** to *'<, Less Than.'*

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 Figure 10 shows only True or False as a result of a condition evaluation, the reality is that there could be four possible results, as described in Table 10.

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 10: Condition Evaluation Results

1.5.2. Table Selection

In order to determine if a particular table will be selected, logical operations are performed on the results of the conditions as determined by the logic in Section 1.5.1. There are several logical combinations that can be selected, as listed in Table 11.

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 11: Conditions 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.

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 12: Conditions Evaluation Based on Selected Logical Operator

The default **"Table X, Conditions Logical Operator"** for Table 1 and Table 2 is *'Cnd1 And Cnd2 And Cnd3,'* while Table 3 is set to be the *'Default Table.'*

1.5.3. Logic Block Output

Recall that Table X, where X = 1 to 3 in the Programmable Logic function block does NOT mean Lookup Table 1 to 3. Each table has a setpoint **"Table X – Lookup Table Block Number"** which allows the user to select which Lookup Tables they want associated with a particular Programmable Logic Block. The default tables associated with each logic block are listed in Table 13.

Programmable Logic Block Number	**Table 1 – Lookup Table Block Number**	**Table 2 – Lookup Table Block Number**	**Table 3 – Lookup Table Block Number**
1	1	2	3
2	4	5	6
3	7	8	9

Table 13: Programmable Logic Block Default Lookup Tables

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

Unlike all other function blocks, the Programmable Logic does NOT perform any linearization calculations between the input and the output data. Instead, it mirrors exactly the input (Lookup Table) data. Therefore, when using the Programmable Logic as a control source for another function block, it is HIGHLY recommended that all the associated Lookup Table Y-Axes either be (a) Set between the 0 to 100% output range or (b) all set to the same scale.

1.6. Math Function Block

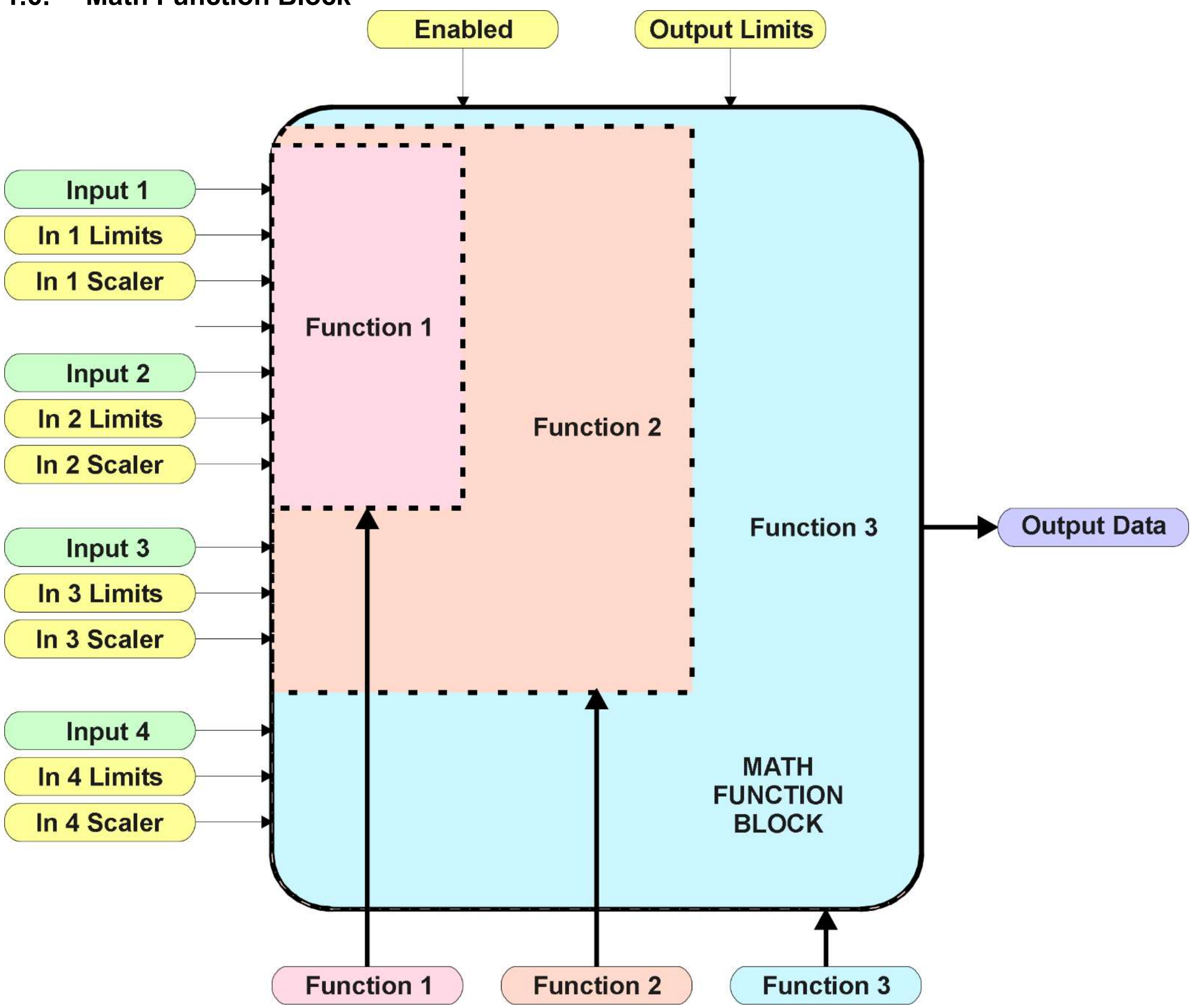


Figure 11– Math Function Block

There are four mathematic function blocks that allow the user to define basic algorithms. A math function block can take up to four input signals, as listed in Table 2 in Section 1.2.2. Each input is then scaled according the associated limit and scaling setpoints.

Inputs are converted into a percentage value based on the **"Math Input X Minimum"** and **"Math Input X Maximum"** values selected, where X = 1 to 4. For additional control, the user can also adjust the **"Math Input X Scaler."** By default, each input has a scaling 'weight' of 1.0. However, each input can be scaled from -1.0 to 1.0 as necessary before it is applied in the function.

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

The appropriate arithmetic or logical operation is performed on the two inputs, InA and InB, according the associated function. The list of selectable function operations is defined in Table 14.

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

Table 14: Math Function Operators

For Function 1, InA and InB are Inputs 1 and 2 respectively.
For Function 2, InA is the result of Function 1, and InB is Input 3.
For Function 3, InA is the result of Function 2, and InB is Input 4.

For a valid result, the control source for an input must be a non-zero value, i.e. something other than *'Control Source Not Used.'* Otherwise, the corresponding function is ignored, and the "Output Data" for the math function block is the result of the earlier function scaled according to the output limit setpoints. For example, if Input 4 is not used, the math output would be the result of the Function 2 operation.

For logical operators (6, 7 or 8), any SCALED input greater than or equal to 0.5 is treated as a TRUE input. For logic output operators (0 to 8), the result of the calculation for the function will always be 0 (FALSE) or 1 (TRUE).

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

For the arithmetic functions (9 to 14), it is recommended to scale the data such that the resulting operation will not exceed full scale (0 to 100%) and saturate the output result.

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

The resulting mathematical calculation, represented as a percentage value, can be scaled into the appropriate physical units using the **"Math Output Minimum Range"** and **"Math Output Maximum Range"** setpoints. These values are also used as the limits when the Math Function is selected as the input source for another function block.

1.7. CAN Receive Function Block

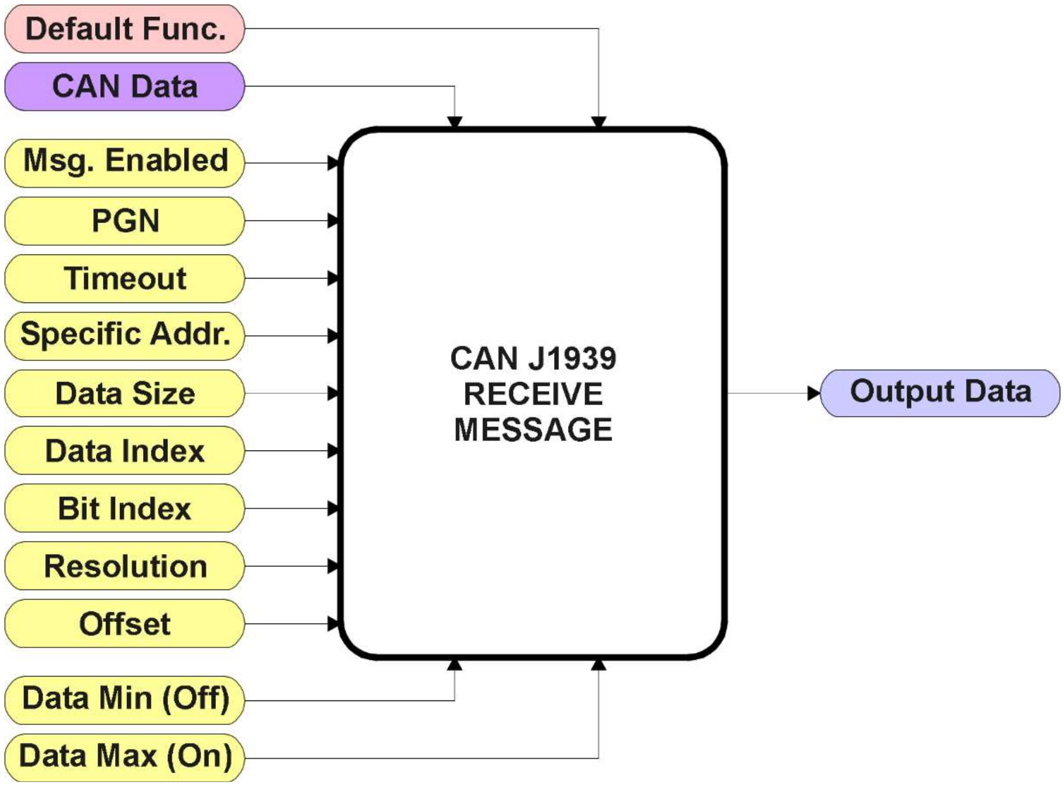


Figure 12 – CAN Receive Function Block

The CAN Receive function block is designed to take any SPN from the J1939 network and use it as an input to any another function block (i.e. Relay Output or Analog Output).

The **"Received Message Enabled"** is the most important setpoint associated with this function block, and it should be selected first. Changing it will result in other setpoints being enabled/disabled as appropriate. By default, only the first three received messages are enabled.

In order to avoid timeouts on a heavily saturated network, it is recommended to set it at least three times larger than the expected update rate. To disable the timeout feature, simply set this value to zero, in which case the received message will never trigger a Lost Communication fault.

By default, all control messages are expected to be sent to the unit on Proprietary B PGNs. However, should a PDU1 message be selected, the **"Enable Specific Addres"** can be configured to TRUE then the unit can be setup to receive it from any ECU by setting the **"Specific Address that sends the PGN"** to the Global Address (0xFF). If a specific address is selected instead, then any other ECU sending data on the PGN will be ignored.

The **"Receive Data Size"**, **"Receive Data Index in Array (LSB)"**, **"Receive Bit Index in Byte (LSB)"**, **"Receive Resolution"** and **"Receive Offset"** can all be use to map any SPN supported by the J1939 standard to the output data of the Received function block. The defaults used by the unit are all for proprietary SPNs and are defined in detail in Section 3.4.

Note: Output Data = CAN Data * Resolution + Offset

As mentioned earlier, a CAN Receive function block can be selected as the source of the control input for the output function blocks. When this is the case, the **“Received Data Min (Off Threshold)”** and **“Received Data Max (On Threshold)”** setpoints become the minimum and maximum values of the X-axis used in the linear calculations. As the names imply, they are also used as the ON/OFF thresholds for digital input types. These values are in whatever units the output data is AFTER the resolution and offset is applied to the CAN data.

This Controller supports up to 10 unique CAN Receive Messages. By default, the first three messages are pre-configured to read a particular type of data. The details are outlined in Section 3.4, and the default list is shown in Table 15 below.

Block #	Default Receive Data
1	Relay Output Command Input Data
2	Analog Output 1 Command Input Data
3	Analog Output 2 Command Input Data
4	Message Not Used
5	Message Not Used
6	Message Not Used
7	Message Not Used
8	Message Not Used
9	Message Not Used
10	Message Not Used

Table 15: Default CAN Receive Messages

1.8. CAN Transmit Function Block

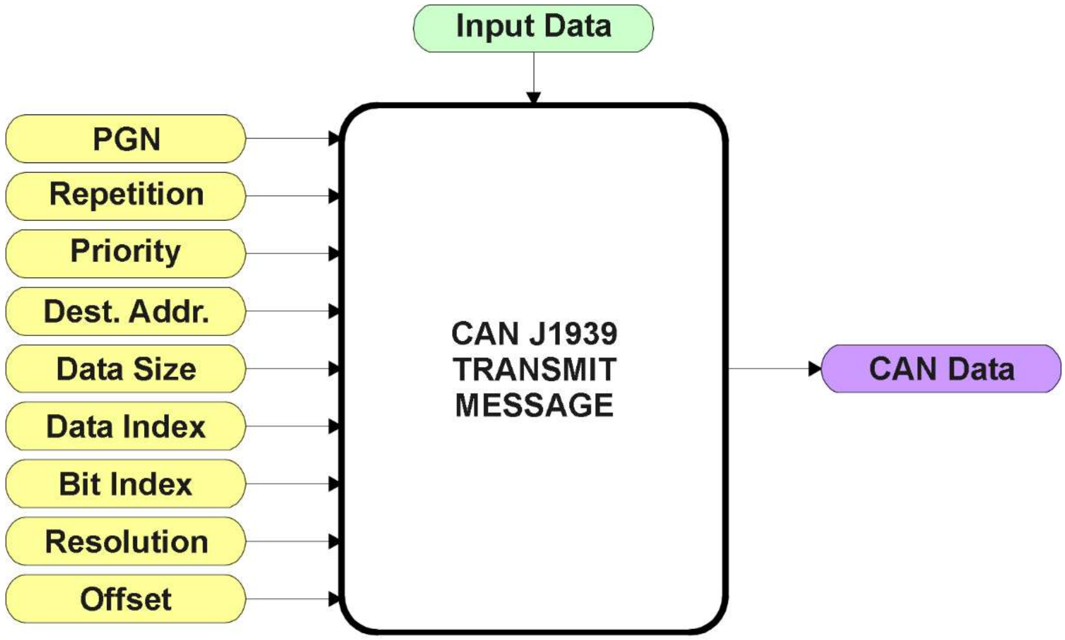


Figure 13– CAN Transmit Function Block

The CAN Transmit function block is used to send any output from another function block (i.e.relay, status or analog signals) to the J1939 network.

Normally, to disable a transmit message, the **“Transmit Repetition Rate”** is set to zero. However, should message share its Parameter Group Number (PGN) with another message, this is not necessarily true. In the case where multiple messages share the same **“Transmit PGN”**, the repetition rate selected in the message with the LOWEST number will be used for ALL the messages that use that PGN.

By default, all messages are sent on Proprietary B PGNs as broadcast messages. The default settings do ‘bundle’ multiple messages onto a PGN, as outlined in Section 3.3. If all of the data is not necessary, disable the entire message by setting the lowest channel using that PGN to zero. If some of the data is not necessary, simply change the PGN of the superfluous channel(s) to an unused value in the Proprietary B range.

At power up, transmitted message will not be broadcasted until after a 5 second delay. This is done to prevent any power up or initialization conditions from creating problems on the network.

Since the defaults are PropB messages, the **“Transmit Message Priority”** is always initialized to 6 (low priority) and the **“Destination Address (for PDU1)”** setpoint is not used. This setpoint is only valid when a PDU1 PGN has been select, and it can be set either to the Global Address (0xFF) for broadcasts, or sent to a specific address as setup by the user.

This Controller supports up to 5 unique CAN Transmit Messages, each CAN transmit message has four associated signals, all of which can be programmed to send any available data to the CAN network.

"Signal X Data Source" setpoint together with **"Signal X Data Number**" setpoint define the signal source of the message. The control source options are same as the output drive which are listed in Table 2. Setting **"Signal X Data Source"** to '*Control Not Used'* disables the signal.

The **"Signal X Data Size"** setpoint selects the data type from options *"Signal Undefined"*, *"Discrete"* and *"Continuous"*. **"Signal X Data Index in Array (LSB)"** determines in which of 8 bytes of the CAN message LSB of the signal is located. Similarly, **"Signal X Bit Index in Byte (LSB)"** determines in which of 8 bits of a byte the LSB is located. These setpoints are freely configurable, thus it is the User's responsibility to ensure that signals do not overlap and mask each other. **"Signal X Data Resolution"** setpoint determines the scaling done on the signal data before it is sent to the bus. and **"Signal X Data Offset"** setpoint determines the value that is subtracted from the signal data before it is scaled. Offset and Resolution are interpreted in units of the selected source signal. These setpoints can all be use to map the data to any SPN supported by the J1939 standard. The defaults used by the controller are all for proprietary SPNs and are defined in detail in Section 3.3.

Note: CAN Data = (Input Data – Offset)/Resolution

By default, the first signal of the first message is pre-configured. It uses the first 1 byte of the 1st CAN transmit message to transmit states of the relay output. The details are outlined in Section 3.3, and the default list is shown in Table 16 Table 1below.

Block #	Default Transmit Data	(PGN)
1	Relay Output (xx FF FF FF FF FF FF FF)	(0xFF00)
2	Control Source Not Used	(0xFFFF)
3	Control Source Not Used	(0xFFFF)
4	Control Source Not Used	(0xFFFF)
5	Control Source Not Used	(0xFFFF)

Table 16: Default CAN Transmit Messages

1.9. Conditional Block

The Conditional Block compares up to four different input sources with different logical or relational operators. The result of each block can therefore only be true (1) or false (0). Figure 14 demonstrates the connections between all parameters.

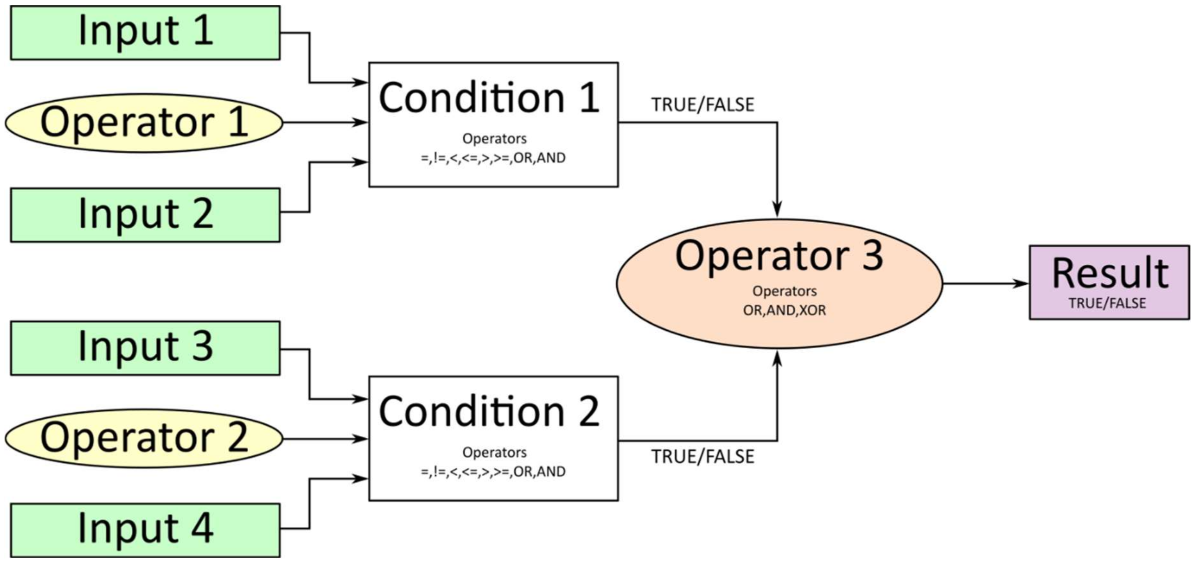


Figure 14: Conditional Block Diagram

Each Conditional Block offers two conditions. Both compare two inputs, which can hold a logical value or an integer value. The output of the conditions can only be true or false and will be compared by Operator 3 with a logical operator. This comparison is the result of the Conditional Block and can control any output source.

value of each source will then be compared to each other with an operator of Table 17. If no source is selected, the output value of an Input will be zero.

Value	Meaning
0	==, True when Argument 1 is equal to Argument 2
1	!=, True when Argument 1 is not equal to Argument 2
2	>, True when Argument 1 is greater than Argument 2
3	>=, True when Argument 1 is greater than Argument 2
4	<, True when Argument 1 is less than Argument 2
5	<=, True when Argument 1 is less than or equal Argument 2
6	OR, True when Argument 1 or Argument 2 is True
7	AND, True when Argument 1 and Argument 2 are True

Table 17: Input Operator Options

Operator 1 and Operator 2 are configured to OR by default. The table above cannot be used for comparing the conditions because they can only be compared with logical operators, which are listed in Table 18.

Value	Meaning
0	OR, True when Argument 1 or Argument 2 is True
1	AND, True when Argument 1 and Argument 2 are True
2	XOR, True when Argument 1 is not equal to Argument 2

Table 18: Condition Operator Options

If only one condition is used, it is to make sure that Operator 3 is set to **OR** so that the result is based solely on the condition which has been chosen.

1.10. Set / Reset Latch Function Block

Set-Reset Block consists of only 2 control sources: **Reset Source** and **Set Source**. The purpose of these blocks is to simulate a modified latching function in which the 'Reset Signal' has more precedence. The 'latching' function works as per the Table 19 below.

'Set Signal'	'Reset Signal'	'Set-Reset Block Output' **(Initial State: *OFF*)**
OFF	*OFF*	*Latched State*
OFF	*ON*	*OFF*
ON	*OFF*	*ON*
ON	*ON*	*OFF*

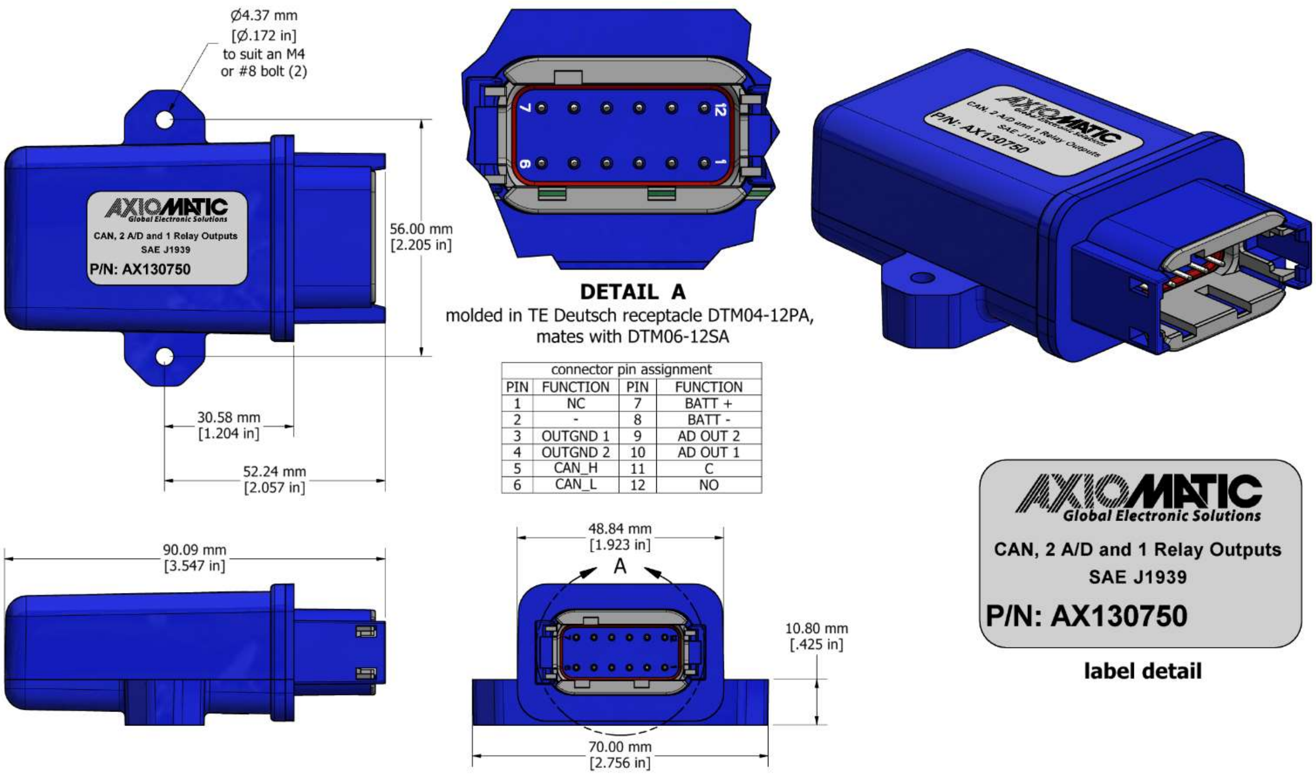
Table 19 – Set-Reset Function block operation

The **Reset** and **Set** sources have associated with them a minimum and maximum threshold values which determine the ON and OFF state. For the **Reset Source** are **Reset Minimum Threshold** and **Reset Maximum Threshold**. Similarly, for the **Set Source** are **Set Minimum Threshold** and **Set Maximum Threshold**. These setpoints also allow to have a dead band in between ON/OFF states and they are in terms of percentage of input selected.

As seen in Table 19 above, the 'Reset Signal' has more precedence over the 'Set Signal' - if the state of 'Reset Signal' is *ON*, the state of 'Set-Reset Block Output' will be *OFF*. To create an *ON* state in 'Set-Reset Block Output' the state of 'Reset Signal' must be *OFF* while the state of 'Set Signal' is *ON*. In this case, the state of 'Set-Reset Block Output' will remain *ON* even if 'Set Signal' turns *OFF* as long as 'Reset Signal' remains *OFF.* As soon as the 'Reset Signal' turns *ON* the 'Set-Reset Block Output' will turn *OFF* regardless of the state of 'Set Signal'.

2. Installation Instructions

2.1 AX130750 Dimensions and Pinout



connector pin assignment

PIN	FUNCTION	PIN	FUNCTION
1	NC	7	BATT +
2	-	8	BATT -
3	OUTGND 1	9	AD OUT 2
4	OUTGND 2	10	AD OUT 1
5	CAN_H	11	C
6	CAN_L	12	NO

Figure 15 – AX130750 Dimensional Drawing

2.2 AX130770 Dimensions and Pinout

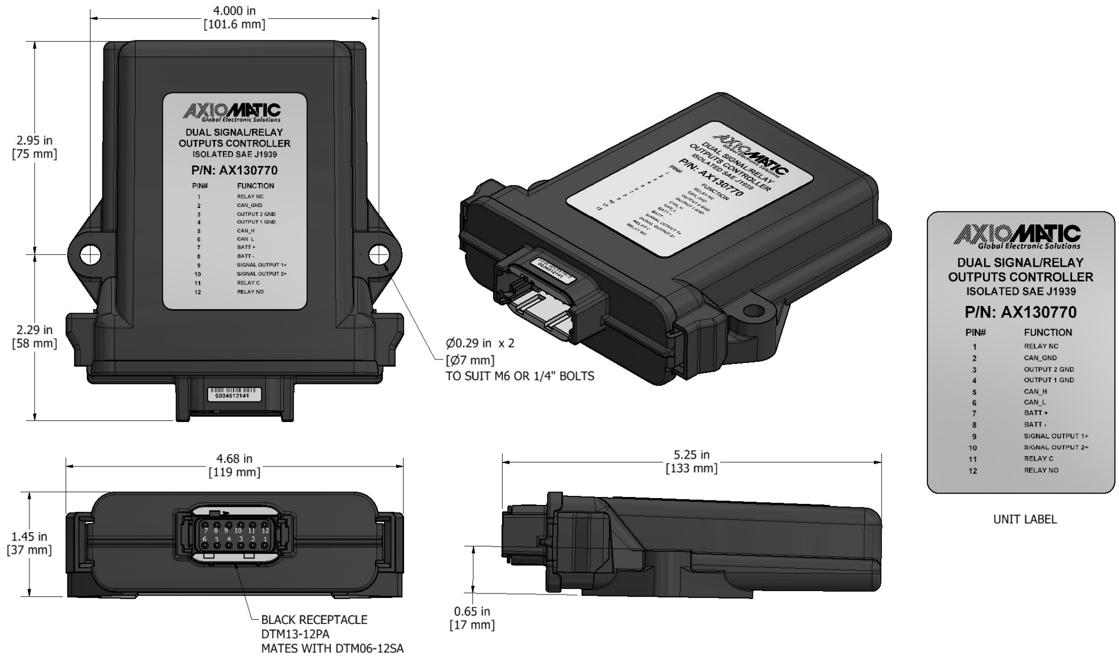


Figure 16 – AX130770 Dimensional Drawing

CAN and I/O Connector	
Pin #	**Description**
1	Relay Output (NC)
2	CAN_GND
3	Output 2 GND
4	Output 1 GND
5	CAN_H
6	CAN_L
7	BATT +
8	BATT-
9	A/D Output 1
10	A/D Output 2
11	Relay Output (C)
12	Relay Output (NO)

Table 20: AX130770 Connector Pinout

3. OVERVIEW OF J1939 FEATURES

The software was designed to provide flexibility to the user with respect to messages sent to and from the ECU by providing:

- Configurable ECU Instance in the NAME (to allow multiple ECUs on the same network)
- Configurable Transmit PGN and SPN Parameters
- Configurable Receive PGN and SPN Parameters
- Sending DM1 Diagnostic Message Parameters
- Reading and reacting to DM1 messages sent by other ECUs
- Diagnostic Log, maintained in non-volatile memory, for sending DM2 messages

3.1. Introduction To Supported Messages

The ECU is compliant with the standard SAE J1939, and supports the following PGNs

From J1939-21 - Data Link Layer

- Request 59904 ($00EA00)
- Acknowledgment 59392 ($00E800)
- Transport Protocol – Connection Management 60416($00EC00)
- Transport Protocol – Data Transfer Message 60160 ($00EB00)
- PropB Transmit, Default Measured Inputs Feedback Message 65280 ($00FF00)

- PropB Transmit, Default Proportional Outputs Target Message 65296 ($00FF10)
- PropB Transmit, Default Proportional Outputs Feedback Message 65312 ($00FF20)
- PropB Transmit, Default Digital I/O State Feedback Message 65328 ($00FF30)
- PropB Receive, Default Output Control Data Message 65408 ($00FF80)
- PropB Receive, Default Output Enable Data Message 65424 ($00FF90)
- PropB Receive, Default Output Override Data Message 65440 ($00FFA0)
- PropB Receive, Default PID Feedback Data Message 65456 ($00FFB0)

Note: Any Proprietary B PGN in the range 65280 to 65535 ($00FF00 to $00FFFF) can be selected
Note: The Proprietary A PGN 61184 ($00EF00) can also be selected for any of the messages

From J1939-73 - Diagnostics

- DM1 – Active Diagnostic Trouble Codes 65226 ($00FECA)
- DM2 – Previously Active Diagnostic Trouble Codes 65227 ($00FECB)
- DM3 – Diagnostic Data Clear/Reset for Previously Active DTCs 65228 ($00FECC)
- DM11 - Diagnostic Data Clear/Reset for Active DTCs 65235 ($00FED3)
- DM14 – Memory Access Request 55552 ($00D900)
- DM15 – Memory Access Response 55296 ($00D800)
- DM16 – Binary Data Transfer 55040 ($00D700)

From J1939-81 - Network Management

- Address Claimed/Cannot Claim 60928 ($00EE00)
- Commanded Address 65240 ($00FED8)

From J1939-71 – Vehicle Application Layer

- Software Identification 65242 ($00FEDA)

None of the application layer PGNs are supported as part of the default configurations, but they can be selected as desired for either transmit or received function blocks.

Setpoints are accessed using standard Memory Access Protocol (MAP) with proprietary addresses. The Electronic Assistant (EA) allows for quick and easy configuration of the unit over the CAN network.

3.2. Name, Address and Software ID

3.2.1. J1939 Name

The unit has the following defaults for the J1939 NAME. The user should refer to the SAE J1939/81 standard for more information on these parameters and their ranges.

Arbitrary Address Capable	Yes
Industry Group	0, Global
Vehicle System Instance	0
Vehicle System	0, Non-specific system
Function	126, Axiomatic I/O Controller
Function Instance	14, Axiomatic AX1307x0, CAN to 1 Relay and 2 Analog Outputs Converter
ECU Instance	**0, First Instance**
Manufacture Code	162, Axiomatic Technologies Corporation
Identity Number	Variable, uniquely assigned during factory programming for each ECU

The ECU Instance is a configurable setpoint associated with the NAME. Changing this value will allow multiple ECUs of this type to be distinguishable by other ECUs (including the Electronic Assistant) when they are all connected on the same network.

3.2.2. ECU Address

The default value of this setpoint is 128 (0x80), which is the preferred starting address for self-configurable ECUs as set by the SAE in J1939 tables B3 to B7. The EA will allow the selection of any address between 0 to 253, and ***it is the user's responsibility to select an address that complies with the standard***. The user must also be aware that since the unit is arbitrary address capable, if another ECU with a higher priority NAME contends for the selected address, the unit will continue select the next highest address until it find one that it can claim. See J1939/81 for more details about address claiming.

3.2.3. Software Identifier

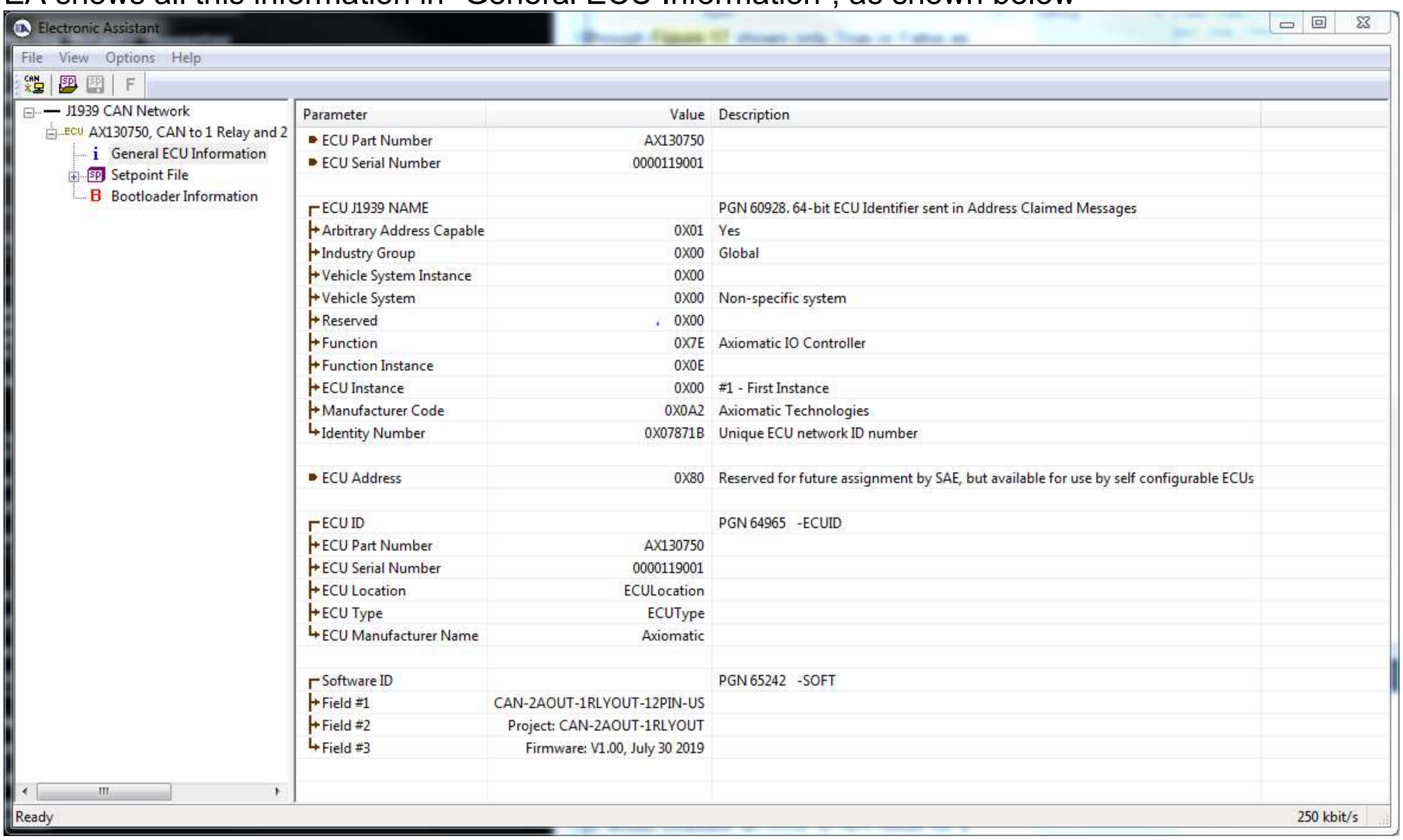
PGN 65242	Software Identification		- SOFT
Transmission Repetition Rate:	On request		
Data Length:	Variable		
Extended Data Page:	0		
Data Page:	0		
PDU Format:	254		
PDU Specific:	218 PGN Supporting Information:		
Default Priority:	6		
Parameter Group Number:	65242 (0xFEDA)		

Start Position	Length	Parameter Name	SPN
1	1 Byte	Number of software identification fields	965
2-n	Variable	Software identification(s), Delimiter (ASCII “*”)	234

For this unit, Byte 1 is set to 1, and the identification fields are as follows

(Part Number)*(Version)*(Date)*(Owner)*(Description)

EA shows all this information in “General ECU Information”, as shown below



Note: The information provided in the Software ID is available for any J1939 service tool which supports the PGN -SOFT.

3.3. CAN Transmit Message Defaults

This section outlines the **default** settings of the unit CAN transmissions. Recall, however, that this is a fully programmable unit, such that all these SPNs can be sent on different PGNs if so desired.

In all the messages shown below, not all the transmitted values have an SPN assigned to them, as this ECU only uses the SPNs for diagnostic trouble codes. If the SPN is shown as N/A, this means that the associated value cannot be used to generate DTCs.

CAN Transmit 1 has the following default configuration.

PGN 65280		Relay Output		
Transmission Repetition:		0s (not sent by default, configurable)		
Data Length:		8		
Data Page:		0		
PDU Format:		254		
PDU Specific:		GE	PGN Supporting Information:	
Default Priority:		6		
Parameter Group Number:		65280 (0xFF00)		
Start Position	Length	Parameter Name		SPN
1	1 byte	Relay Output		520448
2-8	7 byte	Not Used		N/A

Relay Output

This value reflects the states of the relay.

Data Length:	1 byte
Resolution:	1mA/bit, 0 offset
Data Range:	0x00 to 0x01
Type:	Measured
Suspect Parameter Number:	520448 (0x7F100, proprietary SPNs)
Parameter Group Number:	65280

3.4. CAN Receive Message Defaults

This section outlines the **default** settings of this unit CAN receive channels, used as inputs to the various function blocks supported by this ECU. Recall, however, that this is a fully programmable unit, such that all these SPNs can be received on different PGNs if so desired.

In all the messages shown below, none of the received values have an SPN assigned to them, as this ECU only uses the SPNs for diagnostic trouble codes. To have the unit react to a DTC sent by another ECU on the network on a DM1, use the DTC React Function block instead.

By default, all but the first three CAN Receive Messages are disabled, as they are not part of the factory set logic. However, should any of them be enabled by the user, the default settings for each message are as outlined in this section.

The “Output Control Data Message” has the following default configuration.

PGN 65408	Output Control Data	
Transmission Repetition:	0ms (default, configurable)	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	GE	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65408 (0xFF80) (default)	

Start Position	Length (default)	Parameter Name	SPN
1	1 byte	Relay Output Command Input Data	N/A
2	1 byte	Analog Output 1 Command Input Data	N/A
3	1 byte	Analog Output 2 Command Input Data	N/A
4	1 byte	Not Used	N/A
5	1 byte	Not Used	N/A
6	1 byte	Not Used	N/A
7	1 byte	Not Used	N/A
8	1 byte	Not Used	N/A
9	1 byte	Not Used	N/A
10	1 byte	Not Used	N/A

Relay Output Command Input Data

Default value used when a *‘Received CAN J1939 Message’* is used as the control source for the Relay Output Control logic function block (or another block that is linked to the output control.)

Data Length:	1 byte
Resolution:	0.4%/bit, 0 offset
Data Range:	0x00 to 0xFF
Type:	Input
Suspect Parameter Number:	N/A

Parameter Group Number: 65408

Analog Output 1 Command Input Data

Default value used when a *'Received CAN J1939 Message'* is used as the feedback source for a analog output control function block.

Data Length:	1 byte
Resolution:	0.4 [Data]/bit, 0 offset
Data Range:	0 to 100.0[%]
Type:	Input
Suspect Parameter Number:	N/A
Parameter Group Number:	65408

Analog Output 2 Command Input Data

Default value used when a *'Received CAN J1939 Message'* is used as the feedback source for a analog output control function block.

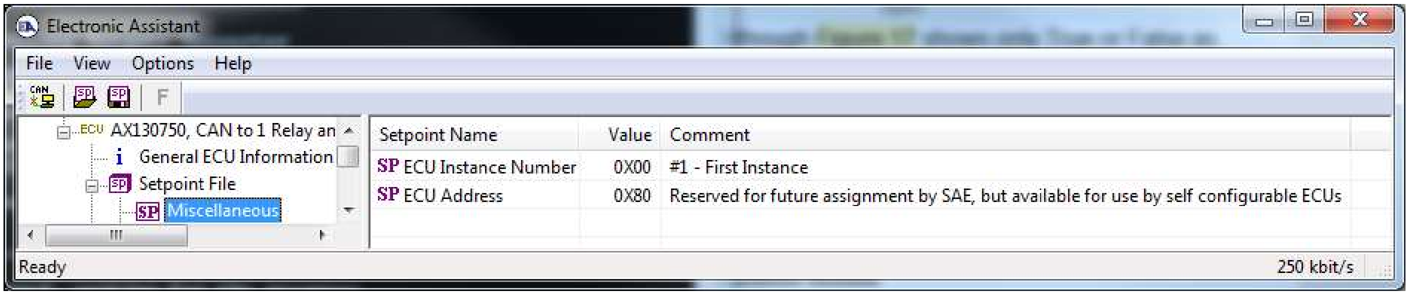
Data Length:	1 byte
Resolution:	0.4 [Data]/bit, 0 offset
Data Range:	0 to 100.0[%]
Type:	Input
Suspect Parameter Number:	N/A
Parameter Group Number:	65408

4. ECU SETPOINTS ACCESSED WITH ELECTRONIC ASSISTANT

Many setpoints have been reference throughout this manual. This section describes in detail each setpoint, and their defaults and ranges. For more information on how each setpoint is used by the controller, refer to the relevant section of the User Manual.

4.1. Miscellaneous Setpoints

The Miscellaneous setpoints primarily deal with the CAN Network. Refer to the notes for more information about each setpoint.



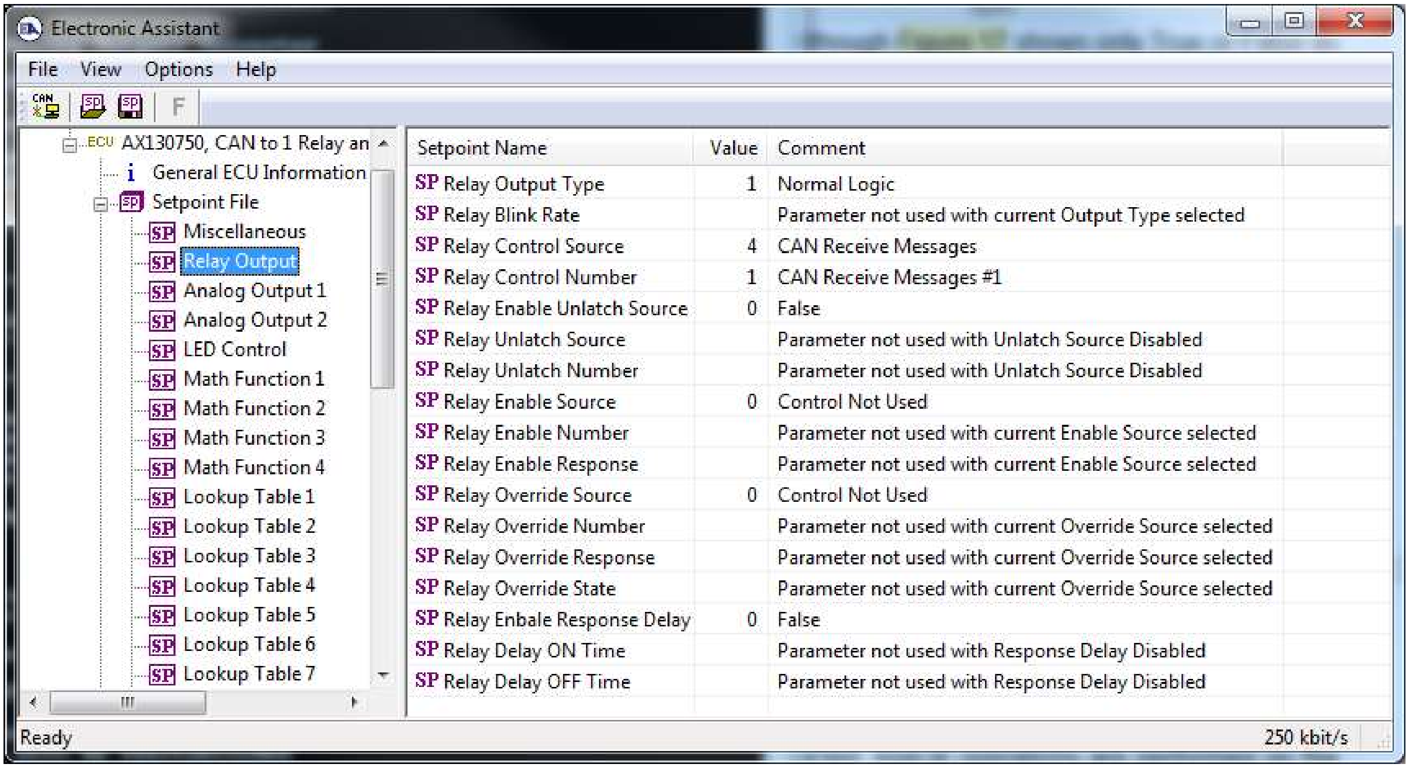
Screen Capture of Default Miscellaneous Setpoints

Name	Range	Default	Notes
ECU Instance Number	Drop List	0, #1 – First Instance	Per J1939-81
ECU Address	0 to 253	128 (0x80)	Preferred address for a self-configurable ECU

mirrored during a setpoint file flashing and will only take effect once the entire file has been downloaded to the unit. After the setpoint flashing is complete, the unit will claim the new address and/or re-claim the address with the new NAME. If these setpoints are changing, it is recommended to close and re-open the CAN connection on EA after the file is loaded so that only the new NAME and address are showing in the J1939 CAN Network ECU list.

4.2. Relay Output Setpoints

The Relay Output function block is defined in Section 1.2. Please refer to that section for detailed information on how these setpoints are used.

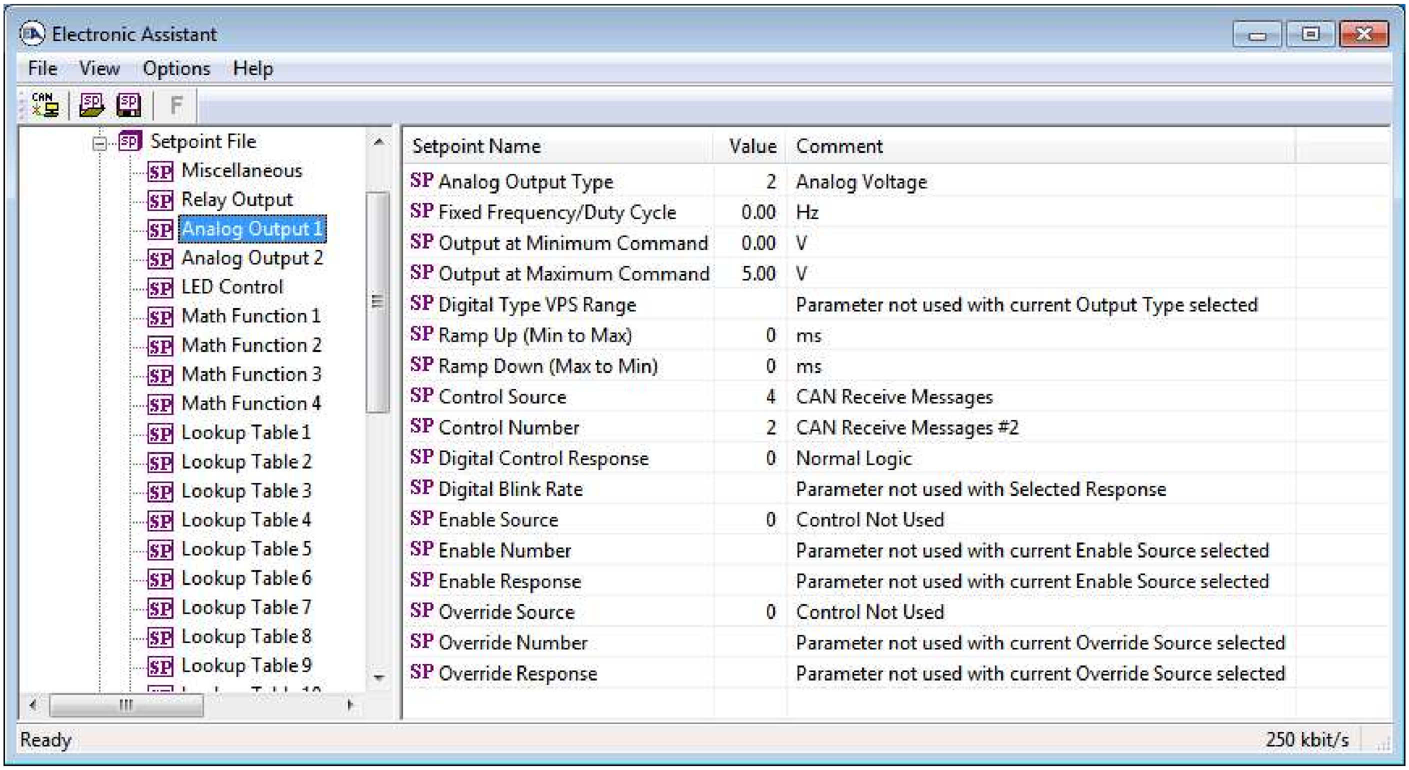


Screen Capture of Default Bipolar Input Setpoints

Name	Range	Default	Notes
Relay Output Type	Drop List	1, Normal Logic	Refer to Section 1.2.1
Relay Blink Rate	[0…60000]	500ms	Only configurable when Relay Output Type is set to toggle logic. Refer to 1.2.1
Relay Control Source	Drop List	4, CAN Receive Messages	See Table 2. Refer to Section 1.2.2
Relay Control Number	Per Source	N/A	See Table 2. Refer to Section 1.2.2
Relay Enable Unlatch Source	Drop List	0, False	True/False
Relay Unlatch Source	Drop List	0, Control Not Used	See Table 2. Refer to 1.2.5
Relay Unlatch Number	Per Source	N/A	See Table 2. Refer to 1.2.5
Relay Enable Source	Drop List	0, Control Not Used	See Table 2. Refer to Section 1.2.3
Relay Enable Number	Per Source	N/A	See Table 2. Refer to Section 1.2.3
Relay Enable Response	Drop List	N/A	See Table 3. Refer to Section 1.2.3
Relay Override Source	Drop List	0, Control Not Used	See Table 2. Refer to Section 1.2.4
Relay Override Number	Per Source	N/A	See Table 2. Refer to Section 1.2.4
Relay Override Response	Drop List	N/A	See Table 4. Refer to Section 1.2.4
Relay Override State	Drop List	N/A	See Table 5. Refer to Section 1.2.4
Relay Enable Response Delay	Drop List	0, False	True/False
Relay Delay ON Time	[0…86400000]	0ms	Up to 24hrs. Refer to Section 1.2.2
Relay Delay OFF Time	[0…86400000]	0ms	Up to 24hrs. Refer to Section 1.2.2

4.3. Analog Output Setpoints

The Analog Output function blocks are defined in Section 1.3. Please refer there for detailed information about how all these setpoints are used.

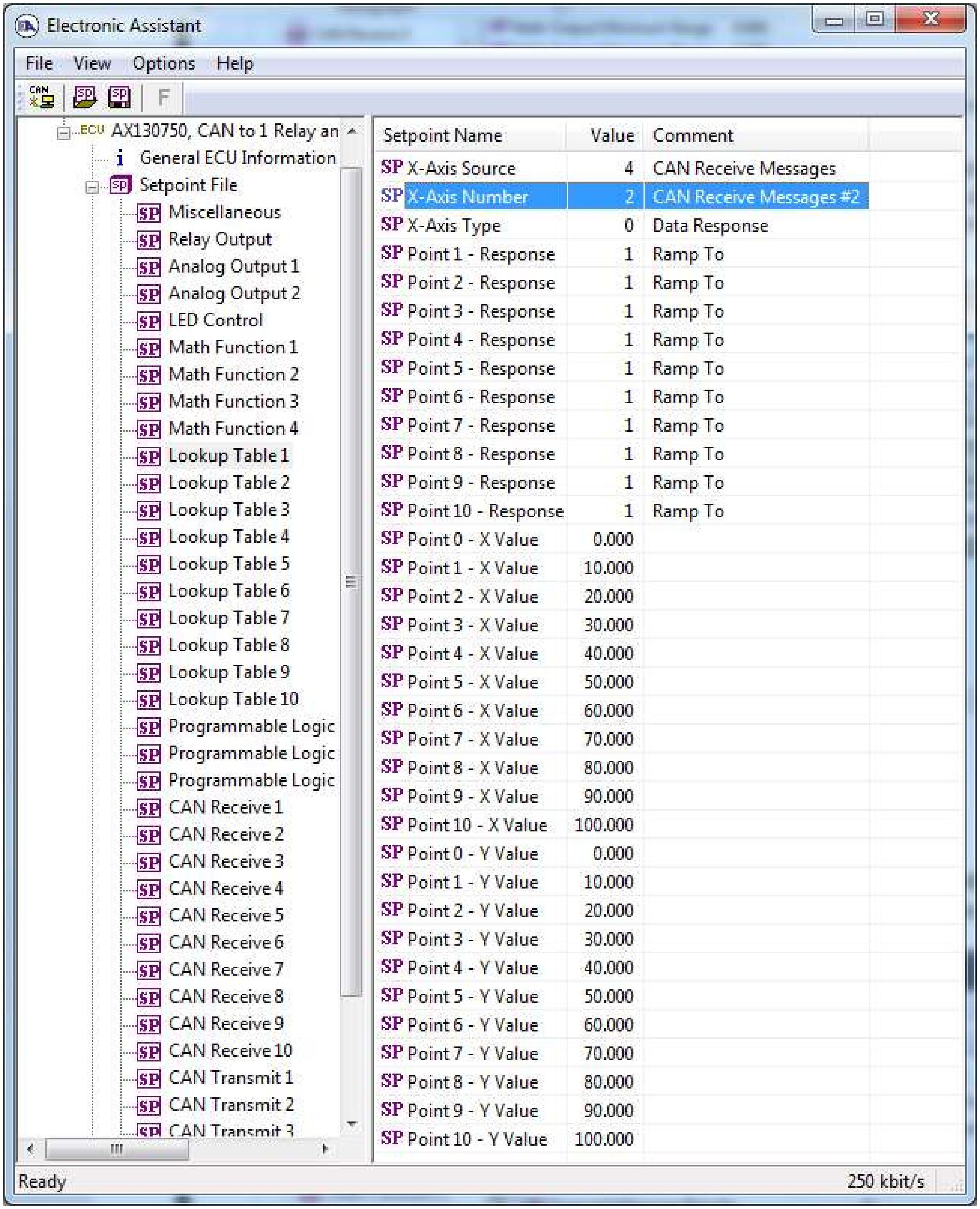


Screen Capture of Default Analog Output Setpoints

Name	Range	Default	Notes
Analog Output Type	Drop List	2, Voltage Output	See Table 6.
Fixed Frequency/Duty Cycle	Depends on Output Type	0.00Hz	Default values depend on output type.
Output at Minimum Command	Depends on Output Type	0V	Analog Voltage: [-10…10] Analog Current: [0…24] Digital PWM: [0…100] Digital Frequency: [0…50000] Digital ON/OFF: [0…1]
Output at Maximum Command	Depends on Output Type	5V	
Digital Type VPS Range	Drop List	0, 0V to 5V	0 = 0V to 5V 1 = 0V to 12V
Ramp Up (Min to Max)	0 to 10,000	0ms	Unit in milliseconds
Ramp Down (Max to Min)	0 to 10,000	0ms	Unit in milliseconds
Control Source	Drop List	4, CAN Receive Messages	See Table 2.
Control Number	Per Source	2, CAN Receive Messages #2 (Analog Output 1) 3, CAN Receive Messages #3 (Analog Output 2)	See Table 2.
Digital Control Response	Drop List	0, Normal Logic	Only configurable when output type is set to Digital ON/OFF. See Table 7.
Digital Blink Rate	100 to 5,000	500ms	Only configurable when control response is set to Blink Logic.
Enable Source	Drop List	0, Control Not Used	See Table 2.
Enable Number	Per Source	N/A	See Table 2.
Enable Response	Drop List	N/A	See Table 8
Override Source	Drop List	0, Control Not Used	See Table 2.
Override Number	Per Source	N/A	See Table 2.
Override Response	Drop List	N/A	See Table 4.

4.4. Lookup Table Setpoints

The Lookup Table function block is defined in Section 1.4. Please refer there for detailed information about how all these setpoints are used. As this function block's X-Axis defaults are defined by the **"X-Axis Source"** selected from Table 2, there is nothing further to define in terms of defaults and ranges beyond that which is described in Section 1.4. Recall, the X-Axis values will be automatically updated if the min/max range of the selected source is changed.



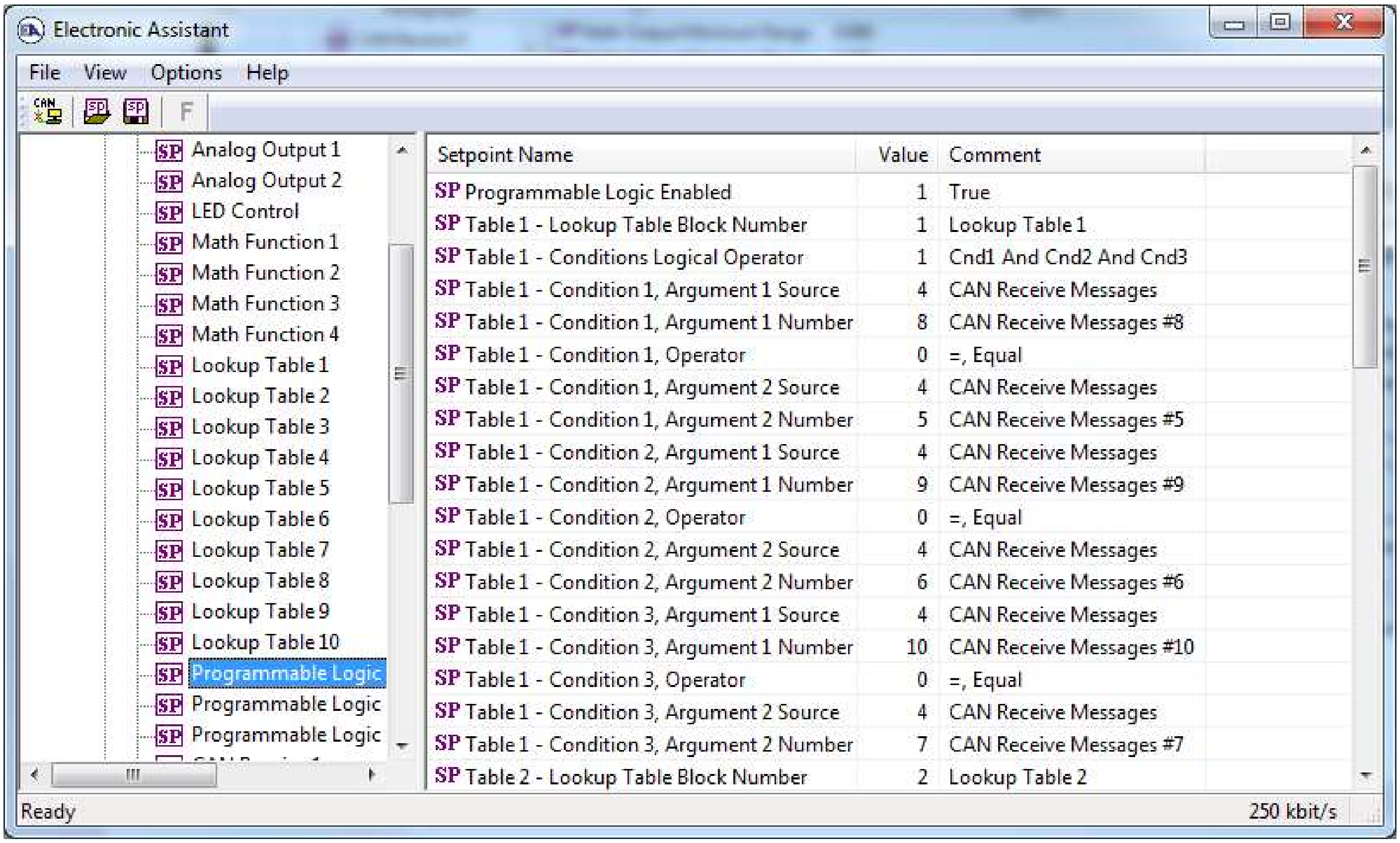
Screen Capture of Example Lookup Table 1 Setpoints

Note: In the screen capture shown above, the "X-Axis Source" has been changed from its default value in order to enable the function block.

4.5. Programmable Logic Setpoints

The Programmable Logic function block is defined in Section 1.5. Please refer there for detailed information about how all these setpoints are used.

As this function block is disabled by default, there is nothing further to define in terms of defaults and ranges beyond that which is described in Section 1.5. The screen capture below shows how the setpoints referenced in that section appear on EA.



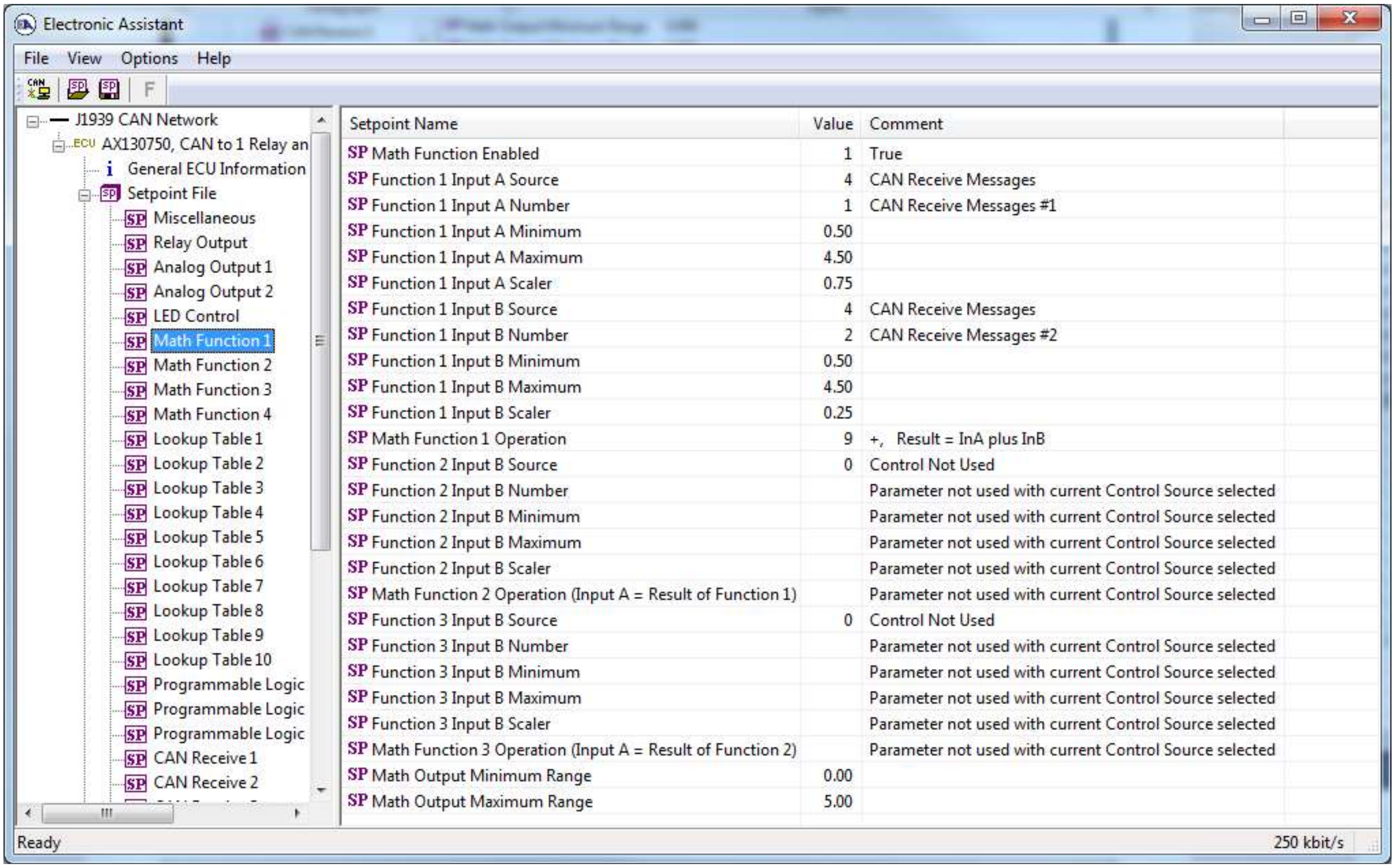
Screen Capture of Default Programmable Logic 1 Setpoints

Note: In the screen capture shown above, the "Programmable Logic Block Enabled" has been changed from its default value in order to enable the function block.

Note: The default values for the Argument1, Argument 2 and Operator are all the same across all the Programmable Logic function blocks, and must therefore be changed by the user as appropriate before this can be used.

4.6. Math Function Setpoints

The Math Function block is defined in Section 1.6. Please refer there for detailed information about how all these setpoints are used.



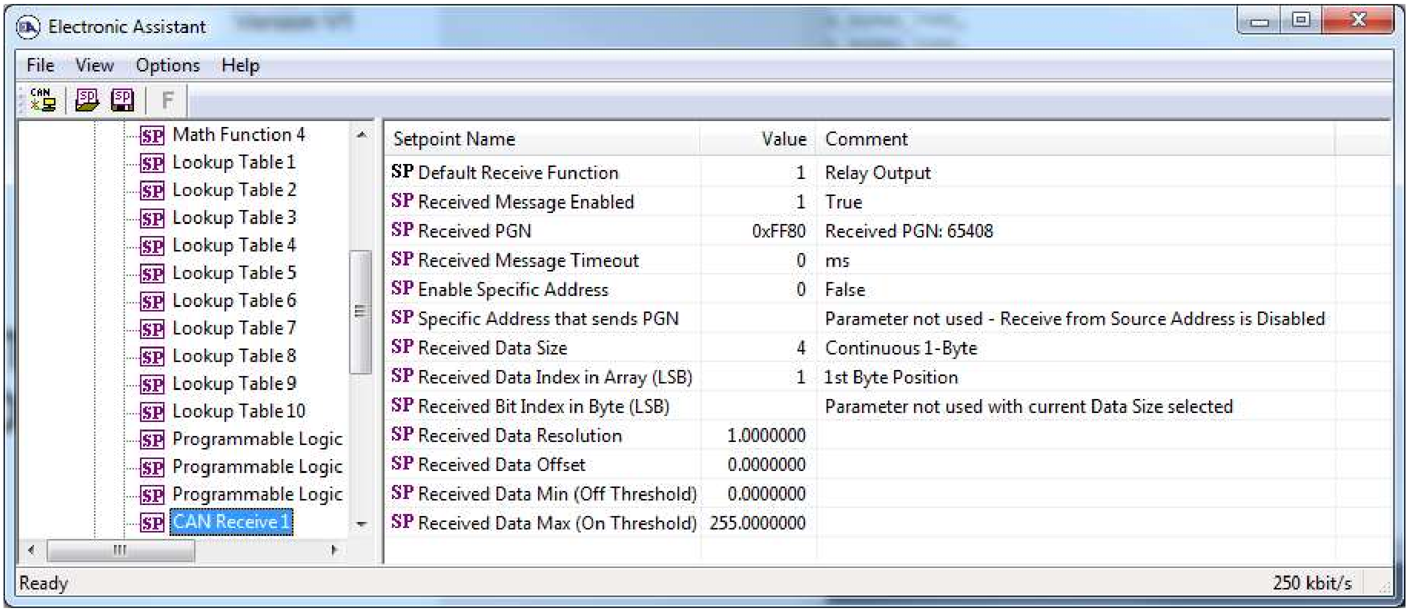
Screen Capture of Example Math Function 1 Setpoints

Note: In the screen capture shown above, the “Math Function Enabled” has been changed from its default value in order to enable the function block. Other setpoints have also been changed from default values in order to illustrate how the block might look when functional, as per the example outlined in Section 1.6*.*

Name	Range	Default	Notes
Math Function Enabled	Drop List	0, False	True or False
Function X Input Y Source (X = 1 to 3, Y = A or B)	Drop List	0, Control Source Not Used	See Table 2
Function X Input Y Number	Per Source	0	See Table 2
Function X Input Y Minimum	-10^4 to 10^4	0.0	Converts input to a percentage before use in the calculation.
Function X Input Y Maximum	-10^4 to 10^4	100.0	
Function X Input Y Scaler	-10^4 to 10^4	1.00	See Section 1.6
Math Output Minimum Range	-10^4 to 10^4	0.0	Converts calculation from a percentage value to the desired physical unit.
Math Output Maximum Range	-10^4 to 10^4	100.0	

4.7. CAN Receive Setpoints

The CAN Receive function block is defined in Section 1.7, with addition information in Section 3.4. Please refer there for detailed information about how all these setpoints are used.



Screen Capture of Default CAN Receive 1 Setpoints

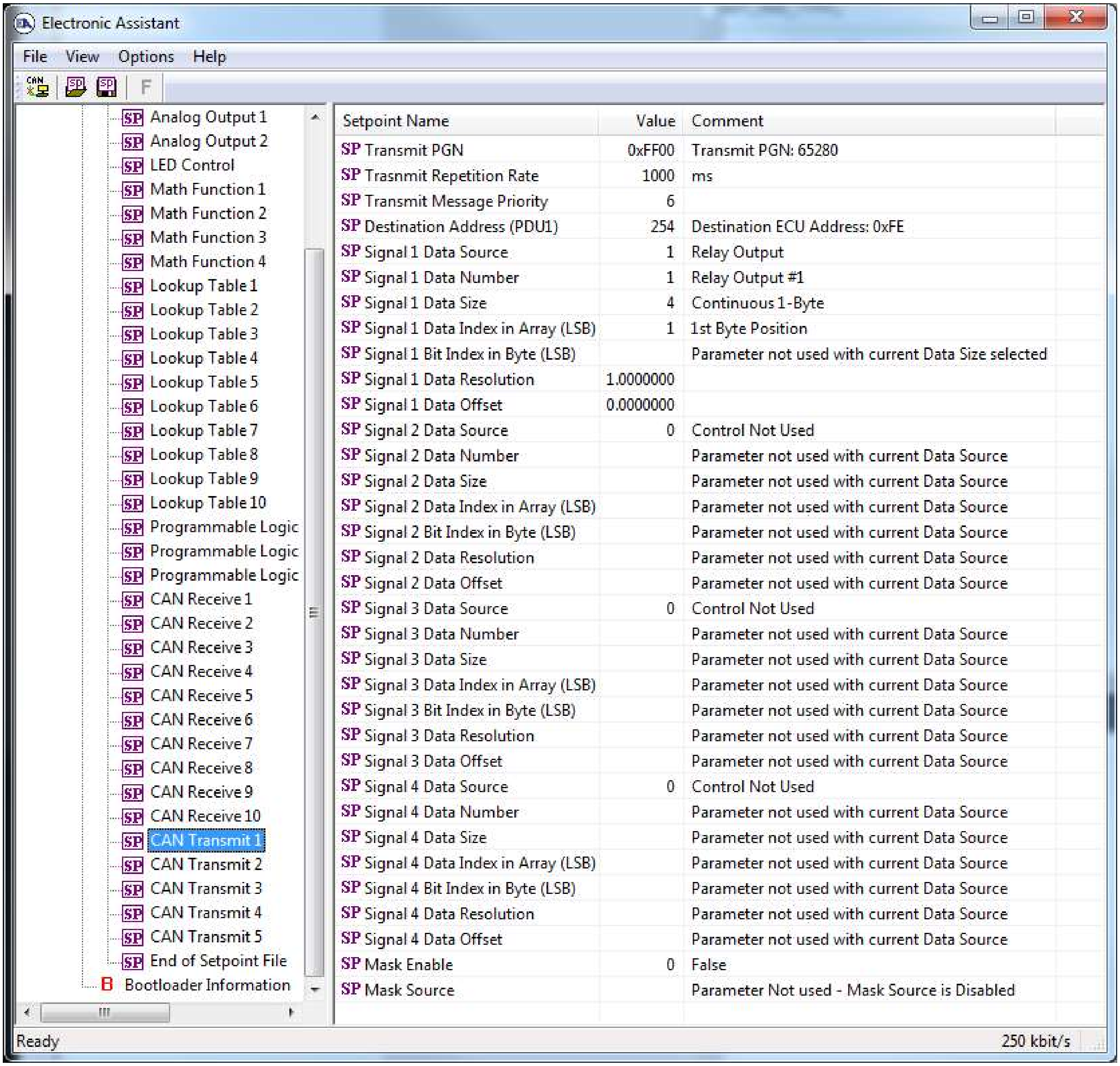
Note: If the "Received Message Enabled" setpoint is False, all the setpoints below it read "Parameter Not Used by Default"*
*Note**: Each Block has different default values set to parameters. Refer to Section 3.4 for more details*

Name	**Range**	**Default**	**Notes**
Default Receive Function	Block Number	Relay Output (CAN Receive 1) Analog Output 1 (CAN Receive 2) Analog Output 2 (CAN Receive 3)	Read only parameter
Received Message Enabled	False or True	1, True (CAN Receive 1 to 3) 2, False (CAN Receive 4 to 10)	See Note* above
Received PGN	0 to 65535	65408 ($FF80)	See Section 3.4 for defaults
Received Message Timeout	0 to 60,000 ms	0 ms	Expects all data at 100ms
Enable Specific Address	False or True	0, False	
Specific Address that sends PGN	0 to 255	254 (0xFE, Null Addr)	Only configurable when specific address is enabled
Receive Data Size	Drop List	Different for each	0 = Not Used (disabled) 1 = 1-Bit 2 = 2-Bits 3 = 4-Bits 4 = 1-Byte 5 = 2-Bytes 6 = 4-Bytes See Section 3.4 for defaults
Receive Data Index in Array (LSB)	0 to 7 Byte Position	Different for each	See Section 3.4 for defaults
Receive Bit Index in Byte (LSB)	0 to 7 Bit Position	Different for each	Only used with Bit Data Types
Receive Data Resolution	-10^5 to 10^5	1.0000000	See Section 3.4 for defaults
Receive Data Offset	-10^5 to 10^5	0.0000000	See Section 3.4 for defaults

Received Data Min (Off Threshold)	-10^5 to 10^5	0.0000000	See Section 3.4 for defaults
Received Data Max (On Threshold)	-10^5 to 10^5	Different for each	See Section 3.4 for defaults

4.8. CAN Transmit Setpoints

The CAN Transmit function block is defined in Section 1.8, with addition information in Section 3.3. Please refer there for detailed information about how all these setpoints are used.



Screen Capture of Default CAN Transmit 1 Setpoints

Name	Range	Default	Notes
Transmit PGN	0 to 65535	Different for each	See Section 3.3 for defaults
Transmit Repetition Rate	0 to 65535 ms	1000ms	0ms disables transmit
Transmit Message Priority	0 to 7	6	Proprietary B Priority
Destination Address (for PDU1)	0 to 255	254 (0xFE, Null Address)	Not used by default
Signal 1 Data Source	Drop List	Different for each	See Table 16 for defaults
Signal 1 Data Number	Per Source	Different for each	See Table 16for defaults

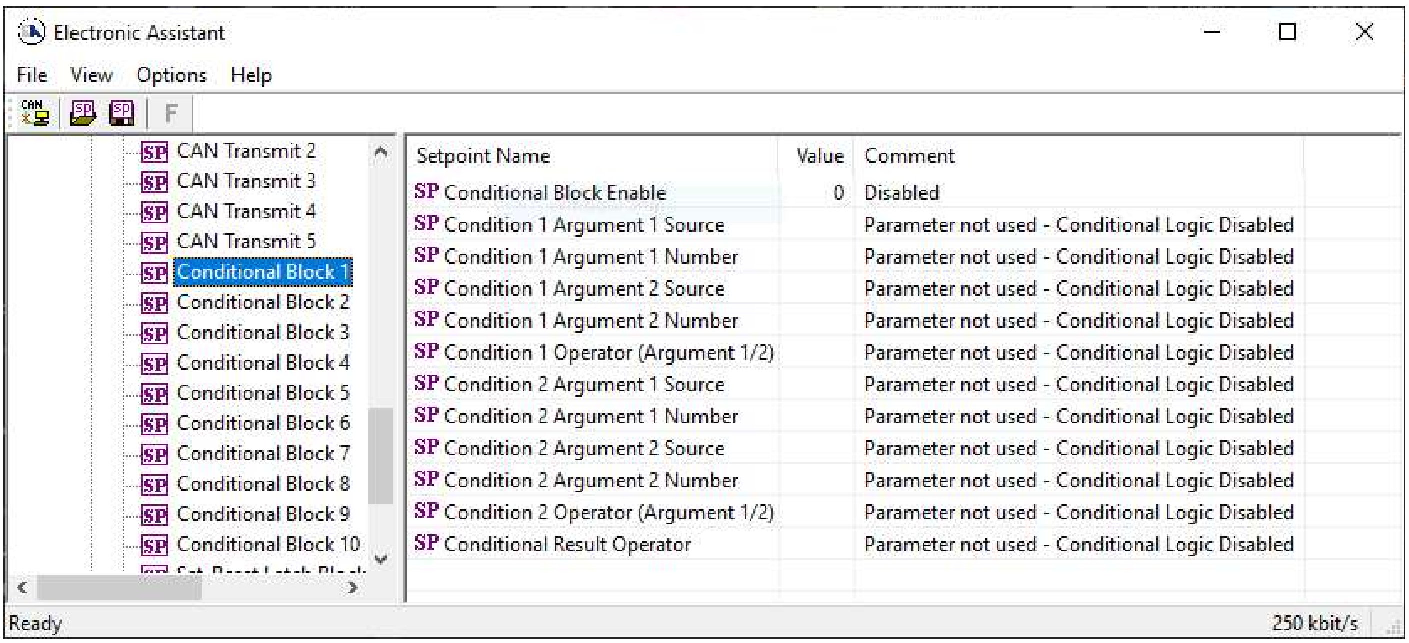
Signal 1 Data Size	Drop List	Different for each	0 = Not Used (disabled) 1 = 1-Bit 2 = 2-Bits 3 = 4-Bits 4 = 1-Byte 5 = 2-Bytes 6 = 4-Bytes See Section 3.3 for defaults
Signal 1 Data Index in Array (LSB)	0 to 7 Byte Position	Different for each	See Section 3.3 for defaults
Signal 1 Bit Index in Byte (LSB)	0 to 7 Bit Position	Different for each	Only used with Bit Data Types
Signal 1 Data Resolution	-10^5 to 10^5	Different for each	See Section 3.3 for defaults
Signal 1 Data Offset	-10^5 to 10^5	Different for each	See Section 3.3 for defaults
Signal 2 Data Source	Drop List	Different for each	See Table 16 for defaults
Signal 2 Data Number	Per Source	Different for each	See Table 16 for defaults
Signal 2 Data Size	Drop List	Different for each	0 = Not Used (disabled) 1 = 1-Bit 2 = 2-Bits 3 = 4-Bits 4 = 1-Byte 5 = 2-Bytes 6 = 4-Bytes See Section 3.3 for defaults
Signal 2 Data Index in Array (LSB)	0 to 7 Byte Position	Different for each	See Section 3.3 for defaults
Signal 2 Bit Index in Byte (LSB)	0 to 7 Bit Position	Different for each	Only used with Bit Data Types
Signal 2 Data Resolution	-10^5 to 10^5	Different for each	See Section 3.3 for defaults
Signal 2 Data Offset	-10^5 to 10^5	Different for each	See Section 3.3 for defaults
Signal 3 Data Source	Drop List	Different for each	See Table 13 for defaults
Signal 3 Data Number	Per Source	Different for each	See Table 13 for defaults
Signal 3 Data Size	Drop List	Different for each	0 = Not Used (disabled) 1 = 1-Bit 2 = 2-Bits 3 = 4-Bits 4 = 1-Byte 5 = 2-Bytes 6 = 4-Bytes See Section 3.3 for defaults
Signal 3 Data Index in Array (LSB)	0 to 7 Byte Position	Different for each	See Section 3.3 for defaults
Signal 3 Bit Index in Byte (LSB)	0 to 7 Bit Position	Different for each	Only used with Bit Data Types
Signal 3 Data Resolution	-10^5 to 10^5	Different for each	See Section 3.3 for defaults
Signal 3 Data Offset	-10^5 to 10^5	Different for each	See Section 3.3 for defaults
Signal 4 Data Source	Drop List	Different for each	See Table 16 for defaults
Signal 4 Data Number	Per Source	Different for each	See Table 16 for defaults
Signal 4 Data Size	Drop List	Different for each	0 = Not Used (disabled) 1 = 1-Bit 2 = 2-Bits 3 = 4-Bits 4 = 1-Byte 5 = 2-Bytes 6 = 4-Bytes See Section 3.3 for defaults
Signal 4 Data Index in Array (LSB)	0 to 7 Byte Position	Different for each	See Section 3.3 for defaults
Signal 4 Bit Index in Byte (LSB)	0 to 7 Bit Position	Different for each	Only used with Bit Data Types

Signal 4 Data Resolution	-10^5 to 10^5	Different for each	See Section 3.3 for defaults
Signal 4 Data Offset	-10^5 to 10^5	Different for each	See Section 3.3 for defaults
Mask Enable	False or True	0, False	
Mask Source	0 to 255	128, (Mask Source Address: 0x80)	

Recall that when multiple messages are sent on the same PGN, only the LOWEST Indexed channel's *'Repetition Rate'* will be used. This means that even if a non-zero value is selected on a higher channel, but the lowest is still 0, no message will be sent.

4.9. Conditional Block Setpoints

The Conditional Block setpoints are defined in Section 1.9. Refer to that section for detailed information on how these setpoints are used. The screen capture in the Figure below displays the available setpoints for each of the Conditional Blocks. The table below the screen capture highlights the allowable ranges for each setpoint.



Screen Capture of Conditional Block Setpoints

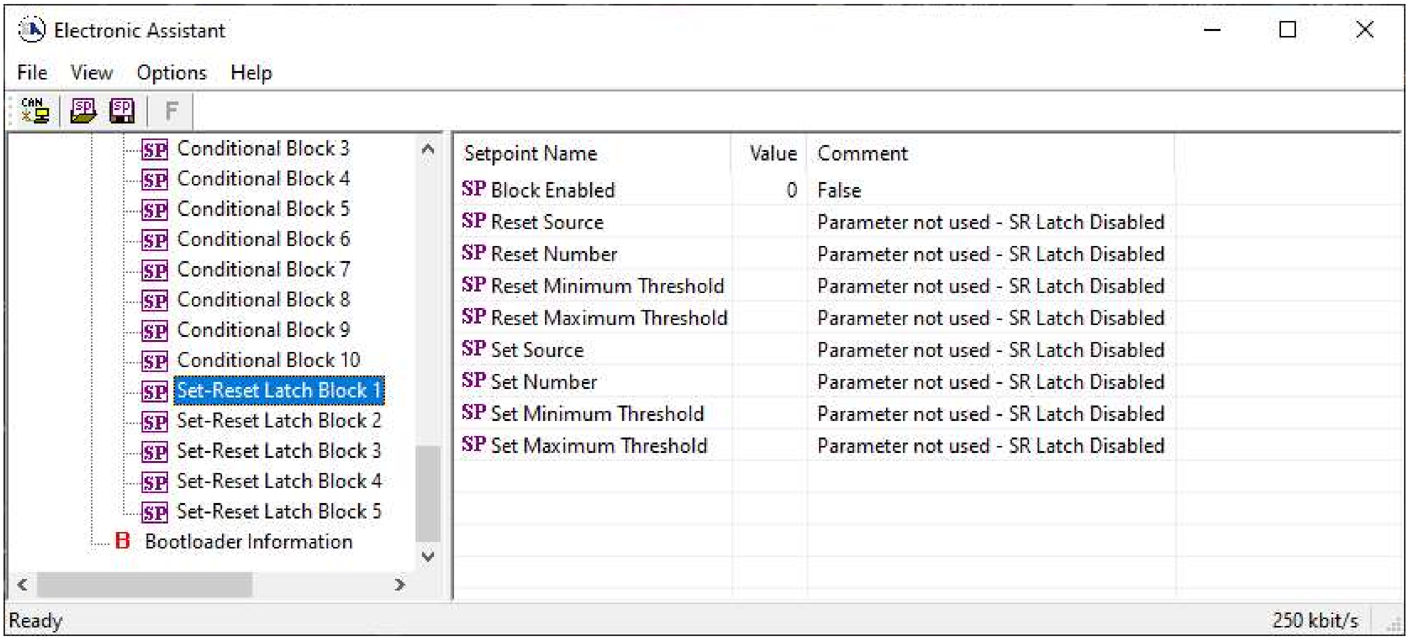
Name	**Range**	**Default**	**Notes**
Conditional Function Enabled	Drop List	Disabled	
Condition 1 Argument 1 Source	Drop List	Digital Input	Refer to Table 1
Condition 1 Argument 1 Number	Depends on Source Selected	0	Refer to Table 1
Condition 1 Argument 2 Source	Drop List	Digital Input	Refer to Table 1
Condition 1 Argument 2 Number	Depends on Source Selected	0	Refer to Table 1
Condition 1 Operator (Argument 1/2)	Drop List	0	Refer to Table 17
Condition 2 Argument 1 Source	Drop List	Digital Input	Refer to Table 1
Condition 2 Argument 1 Number	Depends on Source Selected	0	Refer to Table 1
Condition 2 Argument 2 Source	Drop List	Digital Input	Refer to Table 1

Condition 2 Argument 2 Number	Depends on Source Selected	0	Refer to Table 1
Condition 2 Operator (Argument 1/2)	Drop List	0	Refer to Table 17
Conditional Result Operator	Drop List	OR	Refer to Table 18

Table 21: Default Conditional Block Setpoints

4.10. Set-Reset Latch Block

The Set-Reset Latch Block setpoints are defined in Section 1.10. Refer to that section for detailed information on how these setpoints are used. The screen capture in the Figure below displays the available setpoints for each of the Set-Reset Latch Blocks. The table below the screen capture highlights the allowable ranges for each setpoint.



Screen Capture of Set-Reset Latch Block Setpoints

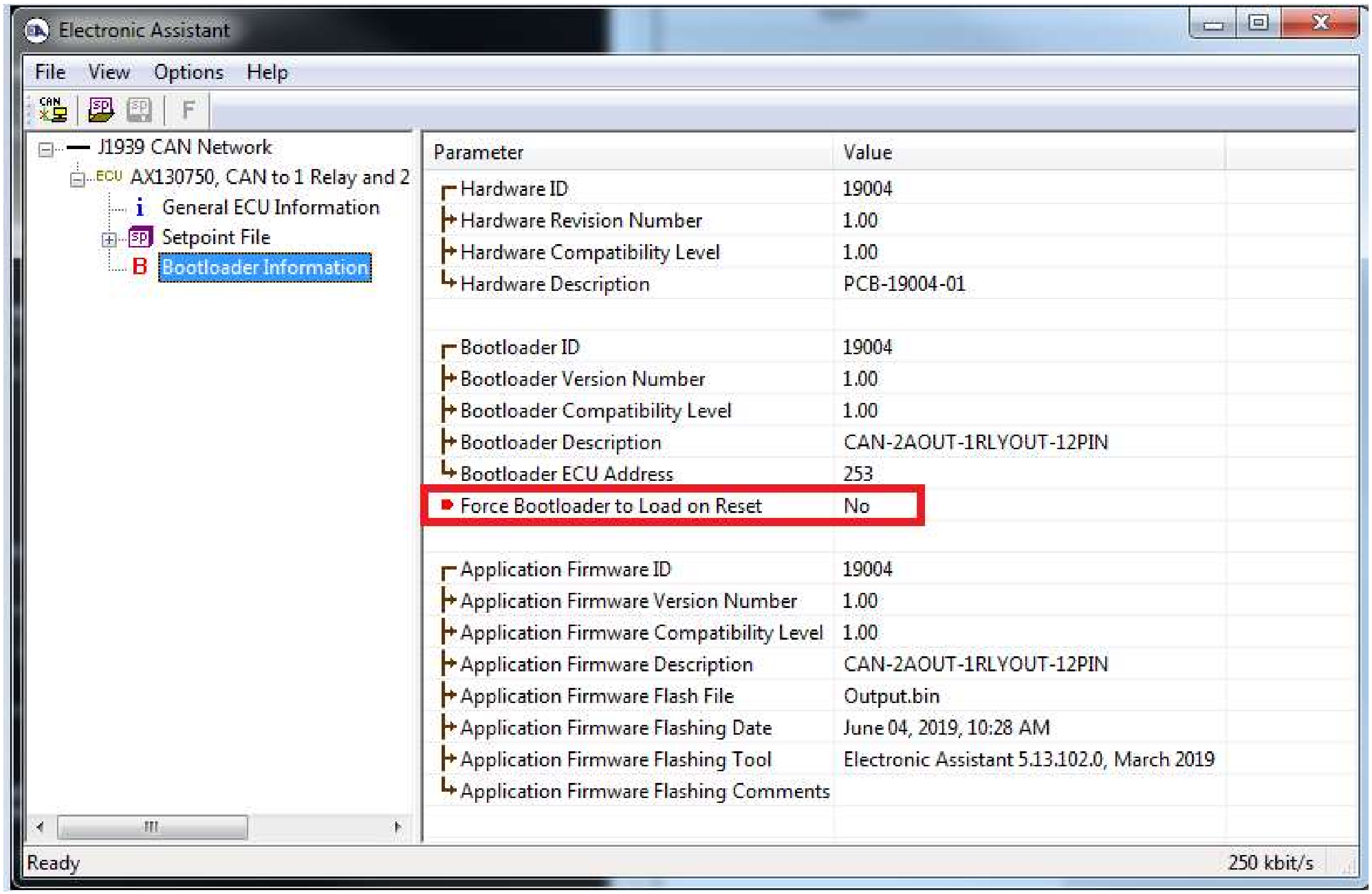
Name	**Range**	**Default**	**Notes**
Block Enabled	Drop List	False	
Reset Source	Drop List	Control Not Used	Refer to **Error! Reference source not found.**
Reset Number	Depends on Source Selected	1	Refer to **Error! Reference source not found.**
Reset Minimum Threshold	Drop List	0%	Refer to Section 1.10
Reset Maximum Threshold	Depends on Source Selected	100%	Refer to Section 1.10
Set Source	Drop List	Control Not Used	Refer to **Error! Reference source not found.**
Set Number	Drop List	1	Refer to **Error! Reference source not found.**
Set Minimum Threshold	Depends on Source Selected	0%	Refer to Section 1.10
Set Maximum Threshold	Drop List	100%	Refer to Section 1.10

Table 22: Default Set-Reset Latch Block Setpoints

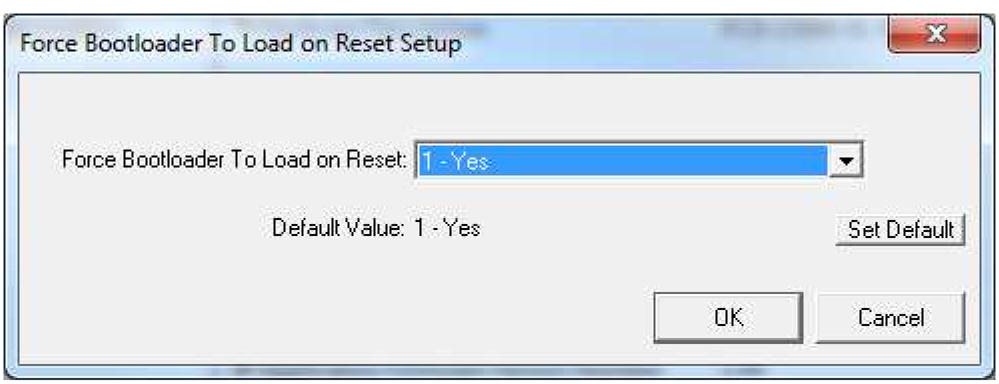
5. REFLASHING OVER CAN WITH EA BOOTLOADER

The AX1307x0 can be upgraded with new application firmware using the **Bootloader Information** section. This section details the simple step-by-step instructions to upload new firmware provided by Axiomatic onto the unit via CAN, without requiring it to be disconnected from the J1939 network.

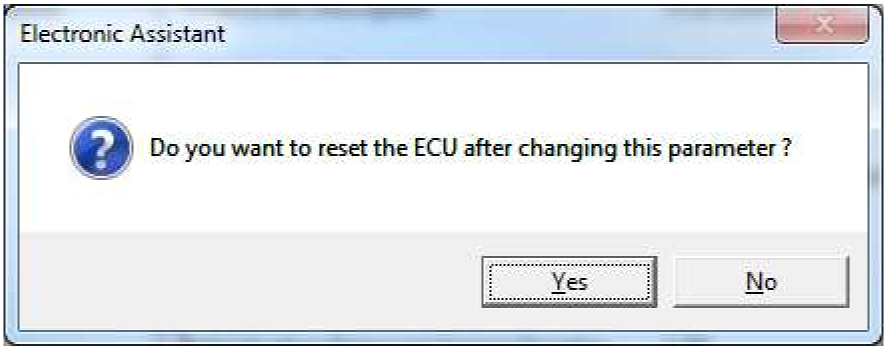
1. When EA first connects to the ECU, the **Bootloader Information** section will display the following information.



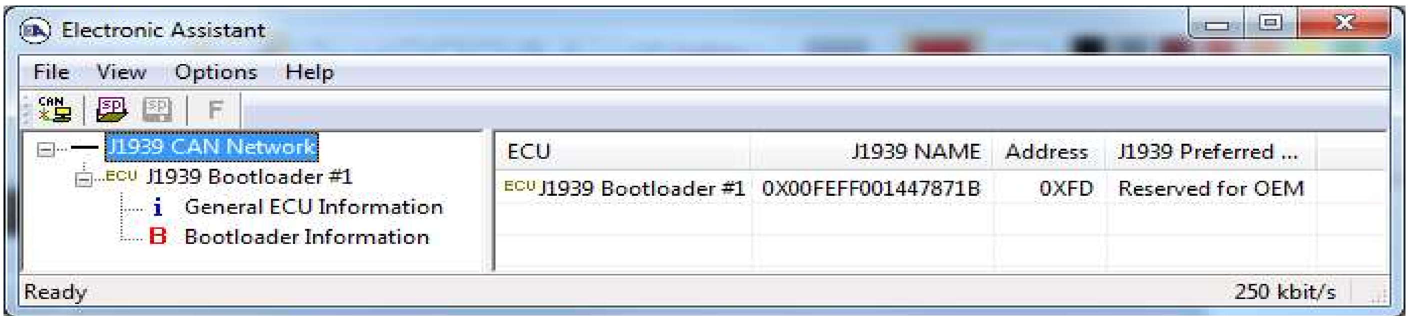
2. To use the bootloader to upgrade the firmware running on the ECU, change the variable **"Force Bootloader To Load on Reset**" to *Yes.*

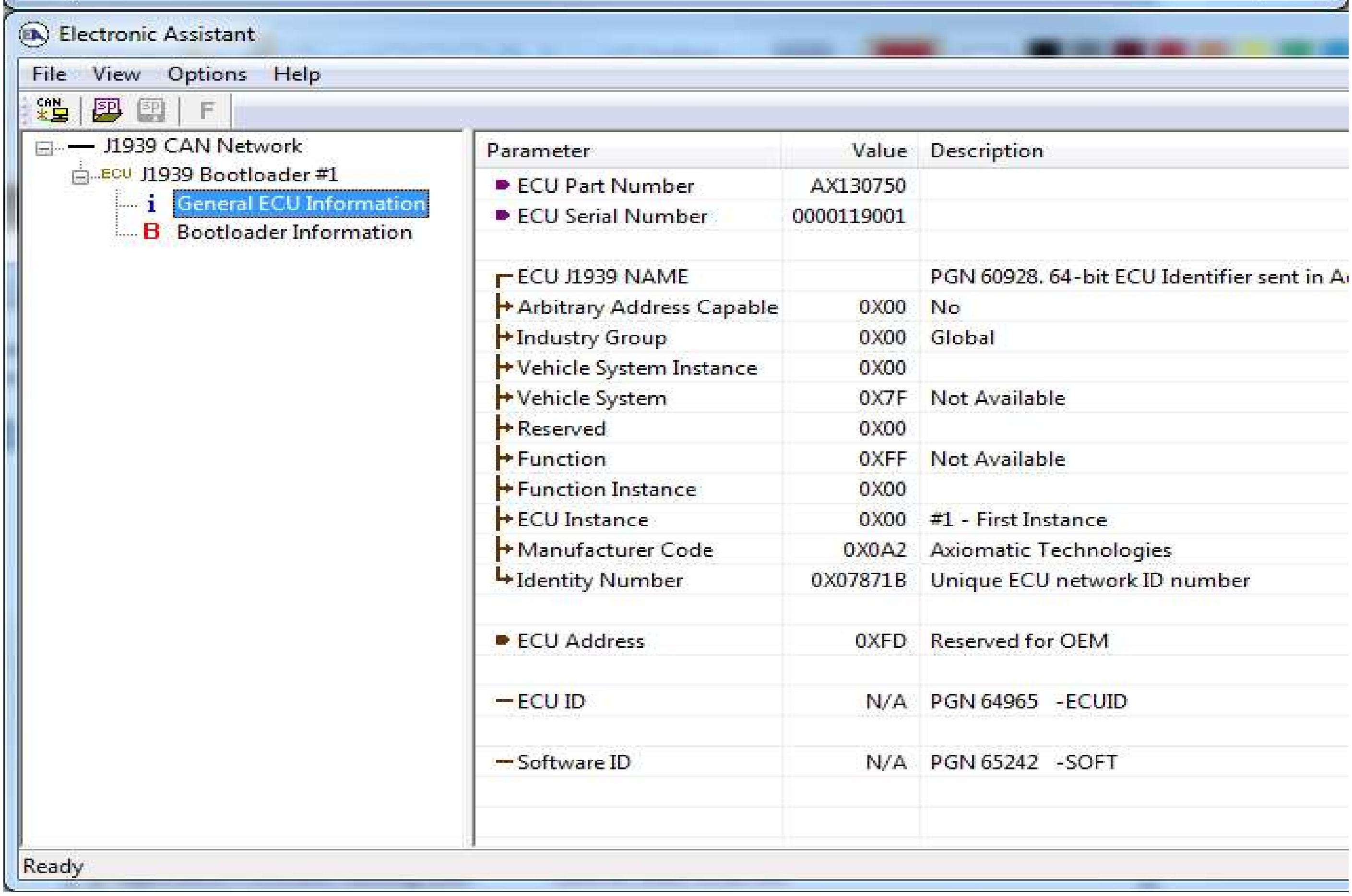


3. When the prompt box asks if you want to reset the ECU, select *Yes*.



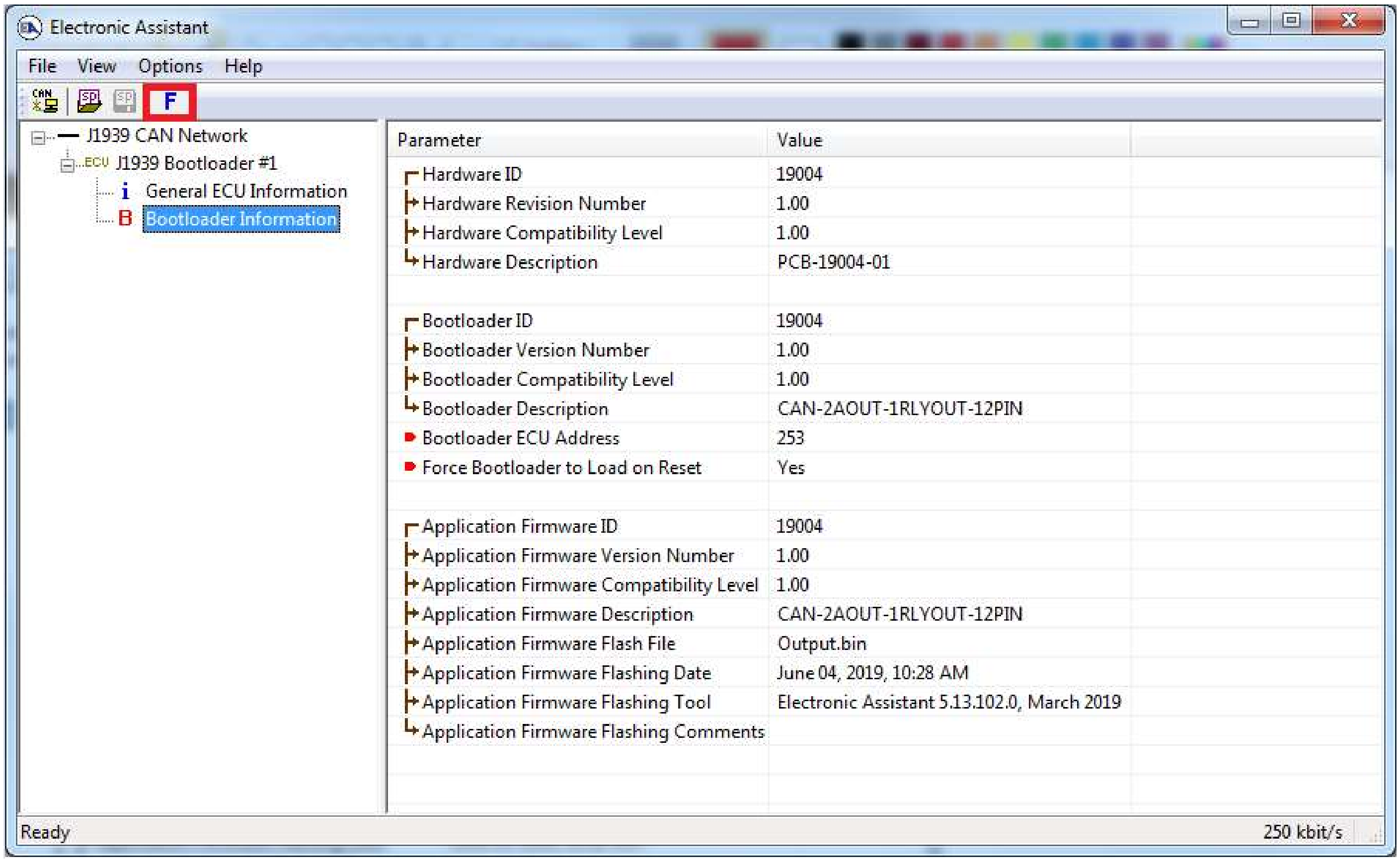
4. Upon reset, the ECU will no longer show up on the J1939 network as an AX1307x0 but rather as **J1939 Bootloader #1**.





Note that the bootloader is NOT Arbitrary Address Capable. This means that if you want to have multiple bootloaders running simultaneously (not recommended) you would have to manually change the address for each one before activating the next, or there will be address conflicts, and only one ECU would show up as the bootloader. Once the 'active' bootloader returns to regular functionality, the other ECU(s) would have to be power cycled to re-activate the bootloader feature.

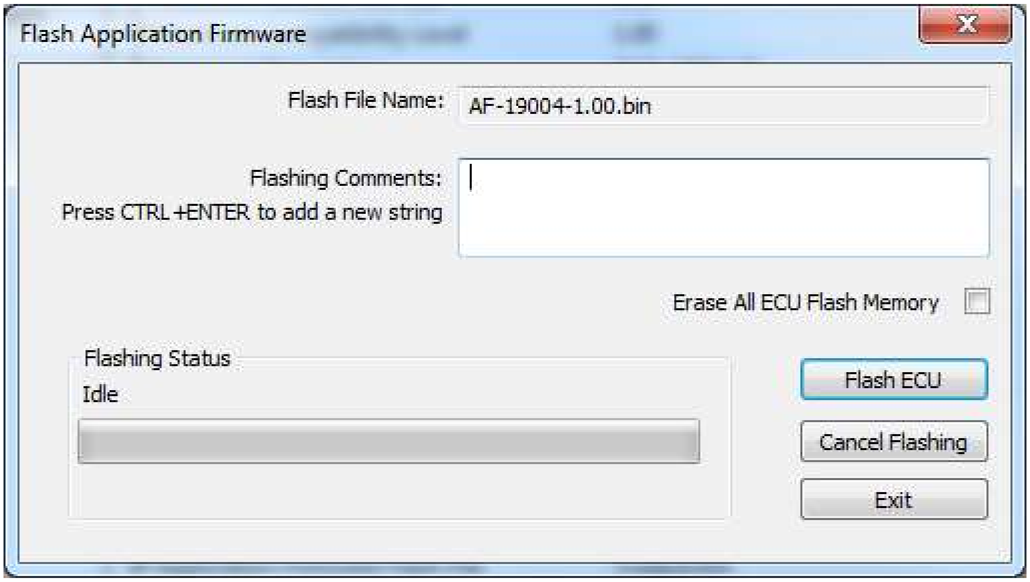
5. When the **Bootloader Information** section is selected, the same information is shown as when it was running the AX1307x0 firmware, but in this case the **F**lashing feature has been enabled.



6. Select the **F**lashing button and navigate to where you had saved the **AF-19004_x.yy.bin** file sent from Axiomatic. (Note: only binary (.bin) files can be flashed using the EA tool)

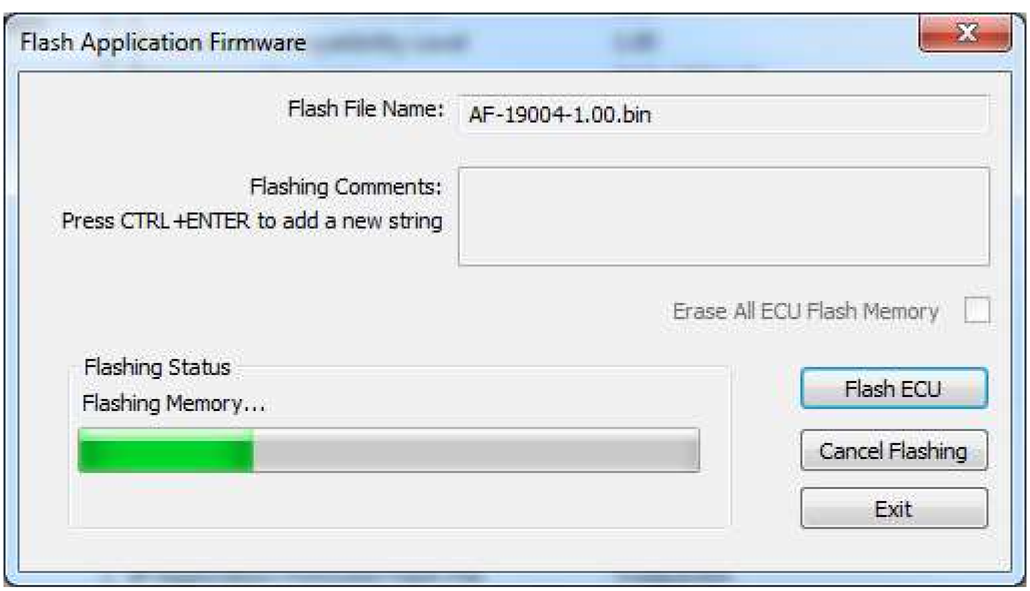
7. Once the Flash Application Firmware window opens, you can enter comments such as "Firmware upgraded by [Name]" if you so desire. This is not required, and you can leave the field blank if you do not want to use it.

   Note: You do not have to date/time-stamp the file, as this is done automatically by the EA tool when you upload the new firmware.



WARNING: Do not check the "Erase All ECU Flash Memory" box unless instructed to do so by your Axiomatic contact. Selecting this will erased ALL data stored in non-volatile flash, including the calibration done by Axiomatic during factory testing. It will also erase any configuration of the setpoints that might have been done to the ECU and reset all setpoints to their factory defaults. By leaving this box unchecked, none of the setpoints will be changed when the new firmware is uploaded.

8. A progress bar will show how much of the firmware has been sent as the upload progresses. The more traffic there is on the J1939 network, the longer the upload process will take.



9. Once the firmware has finished uploading, a message will popup indicating the successful operation. If you select to reset the ECU, the new version of the AX1307x0 application will start running, and the ECU will be identified as such by EA. Otherwise, the next time the ECU is power-cycled, the AX1307x0 application will run rather than the bootloader function.

Note: If at any time during the upload the process is interrupted, the data is corrupted (bad checksum) or for any other reason the new firmware is not correct, i.e. bootloader detects that the file loaded was not designed to run on the hardware platform, the bad or corrupted application will not run. Rather, when the ECU is reset or power-cycled the **J1939 Bootloader** will continue to be the default application until valid firmware has been successfully uploaded into the unit.

6. VERSION HISTORY

Version	Date	Author	Modifications
V1	Aug 1st , 2019	Jessica Chen	Initial Draft
-	August 9, 2019	Amanda Wilkins	Marketing Review
-	November 20th, 2019	Jessica Chen	Updated AX130750 Drawing
-	February 10th, 2020	Jessica Chen	Added AX130770 Weight
V2	June 1, 2020	Amanda Wilkins	Removed LED reference in spec and updated drawing. Removed LED section 1.4 and 4.4 (EA)
V2A	November 9, 2021	Dmytro Tsebrii	Added auto baud rate. Added Conditional and Set Reset Function Blocks Updated tables and figures
V2B	October 6, 2022	Dmytro Tsebrii	Added information about Conditional Logic and Set-Reset Function Blocks. Updated Table of Content

APPENDIX - 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 www.axiomatic.com/service.html.

Power

Power Supply Input - Nominal	12 V or 24 Vdc nominal; 9…36 Vdc The minimum allowable supply voltage for the power pin is 7 Vdc.
Surge Protection	Meets the surge requirements of SAE J1445
Reverse Polarity Protection	Provided
Under and Over Voltage Protections	Under-voltage shutdown at 8V. Over-voltage shutdown at 48V.

Outputs

Analog/Digital Output	AX130750: 2 signal outputs configurable as: 0-5V, 0-10V, 4-20 mA or PWM/Frequency AX130770: 2 isolated signal outputs configurable as: 0-5V, 0-10V, 4-20 mA, PWM/Frequency or Digital Analog Voltage or Current Outputs: Voltage Output: 0-5 Vdc, 0-10 Vdc -5 to 5 Vdc, -10 to 10 Vdc Maximum load is 30 mA. Current Output: 0-20 mA or 4-20 mA Maximum load resistance is < 500 Ohms. Compliance Voltage is 14V. Digital Types: PWM or Frequency Outputs 0.1 Hz to 20 kHz 0-100% D.C. 5 V or 12 V Amplitude Push pull output Maximum load is 50 mA. Over-current protection (50 mA) 12-bit Protected against shorts to GND or +Vcc
Output Accuracy	Voltage: 0.2% Current: 0.2% PWM Signal: 0.1% Frequency Signal: 0.1% Digital: 1%
Relay Output	Sets 1 Form C relay output Resistive load: • 5A (NO)/5 A (NC) at 30Vdc Dielectric strength: • 3,000 VAC, 50/60 Hz for 1 min between coil and contacts • 2,500 Vrms between open contacts There is no special overcurrent/overvoltage protection on the relay outputs. The user is advised to provide a fast acting 6A fuse or an adequate external protection if necessary.

Control Software

Software Platform	Pre-programmed with standard logic.

General Specifications

Memory	STM32F405RGT7; 32-bit, 1024 Kbytes Flash Program Memory
CAN Port	AX130750: 1 CAN (SAE J1939) AX130770: 1 Isolated CAN (SAE J1939) Auto baud rate with the following baud rates: 250, 500, 667, 1000 kB/s
Isolation	300 Vrms; 4 Way isolation (power-output1-output2-CAN)
Quiescent Current Draw	AX130750: Typical 63mA @12Vdc; 33mA @ 24Vdc AX130770: Typical 65mA @12Vdc; 35mA @ 24Vdc
Response Time	<10 mSec. Typical
Operating Conditions	-40 to 85°C (-40 to 185°F)
Weight	AX130750: 0.15 lb. (0.068 kg) preliminary AX130770: 0.50 lb. (0.227 kg)
Protection Rating	IP67
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
Enclosure and Dimensions	AX130750: Molded Enclosure, integral connector Nylon 6/6, 30% glass Ultrasonically welded 3.54 x 2.75 x 1.31 inches (90.09 x 70.00 x 33.35 mm) L x W x H including integral connector Refer to Figure 14, dimensional drawing. AX130770: High Temperature Nylon housing – TE Deutsch PCB Enclosure (EEC-325X4B) 4.677 x 5.236 x 1.417 inches 118.80 x 133.00 x 36.00 mm (W x L x H excluding mating plugs) Refer to Figure 15, dimensional drawing.
Mating Plug Kit	AX130750: PL-DTM06-12SA Mating Plug Kit (1 DTM06-12SA, 1 WM-12S, 10 0462-201-20141, 2 0413-204-2005 Sealing Plug) AX130770: Axiomatic PN: PL-DTM06-12SA It is comprised of the following TE Deutsch parts: DTM06-12SA; wedgelock WM12S; 12 contacts (0462-201-20141); and 6 sealing plugs (0413-204-2005).
User Interface, Reflashing	Axiomatic Electronic Assistant **AX070502**

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Resolver Signal Conditioners

Service Tools

Signal Conditioners, Converters

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Surge Suppressors

OUR COMPANY

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

QUALITY DESIGN AND MANUFACTURING

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

WARRANTY, APPLICATION APPROVALS/LIMITATIONS

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

COMPLIANCE

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

SAFE USE

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

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

SERVICE

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

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

DISPOSAL

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

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