USER MANUAL UMAX032160
Version 1.0.3

6 Digital Input Controller with Dual CAN, SAE J1939

USER MANUAL

P/N: AX032160

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VERSION HISTORY

Version	Date	Author	Modification
1.0.0	Nov. 10, 2023	Weixin Kong	Initial draft
1.0.1	Nov. 29, 2023	M Ejaz	Marketing review Added technical specification, dimensional drawing, and pinout
1.0.2	Apr. 16, 2024	Weixin Kong	Introduced a new functionality for CAN Transmit “On-Change Repetition Rate”.
1.0.3	Jul. 10, 2024	M Ejaz	Updated dimensional drawing Added quiescent current, vibration, shock and compliance information
1.0.4	Oct. 17, 2024	M Ejaz	Updated input pull-up and pull-down Added CAN isolation Added applications

ACRONYMS

ACK	Positive Acknowledgement (from SAE J1939 standard)
BATT +/-	Battery positive (a.k.a. Vps) or Battery Negative (a.k.a. GND)
DIN	Digital Input is used to measure active high or low signals.
DM	Diagnostic Message (from SAE J1939 standard)
DTC	Diagnostic Trouble Code (from SAE J1939 standard)
EA	Axiomatic Electronic Assistant (A Service Tool for Axiomatic ECUs)
ECU	Electronic Control Unit (from SAE J1939 standard)
GND	Ground reference (a.k.a. BATT-)
I/O	Inputs and Outputs
MAP	Memory Access Protocol
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)
TP	Transport Protocol
UIN	Universal input is used to measure voltage, current, frequency or digital inputs.
Vps	Voltage Power Supply (a.k.a. BATT+)
%dc	Percent Duty Cycle (Measured from a PWM input)

Note:

An Axiomatic Electronic Assistant KIT may be ordered as P/N: AX070502 or AX070506K

TABLE OF CONTENTS

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, March 2017
TDAX032160	Technical Datasheet, Axiomatic Technologies
UMAX07050x	User Manual, Axiomatic 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 not described in this document.

NOTE: This product is supported by Axiomatic Electronic Assistant V4.10.78.0 and higher.

1. OVERVIEW OF CONTROLLER

The 6 Digital Input Controller with Dual CAN Controller (ECU) is meticulously designed to measure digital inputs and transmit data to an SAE J1939 Network. All six inputs are configurable to measure frequency/PWM or digital signals. The device provides a comprehensive set of configurable settings, allowing users to create custom configurations without the need for reprogramming. The sophisticated control algorithms empower users to program the controller for a broad spectrum of applications without the necessity for custom software. Of particular significance, the AX032160 model incorporates an Auto Baud Rate functionality, enhancing its overall versatility and utility.

The Axiomatic Electronic Assistant is used to configure the 6 Digital Input Controller. Programming configurable properties, Axiomatic EA setpoints, are listed in chapter 4. Setpoint configuration can be saved in a file which can then be utilized to program the same configuration to another 6 Digital Input Controller. Throughout this document, Axiomatic EA setpoint names are referred to with bolded text in double-quotes, and the setpoint option is referred to with italicized text in single-quotes. For example, "**Input Type**" setpoint set to option '*Discrete Voltage Input*'.

In this document the configurable properties of the ECU are divided into function blocks, namely input function block, output function block, diagnostic function block, lookup table function block, programmable logic function block, math function block, CAN transmit message function block and CAN receive message function block. Input function block includes properties used to select input sensor functionality. Diagnostic function block properties are used to configure fault detection and reaction functionalities. Lookup table function blocks, programmable logic function blocks, math function blocks offer some logical programming to convert signals. The CAN transmit message function block configures properties of the messages sent to the CAN buses. And the CAN receive message function block configures properties of the messages received from the CAN buses. These function blocks are presented in detail in the next subchapters.

The 6DIN-2CAN Controller can be ordered using the following part numbers depending on the application.

AX032160	Controller with the J1939 auto-baud-rate detection

1.1. Input Function Blocks

The controller is equipped with a total of six inputs. Each input is configurable to measure Discrete Voltage, PWM, Frequency or pulse count signals.

1.1.1. Input Type

Within the input setpoint groups, the "Input Type" setpoint plays a pivotal role in configuring the input type. It is imperative to choose the input type first, as it significantly influences the interpretation of other setpoints within this block. **Table 1** outlines the input sensor types for all six inputs.

Table 1. Input Type Options

Input Parameter	Type	Units
Input Disable		
Discrete Voltage Input	Discrete	{0,1}
Frequency Input	Continuous	Hz
PWM Duty Cycle Input	Continuous	%
Pulse Counter Input	Discrete	

1.1.2. Pullup / Pulldown Resistor Options

With **Input Types:** Discrete voltage input, Frequency, PWM, Pule Counter Type, the user has the option of three (3) different pull up/pull down options as listed in Table 2.

0	*No Pull*
1	*Pull-Up Enabled*
2	*Pull-Down Enabled*

Table 2. Pullup/Pulldown Resistor Options

These options can be enabled or disabled by adjust the setpoint **Pullup/Pulldown Resistor** in the Axiomatic Electronic Assistant.

1.1.3. Input Polarity

In the case of Discrete Voltage Input, the options **Input Polarity** are used to configure how a signal high, or signal low is interpreted. The following table below is the available options provided. By default, *Normal Logic is* selected.

0	*Normal Logic*
1	*Inverse Logic*
2	*Toggled Logic*

Table 3 - Input Polarity

1.1.4. Counter Type

The 6DIN-2CAN controller supports three different variations of the Counter input type. These variations are listed in Table 4 below:

0	*Pulses Within Measuring Window*
1	*Time Measurement of Pulse Count*
2	*Trigger on Pulse Count Completion*

Table 4- Counter Input Types

The first option *Pulses Within Measuring Window* is used to count the number of pulses that occur within a configurable time frame (Measuring Window) in terms of milliseconds. This particular Counter type uses the other setpoint **Measuring Window** to select the time frame in which pulses are to be counted.

Time Measurement of Pulse Count is another option which allows time measurement of selected number of pulses to occur. Time measurement can be from 0ms to 65,000ms. If the time measurement has reached it maximum but not yet counted the selected number of pulses, the time will remain at maximum value. Therefore, it is important to select a number of pulses which could occur within the maximum time frame. Once the selected number of pulses have been read, the time will be restarted until the pulses have been read.

Trigger on Pulse Count Completion is Counter input type which triggers an 'ON' signal as soon as the selected number of pulses have been read. Setpoints **Pulses to Count**, **Edge to Trigger Pulse** and **Trigger on First Pulse** work together in this particular Counter type. When the controller reads all pulses in **Pulses to Count**, the input will be triggered 'ON' until the next pulse is received which will reset the trigger to 'OFF'. The setpoint **Edge to Trigger** determines on which edge of the pulse is the pulse count to be incremented. If the edge selected is *Falling Edge,* then the pulse count will not be incremented until the falling edge of the pulse is received. Likewise, if the selected edge is *Rising Edge*, then the pulse count will be incremented as soon as the rising edge of the pulse is received. The other setpoint is **Trigger on First Pulse**. This setpoint gives the user the option of triggering on the first pulse counted or the last pulse counted in **Pulses to Count**.

For example, if **Pulses to Count** is set to 100, **Edge to Trigger** is set to *Rising Edge*, and **Trigger on First Pulse** is set to TRUE, then the rising edge of the first pulse will trigger an 'ON' signal. The signal will remain 'ON' until the rising edge of the next pulse (the first pulse of the 100) is received, which turns the signal to 'OFF'. The signal will toggle states every 100 pulses.

1.1.5. Minimum and Maximum Ranges

The **Minimum Range** and **Maximum Range** setpoints are used to create the overall useful range of the inputs. For example, if **Minimum Range** is set to 0Hz and **Maximum Range** is set to 1000Hz, the overall useful range (0-100%) is between 0Hz to 1000Hz. Anything below the **Minimum Range** will saturate at **Minimum Range**. Similarly, anything above the **Maximum Range** will saturate at **Maximum Range**. In order to generate an input fault if the measured input falls output of the **Minimum Range** or **Maximum Range**, the Diagnostics function block can be used. Please refer to Section 0 for more details.

1.1.6. Input Software Filter Types

All input types with the exception of Discrete Voltage Input and Pulse Counter Input can be filtered using **Filter Type** and **Filter Constant** setpoints. There are three (3) filter types available as listed in Table 5.

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

Table 5 - Input Filtering Types

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

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

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

Equation 1 - Moving Average Filter Function

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

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

Equation 2 - Repeating Average Transfer Function

1.2. Internal Function Block Control Sources

The 6DIN-2CAN controller allows for internal function block sources to be selected from the list of the logical function blocks supported by the controller. As a result, any output from one function block can be selected as the control source for another. Keep in mind that not all options make sense in all cases, but the complete list of control sources is shown in Table 6.

Value	Meaning
0	*Control Not Used*
1	*Received CAN Message*
2	*Input Measured*
3	*Lookup Table*
4	*Programmable Logic Block*
5	*Math Function Block*
6	*Conditional Logic Block*
7	*Set-Reset Latch Logic Block*
8	*Control Constant Data*
9	*Power Supply Measured*
10	*Processor Temperature Measured*
11	*Receive Message Timeout*
12	*DTC React*

Table 6 - 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 7 outlines the ranges supported for the number objects, depending on the source that had been selected.

Control Source	Control Source Number
Control Not Used (Ignored)	[0]
Received CAN Message	[1…15]
Input Measured	[1…6]
Lookup Table	[1…10]
Programmable Logic Block	[1…4]
Math Function Block	[1…5]
Conditional Logic Block	[1…10]
Set-Reset Latch Logic Block	[1…5]
Control Constant Data	[1…1]
Power Supply Measured	[1…255]
Processor Temperature Measured	[1…255]
Receive Message Timeout	[1…15]
DTC React	[1…16]

Table 7 - Control Source Number Options

If a non-digital signal is selected to drive a digital input, the signal is interpreted to be OFF at or below the minimum of selected source and ON at or above the maximum of the selected source, and it will not change in between those points. Thus, non-digital to digital interpretation has a built-in hysteresis defined by minimum and maximum of the selected source, as shown in Figure 3. For example, Input Measure signal is interpreted to be ON at or above "Maximum Range" and OFF at or below "Minimum Range".

Control Constant Data has no unit nor minimum and maximum assigned to it, thus user must assign appropriate constant values according to intended use.

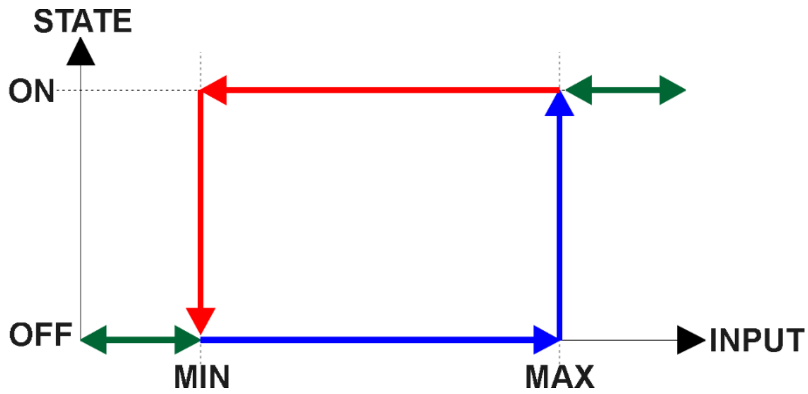


Figure 1 - Non-digital source to Digital input

1.3. Diagnostic Function Blocks

The 6DIN-2CAN Controller ECU supports diagnostic messaging. DM1 message is a message, containing Active Diagnostic Trouble Codes (DTC) that is sent to the J1939 network in case a fault has been detected. A Diagnostic Trouble Code is defined by the J1939 standard as a four byte value which is a combination of:

SPN	Suspect Parameter Number	(user defined)
FMI	Failure Mode Identifier	(see Table 10)
CM	Conversion Method	(always set to 0)
OC	Occurrence Count	(number of times the fault has happened)

In addition to supporting the DM1 message, 6DIN-2CAN Controller Input also supports:

DM2	Previously Active Diagnostic Trouble Codes	Sent only on request
DM3	Diagnostic Data Clear/Reset of Previously Active DTCs	Done only on request
DM11	Diagnostic Data Clear/Reset for Active DTCs	Done only on request

Fault detection and reaction is a standalone functionality that can be configured to monitor and report diagnostics of various controller parameters. The 6DIN-2CAN Controller supports 16 Diagnostics Definitions, each freely configurable by the user.

By default, the monitoring of operating voltage, CPU temperature and receive message timeouts is configured to diagnostics blocks 1, 2 and 3., In case any of these three diagnostics blocks are needed for some other use, the default settings can be adjusted by the user to suit the application.

There are 4 fault types that can be used, "**Minimum and maximum error**", "**Absolute value error**", "**State error**" and "**Double minimum and maximum error**".

Minimum and maximum error has two thresholds, "MIN Shutdown" and "MAX Shutdown" that have configurable, independent diagnostics parameters (SPN, FMI, Generate DTCs, delay before flagging status). In case the parameter to monitor stays between these two thresholds, the diagnostic is not flagged.

Absolute value error has one configurable threshold with configurable parameters. In case the parameter to monitor stays below this threshold, the diagnostic is not flagged.

State error is similar to the Absolute value error, the only difference is that State error does not allow the user to specify specific threshold values; thresholds ‘1’ and ‘0’ are used instead. This is ideal for monitoring state information, such as received message timeouts.

Double minimum and maximum error lets user to specify four thresholds, each with independent diagnostic parameters. The diagnostic status and threshold values is determined and expected as show in Figure 2 below.

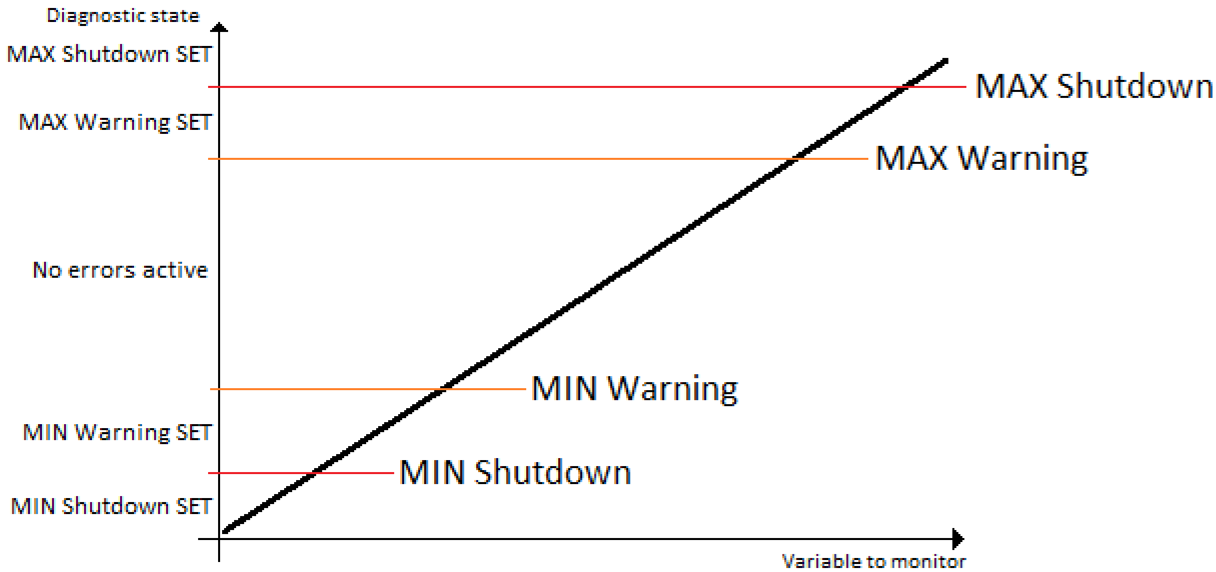


Figure 2 – Double Minimum and Maximum Error Thresholds

In case any of the Diagnostics blocks is configured to monitor Output Current Feedback, there is an internal error status flag maintained automatically for that particular output. This internal flag can be used for driving the particular output to a specified state in case of diagnostic event using Proportional Current Output setpoints “Control Fault Response”, “Output in Fault Mode” and “Fault Detection Enabled”.

There is also built in error status flags for power supply and CPU temperature monitoring. In case any of the diagnostics blocks is measuring these two parameters, the corresponding internal error status flags can be used for shutting down the unit in case of failure. The setpoints “**Power Fault Disables Outputs**” and “**Over Temperature Shutdown**” can be used for enabling the shutdown of the unit (shutdown == output driving is turned off).

While there are no active DTCs, the 6DIN-2CAN Controller will send “No Active Faults” message. If a previously inactive DTC becomes active, a DM1 will be sent immediately to reflect this. As soon as the last active DTC goes inactive, a DM1 indicating that there are no more active DTCs will be sent.

If there is more than one active DTC at any given time, the regular DM1 message will be sent using a multipacket message to the Requester Address using the Transport Protocol (TP).

At power up, the DM1 message will not be broadcasted until after 5 second delay. This is done to prevent any power up or initialization conditions from being flagged as an active error on the network.

When the fault is linked to a DTC, a non-volatile log of the occurrence count (OC) is kept. As soon as the controller detects a new (previously inactive) fault, it will start decrementing the "**Delay before Event is flagged**" timer for that Diagnostic function block. If the fault has remained present during the delay time, then the controller will set the DTC to active, and will increment the OC in the log. A DM1 will immediately be generated that includes the new DTC. The timer is provided so that intermittent faults do not overwhelm the network as the fault comes and goes, since a DM1 message would be sent every time the fault shows up or goes away.

By default, the fault flag is cleared when error condition that has caused it goes away. The DTC is made Previously Active and is it is no longer included in the DM1 message. To identify a fault having happened, even if the condition that has caused is one away, the "**Event Cleared only by DM11**" setpoint can be set to '*True*'. This configuration enables DTC to stay Active, even after the fault flag has been cleared, and be included in DM1 message until a Diagnostic Data Clear/Reset for Active DTCs (DM11) has been requested.

As defined by J1939 Standard the first byte of the DM1 message reflects the Lamp status. "**Lamp Set by Event**" setpoint determines the lamp type set in this byte of DTC. "**Lamp Set by Event"** setpoint options are listed in Table 8. By default, the '*Amber, Warning'* lamp is typically the one set be any active fault.

Table 8 – Lamp Set by Event in DM1 Options

0	Protect
1	Amber Warning
2	Red Stop
3	Malfunction

"**SPN for Event**" defines suspect parameter number used as part of DTC. The default value zero is not allowed by the standard, thus no DM will be sent unless "**SPN for Event**" in is configured to be different from zero. **It is user's responsibility to select SPN that will not violate J1939 standard.** When the "**SPN for Event**" is changed, the OC of the associated error log is automatically reset to zero.

Table 9 – FMI for Event Options

0	*Data Valid But Above Normal Operational Range - Most Severe Level*
1	*Data Valid But Below Normal Operational Range - Most Severe Level*
2	*Data Intermittent*
3	*Voltage Above Normal, Or Shorted To High Source*
4	*Voltage Below Normal, Or Shorted To Low Source*
5	*Current Below Normal Or Open Circuit*
6	*Current Above Normal Or Grounded Circuit*
7	*Mechanical Error*
8	*Abnormal Frequency Or Pulse Width Or Period*
9	*Abnormal Update Rate*
10	*Abnormal Rate Of Change*
11	*Root Cause Not Known*
12	*Bad Component*
13	*Out Of Calibration*
14	*Special Instructions*
15	*Data Valid But Above Normal Operating Range – Least Severe Level*
16	*Data Valid But Above Normal Operating Range – Moderately Severe Level*
17	*Data Valid But Below Normal Operating Range – Least Severe Level*
18	*Data Valid But Below Normal Operating Range – Moderately Severe Level*
19	*Network Error*
20	*Data Drifted High*
21	*Data Drifted Low*
31	*Condition Exists*

Every fault has associated a default FMI with them. The used FMI can be configured with "**FMI for Event**" setpoint, presented in

Table 9. When an FMI is selected from Low Fault FMIs in Table 10 for a fault that can be flagged either high or low occurrence, it is recommended that the user would select the high occurrence FMI from the right column of Table 10. There is no automatic setting of High and Low FMIs in the firmware, the user can configure these freely.

Table 10 – Low Fault FMIs and corresponding High Fault FMIs

Low Fault FMIs	High Fault FMIs
FMI=1, Data Valid But Below Normal Operation Range – Most Severe Level	FMI=0, Data Valid But Above Normal Operational Range – Most Severe Level
FMI=4, Voltage Below Normal, Or Shorted to Low Source	FMI=3, Voltage Above Normal, Or Shorted To High Source
FMI=5, Current Below Normal Or Open Circuit	FMI=6, Current Above Normal Or Grounded Circuit
FMI=17, Data Valid But Below Normal Operating Range – Least Severe Level	FMI=15, Data Valid But Above Normal Operating Range – Least Severe Level
FMI=18, Data Valid But Below Normal Operating Level – Moderately Severe Level	FMI=16, Data Valid But Above Normal Operating Range – Moderately Severe Level
FMI=21, Data Drifted Low	FMI=20, Data Drifted High

1.4. Math Function Block

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

Inputs are converted into percentage value based on the "Input X Minimum" and "Input X Maximum" values selected. For additional control the user can also adjust the "Input X Decimal Digits" setpoint to increase the resolution of the input data and the min and max values.

A mathematical function block includes three selectable functions, in which each implements equation A operator B, where A and B are function inputs and operator is function selected with a setpoint "Math Function X". Setpoint options are presented in

Table 11. The functions are connected together, so that result of the preceding function goes into Input A of the next function. Thus Function 1 has both Input A and Input B selectable with setpoints, where Functions 2 to 4 have only Input B selectable. Input is selected by setting "Function X Input Y Source" and "Function X Input Y Number". If "Function X Input B Source" is set to 0 'Control not used' signal goes through function unchanged.

$$Math\ Block\ Output = \left(\left((A1\ op1\ B1)op2\ B2\right)op3\ B3\ \right)op4\ B4$$

Table 11. Math function X Operator Options

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 either InA or 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

For logic operations (6, 7, and 8) scaled input greater than or equal to 1 is treated as TRUE. For logic operations (0 to 8), the result of the function will always be 0 (FALSE) of 1 (TRUE). For the arithmetic functions (9 to 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 divider will always result in a 100% output value for the associated function.

Lastly the resulting mathematical calculation, presented as a percentage value, can be scaled into the appropriate physical units using the "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.

1.5. 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 3 demonstrates the connections between all parameters.

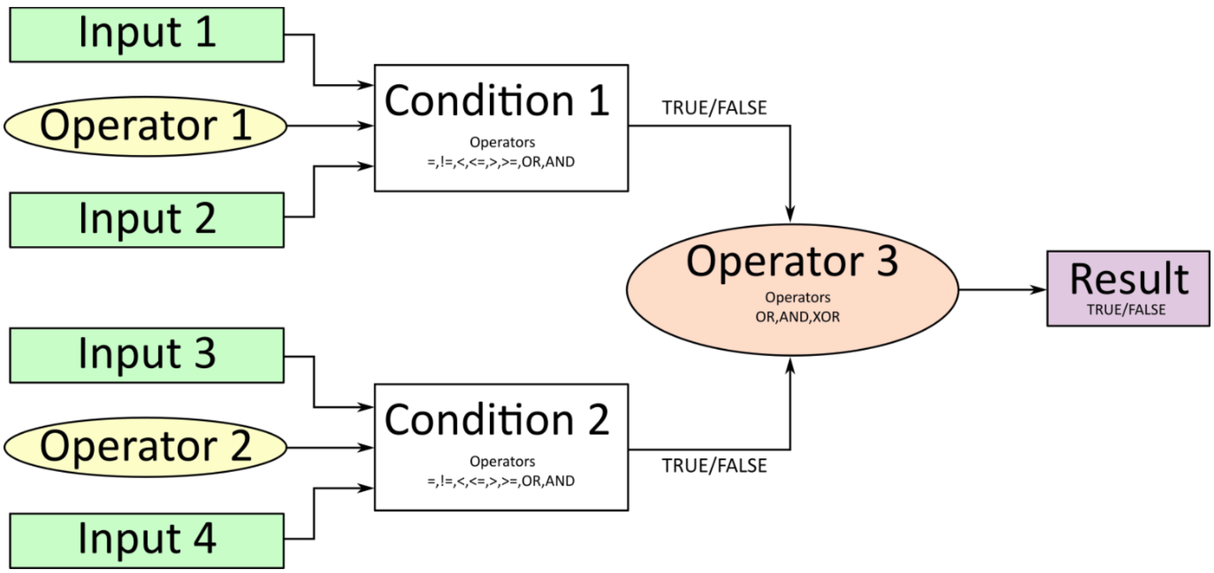


Figure 3: Conditional Block Diagram

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 12. If no source is selected, the output value of an Input will be zero.

Table 12. Input Operator Options

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

The table above cannot be used for comparing the conditions because they can only be compared with logical operators, which are listed in Table 13.

Table 13. Condition Operator Options

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

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.

1.6. 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 14 below.

Table 14. Set-Reset Function block operation.

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

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 14 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’.

1.7. Lookup Table Function Block

Lookup Tables are used to give output response up to 10 slopes per input. 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 described in Section 0.

Lookup tables have two differing modes defined by “X-Axis Type” setpoint, given in Table 15. Option ‘0 – Data Response’ is the normal mode where block input signal is selected with the “X-Axis Source” and “X-Axis Number” setpoints and X values present directly input signal values. With option ‘1 – Time Response’ the input signal is time and X values present time in milliseconds. And selected input signal is used as digital enable.

Table 15. X-Axis Type Options

0	Data Response
1	Time Response

The slopes are defined with (x, y) points and associated point response. X value presents input signal value and Y value corresponding Lookup Table output value. “PointN – Response” setpoint defines the type of slope from preceding point to the point in question. Response options are given in Table 16. ‘Ramp To’ gives a linearized slope between points, whereas ‘Jump to’ gives a point-to-point response, where any input value between XN-1 and XN will result Lookup Table output being YN. “Point0 – Response” is always ‘Jump To’ and cannot be edited. Choosing ‘Ignored’ response causes associated points and all the following points to be ignored.

Table 16. PointN – Response Options

0	Ignore
1	Ramp To
2	Jump To

The X values are limited by the minimum and maximum range of the selected input source if the source is a Math Function Block. For the afore-mentioned sources X-Axis data will be redefined when ranges are changed, therefore inputs should be adjusted before changing X-Axis values. For other sources X_{min} and X_{max} are -100000 and 1000000. The X-Axis is constraint to be in rising order, thus the value of the next index is greater than or equal to the preceding one. Therefore, when adjusting the X-Axis data, it is recommended that X10 is changed first, then lower indexes in descending order.

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

The Y-Axis has no constraints on the data it presents, thus inverse, decreasing, increasing or other response can be easily established. The Smallest of the Y-Axis values is used as Lookup Table output min and the largest of the Y-Axis values is used as Lookup Table output max (i.e. used as Xmin and Xmax values in linear calculation.). Ignored points are not considered for min and max values.

1.8. Programmable Logic Function Block

The Programmable Logic Function Block is a powerful tool. Programmable Logic can be linked to up to three Lookup Tables, any of which would be selected only under given conditions. Thus, the output of a Programmable Logic at any given time will be the output of the Lookup Table selected by the defined logic. 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.

In order to enable any one of the Programmable Logic blocks, the “Logic Enabled” setpoint must be set to ‘True’. By default, all Logic blocks are disabled.

The three associated tables are selected by setting “Table Number X” setpoint to desired Lookup Table number, for example selecting 1 would set Lookup Table 1 as TableX.

For each TableX there are three conditions that define the logic to select the associated Lookup Table as Logic output. Each condition implements function $Argument1\ Operator\ Argument2$ where Operator is logical operator defined by setpoint “Table X – Condition Y Operator”. Setpoint options are listed in Table 17. Condition arguments are selected with “Table X – Condition Y Argument Z Source” and “Table X – Condition Y Argument Z Number” setpoints. If ‘0 – Control not Used’ option is selected as “Table x – Condition Y Argument Z Source” the argument is interpreted as 0.

Table 17. Table X – Condition Y Operator Options

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

The three conditions are evaluated and if the result satisfies logical operation defined with "Logical Operator X" setpoint, given in Table 18, the associated Lookup Table is selected as output of the Logical block. Option '0 – Default Table' selects associated Lookup Table in all conditions.

Table 18. Table X – Conditions Logical Operator Options

0	Default Table (Table1)
1	Cnd1 And Cnd2 And Cnd3
2	Cnd1 Or Cnd2 Or Cnd3
3	(Cnd1 And Cnd2) Or Cnd3
4	(Cnd1 Or Cnd2) And Cnd3

The three logical operations are evaluated in order and the first to satisfy gets selected, thus if Table1 logical operation is satisfied, the Lookup Table associated with Table1 gets selected regardless of two other logical operations.

1.9. Constant Data

The Constant Data Block contains 2 fixed (False/True) and 13 configurable constant data setpoints which can be used as a control source for other functions. While they are available as a control source to all functions, it is recommended not to use constant data as a control source for the Set-Reset Latch Block.

1.10. DTC React

DTC React is a function block that allows the ECU to receive and process the DM1 messages. There are 16 separated function blocks that can capture up to 16 different DM1 messages. Each DTC React has two mandatory and 2 optional parameters. The mandatory parameters are the SPN and FMI. If only these parameters are used, the output will be set to high if the DM1 message with the combination of selected SPN and FMI. The state will remain high for five seconds and will be set if the DM1 message is received again.

Among optional parameters there are lamp setting and the source address. To enable them, the "**Lamp Used to Trigger Reaction**" and "**Source Address Used to Trigger Reaction**" should be set to 1, *True*. In this case, beside SPN and FMI the ECU will compare the Lamp Setting and/or Source Address of the received message.

The exceptions are the following SPN:

- SPN1213 and Lamp Status 0x40.
- SPN623 and Lamp Status 0x10.
- SPN624 and Lamp Status 0x04.
- SPN987 and Lamp Status 0x01.

In case the SPNs above are chosen, the DTC React function block will set the output to HIGH if SPN and Lamp Status match even if FMI doesn't match. However, if the "**Source Address Used to Trigger Reaction**" is set to 1, *True* and selected address doesn't match, the DTC React output will be set to FALSE.

1.11. CAN Transmit Message Function Block

The CAN Transmit function block is used to send any output from another function block (i.e., input, CAN receive) to the J1939 network. The AX032160 ECU has eleven CAN Transmit Messages, and each message has four completely user defined signals.

1.11.1. CAN Transmit Message Setpoints

Each CAN Transmit Message setpoint group includes setpoints that affect the whole message and are thus mutual for all signals of the message. These setpoints are presented in this section. The setpoints that configure an individual signal are presented in the next section.

"**CAN Interface**" setpoint is used to define which of the two CAN Interfaces is used to transmit the message in question.

The "**Transmit PGN**" setpoint sets PGN used with the message. **Users should be familiar with the SAE J1939 standard and select values for PGN/SPN combinations as appropriate from section J1939/71**.

"**Repetition Rate**" setpoint defines the interval used to send the message to the J1939 network. If the "**Repetition Rate**" is set to zero, the message is disabled unless it shares its PGN with another message. In the case of a shared PGN repetition rate of the LOWEST numbered message are used to send the message 'bundle'.

The **"On-Change Repetition Rate"** setpoint determines whether or not the timer will reset when the Data Source receives a valid change in data.

When utilizing **'On-Change with Repetition Rate Reset'**, the timer rests upon reception of a valid change in data by the Data Source. Upon receiving a valid change in data, CAN Tx will immediately transmit the updated data (as depicted in Message 2 in the diagram below) and resets the timer. Message 3 in the diagram below will then be transmitted according to the "Repetition Rate" in reference to Message 2.

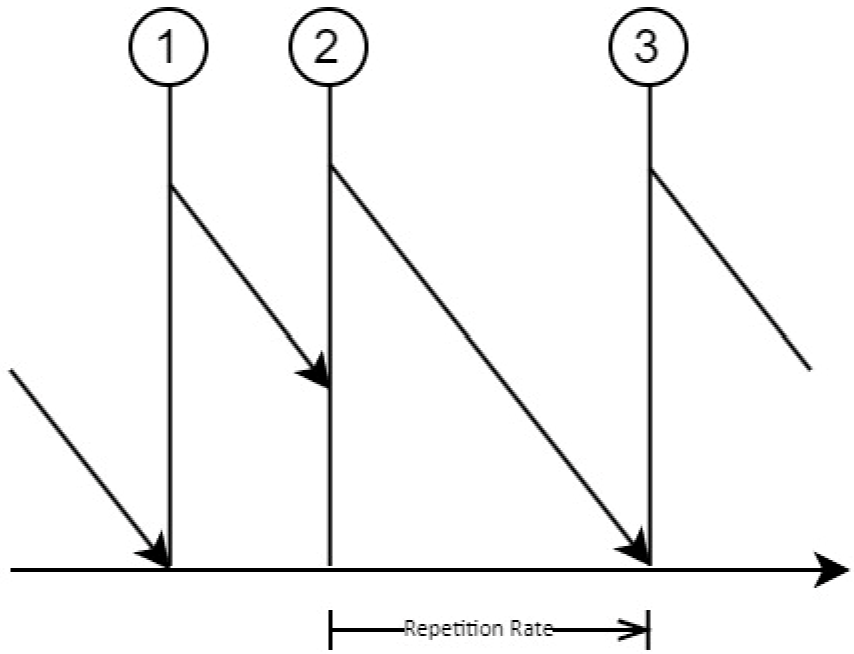


Figure 4 - On-Change with Repetition Rate Reset

Similarly, when utilizing **'On-Change without Repetition Rate Reset**', CAN Tx will immediately transmit the updated data (as depicted in Message 2 in the diagram below) and will not reset the timer. Message 3 in the diagram below will then be transmitted according to the "Repetition Rate" in reference to Message 1.

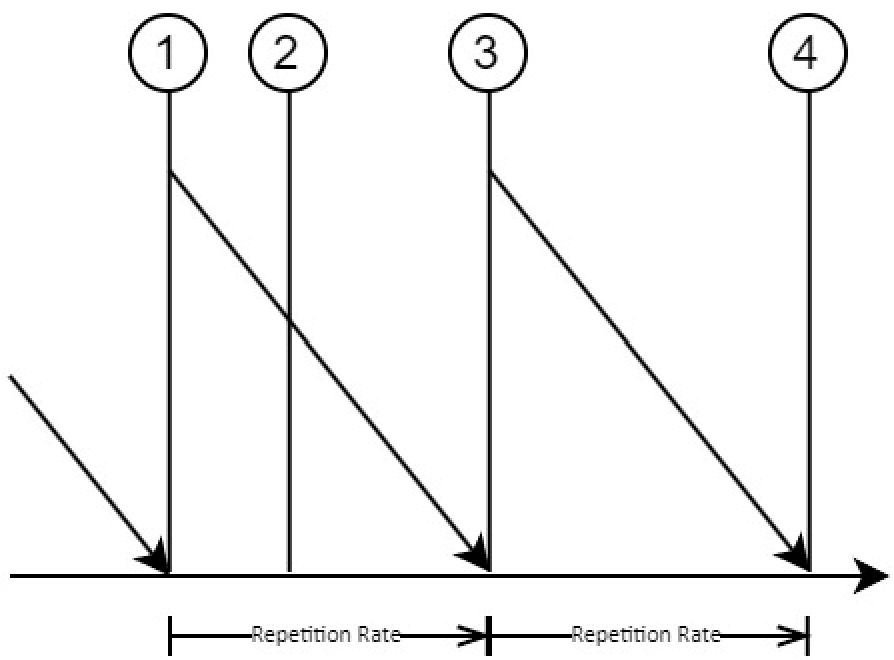


Figure 5 - On-Change without Repetition Rate Reset

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.

By default, all messages are sent on Proprietary B PGNs as broadcast messages. Thus "**Transmit Message Priority**" is always initialized to 6 (low priority) and the "**Destination Address**" setpoint is not used. This setpoint is only valid when a PDU1 PGN has been selected, and it can be set either to the Global Address (0xFF) for broadcasts or sent to a specific address as setup by the user.

1.11.2. CAN Transmit Signal Setpoints

Each CAN transmit message has four associated signals, which define data inside the Transmit message. "**Control Source**" setpoint together with "**Control Number**" setpoint define the signal source of the message. "**Control Source**" and "**Control Number**" options are listed in **Error! Reference source not found.**. Setting "**Control Source**" to '*Control Not Used'* disables the signal.

"**Transmit Data Size**" setpoint determines how many bits signal reserves from the message. "**Transmit Data Index in Array**" determines in which of 8 bytes of the CAN message LSB of the signal is located. Similarly, "**Transmit Bit Index in Byte**" 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**.

"**Transmit Data Resolution**" setpoint determines the scaling done on the signal data before it is sent to the bus. "**Transmit 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.

1.12. 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 another function block (i.e., Outputs).

"**CAN Interface**" setpoint is used to define from which of the two CAN Interfaces the message in question is received.

The "**Receive 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, ALL receive messages are disabled.

Once a message has been enabled, a Lost Communication fault will be flagged if that message is not received off the bud within the "**Receive Message Timeout**" period. This could trigger a Lost Communication event as described in section 0. In order to avoid timeouts on a heavily saturated network, it is recommended to set the period at least three times longer 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 6DIN-2CAN Controller on Proprietary B PGNs. However, should a PDU1 message be selected, the 6DIN-2CAN Controller 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 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 used to map any SPN supported by the J1939 standard to the output data of the Received function block.

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

The 6DIN-2CAN Controller supports up to fifteen unique CAN Receive Messages. Defaults setpoint values are listed in section 0.

2. INSTALLATION INSTRUCTIONS

2.1. Dimensions and Pinout

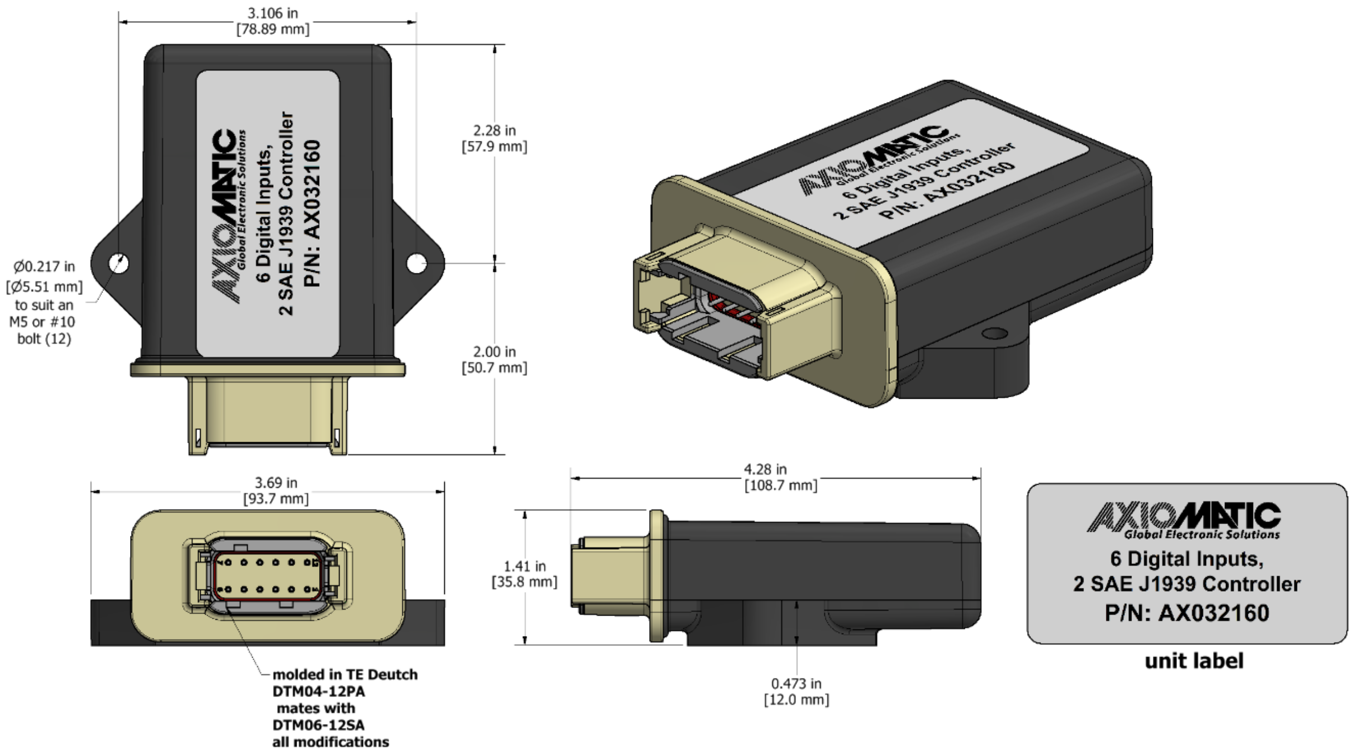


Figure 6 – AX032160 Dimensional Drawing

PIN #	FUNCTION
1	Power+
2	Digital Input 2
3	Digital Input 4
4	Digital Input 6
5	CAN1_H
6	CAN2_H
7	CAN2_L
8	CAN1_L
9	Digital Input 5
10	Digital Input 3
11	Digital Input 1
12	Power-

Table 19 – AX032160 Connector Pinout

3. OVERVIEW OF J1939 FEATURES

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

- Configurable ECU Instance in the NAME (to allow multiple ECUs on the same network)
- Configurable Input Parameters
- Configurable PGN and Data Parameters
- Configurable Diagnostic Messaging Parameters, as required.
- Diagnostic Log, maintained in non-volatile memory.

3.1. Introduction to Supported Messages

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

From J1939-21 – Data Link Layer

• Request		59904	0x00EA00
• Acknowledgement		59392	0x00E800
• Transport Protocol – Connection Management		60416	0x00EC00
• Transport Protocol – Data Transfer Message		60160	0x00EB00
• Proprietary B	from	65280	0x00FF00
	to	65535	0x00FFFF

From J1939-73 – Diagnostics

• DM1 – Active Diagnostic Trouble Codes	65226	0x00FECA
• DM2 – Previously Active Diagnostic Trouble Codes	65227	0x00FECB
• DM3 – Diagnostic Data Clear/Reset for Previously Active DTCs	65228	0x00FECC
• DM11 – Diagnostic Data Clear/Reset for Active DTCs	65235	0x00FED3

From J1939-81 – Network Management

• Address Claimed/Cannot Claim	60928	0x00EE00
• Commanded Address	65240	0x00FED8

From J1939-71 – Vehicle Application Layer

• Software Identification	65242	0x00FEDA
• Software Identification	65242	0x00FEDA
• Component Identification	65259	0x00FEEB

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

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

3.2. NAME, Address and Software ID

The 6DIN-2CAN Controller ECU has the following default 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	127, I/O Controller
Function Instance	7, Axiomatic AX032160
ECU Instance	0, First Instance
Manufacture Code	162, Axiomatic Technologies
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 from one another when they are connected on the same network.

The default value of the “ECU Address” setpoint is 128 (0x80), which is the preferred starting address for self-configurable ECUs as set by the SAE in J1939 tables B3 and B7. The Axiomatic EA supports the selection of any address between 0 and 253. ***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 6DIN-2CAN Controller will continue select the next highest address until it finds one that it can claim. See J1939/81 for more details about address claiming.

ECU Identification Information

PGN 64965 ECU Identification Information -ECUID

Transmission Repetition Rate: On request

Data Length: Variable
Extended Data Page: 0
Data Page: 0
PDU Format: 253
PDU Specific: 197 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 64965 (0x00FDC5)

Start Position	Length	Parameter Name	SPN
a	Variable	ECU Part Number, Delimiter (ASCII “*”)	2901
b	Variable	ECU Serial Number, Delimiter (ASCII “*”)	2902
c	Variable	ECU Location, Delimiter (ASCII “*”)	2903
d	Variable	ECU Type, Delimiter (ASCII “*”)	2904
e	Variable	ECU Manufacturer Name, Delimiter (ASCII “*”)	4304

(a)*(b)*(c)*(d)*(e)*

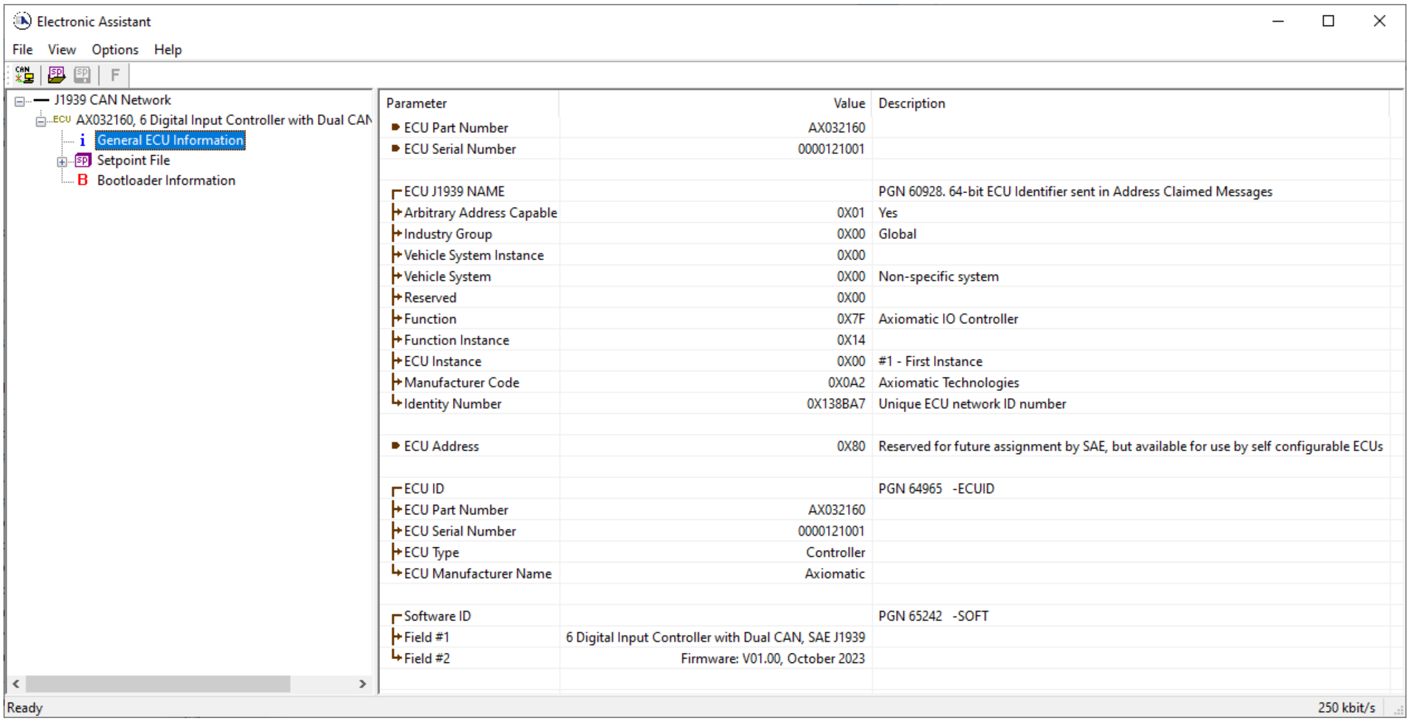


Figure 7 – General ECU Information

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 the 6DIN-2CAN Controller ECU, Byte 1 is set to 5, and the identification fields are as follows.

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

The Axiomatic 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.

Component Identification

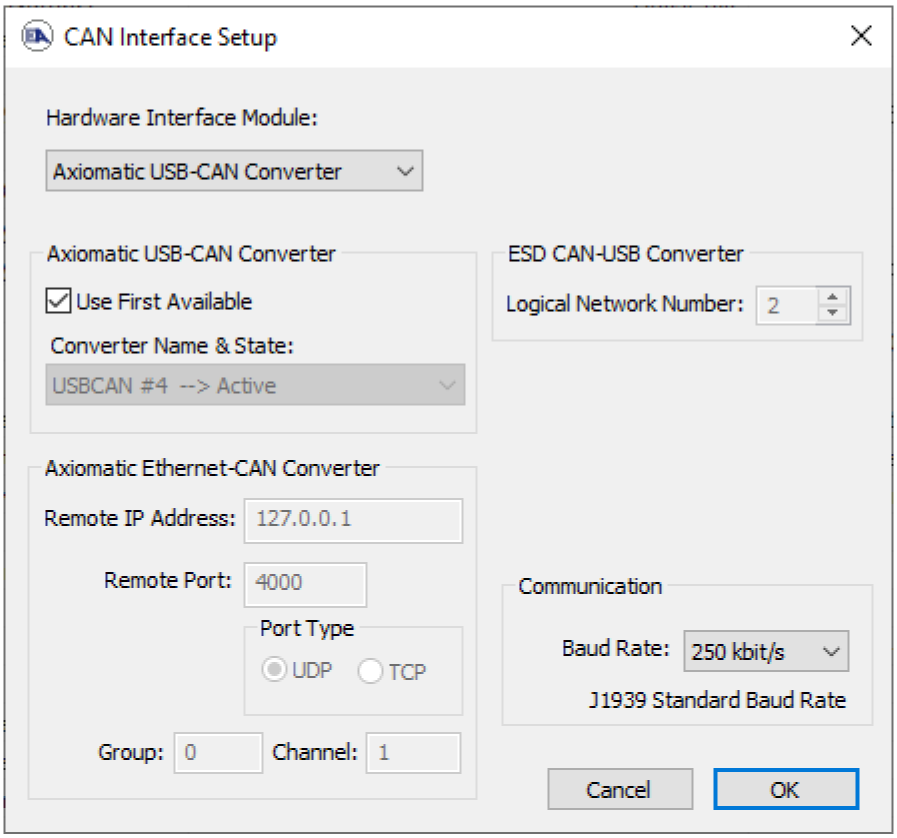
PGN 65259		Component Identification		-CI
Transmission Repetition Rate:		On request		
Data Length:		Variable		
Extended Data Page:		0		
Data Page:		0		
PDU Format:		254		
PDU Specific:		235 PGN Supporting Information:		
Default Priority:		6		
Parameter Group Number:		65259 (0x00FEEB)		
Start Position	Length	Parameter Name	SPN	
a	1-5 Byte	Make, Delimiter (ASCII "*")	586	
b	Variable	Model, Delimiter (ASCII "*")	587	
c	Variable	Serial Number, Delimiter (ASCII "*")	588	
d	Variable	Unit Number (Power Unit), Delimiter (ASCII "*")	233	
(a)*(b)*(c)*(d)*(e)*				

4. ECU SETPOINTS ACCESSED WITH THE AXIOMATIC ELECTRONIC ASSISTANT

This section describes in detail each setpoint, and their default and ranges. The setpoints are divided into setpoint groups as they are shown in the Axiomatic EA. For more information on how each setpoint is used by 10 Analog Input, refer to the relevant section in this user manual.

4.1. Accessing the ECU Using the Axiomatic Electronic Assistant

ECU with P/N AX032160 does not need any specific setup for the Axiomatic EA. In order to access the high-speed versions, the CAN bus Baud Rate needs to be set accordingly. The CAN Interface Setup can be found from “Options” menu in EA. Please refer to UMAX07050x **Connecting to the J1939 Bus** section for Axiomatic Electronic Assistant CAN Interface Setup instructions.



4.2. J1939 Network Parameters

“ECU Instance Number” and “ECU Address” setpoints and their effect are defined in section 3.2.

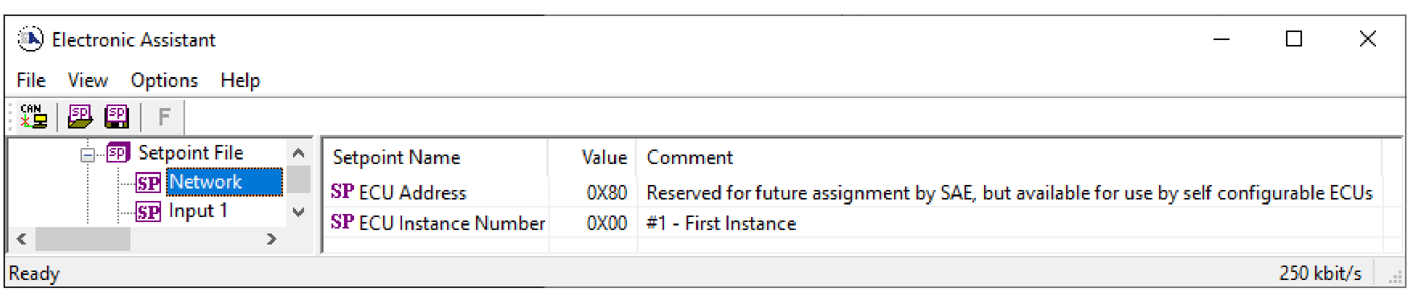


Figure 8 – Screen Capture of J1939 Setpoints

Table 20 – J1939 Network Setpoints

Name	Range	Default	Notes
ECU Address	0x80	0-253	Preferred address for a self-configurable ECU
ECU Instance	0-7	0x00	Per J1939-81

If non-default values for the **"ECU Instance Number"** or **"ECU Address"** are used, they will be 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 the Axiomatic EA after the file is loaded, such that only the new NAME and address appear in the J1939 CAN Network ECU list.

4.3. Input Setpoints

The Inputs are defined in section 0.

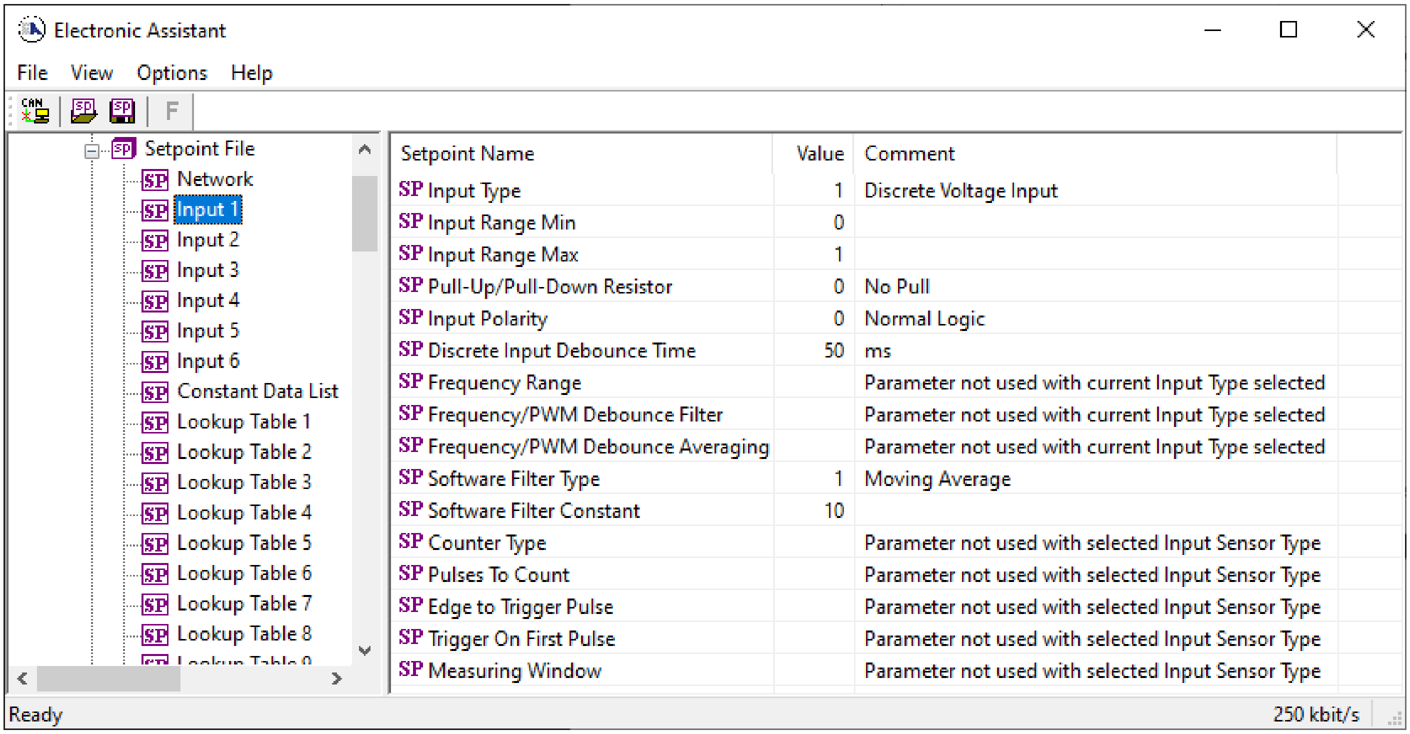


Figure 9 – Screen Capture of Universal Input Setpoints

Table 21 – Universal Input Setpoints

Name	**Range**	**Default**	**Notes**
Input Type	Drop List	Input Disabled	See *1.1.1*
Input Range Min	From Minimum Error to Maximum Range	Depends on Input Sensor Type	
Input Range Max	From Minimum Range to Maximum Error	Depends on Input Sensor Type	
Pullup/Pulldown Resistor	Drop List	0, No Pull	See 1.1.2
Input Polarity	Drop List	0, Normal Logic	See 1.1.3
Discrete Input Debounce Time	0..60000	50 ms	
Frequency Range	Read only	1Hz to 10kHz	
Frequency/PWM Debounce Filter	Drop List	0, No Filter	
Frequency/PWM Debounce Averaging	Drop List	0, No Averaging	
Software Filter Type	Drop List	0, No Filter	See 1.1.6
Software Filter Constant	0..60000	10	See 1.1.6
Counter Type	Drop List	0, Pulses Within Measuring Window	See 1.1.4
Pulses to Count	0..10000	1000 pulses	See 1.1.4
Edge to Trigger Pulse	Drop List	0, Falling Edge	See 1.1.4
Trigger On First Pulse	Drop List	TRUE	See 1.1.4
Measuring Window	10..10000	1000 ms	See 1.1.4

4.4. Constant Data List

The Constant Data List Function Block is provided to allow the user to select values as desired for various logic block functions.

The first two constants are fixed values of 0 (False) and 1 (True) for use in binary logic. The remaining 13 constants are fully user programmable to any value between +/. 1 000 000. The default values (shown in Figure 10) are arbitrary and should be configured by the user as appropriate for their application.

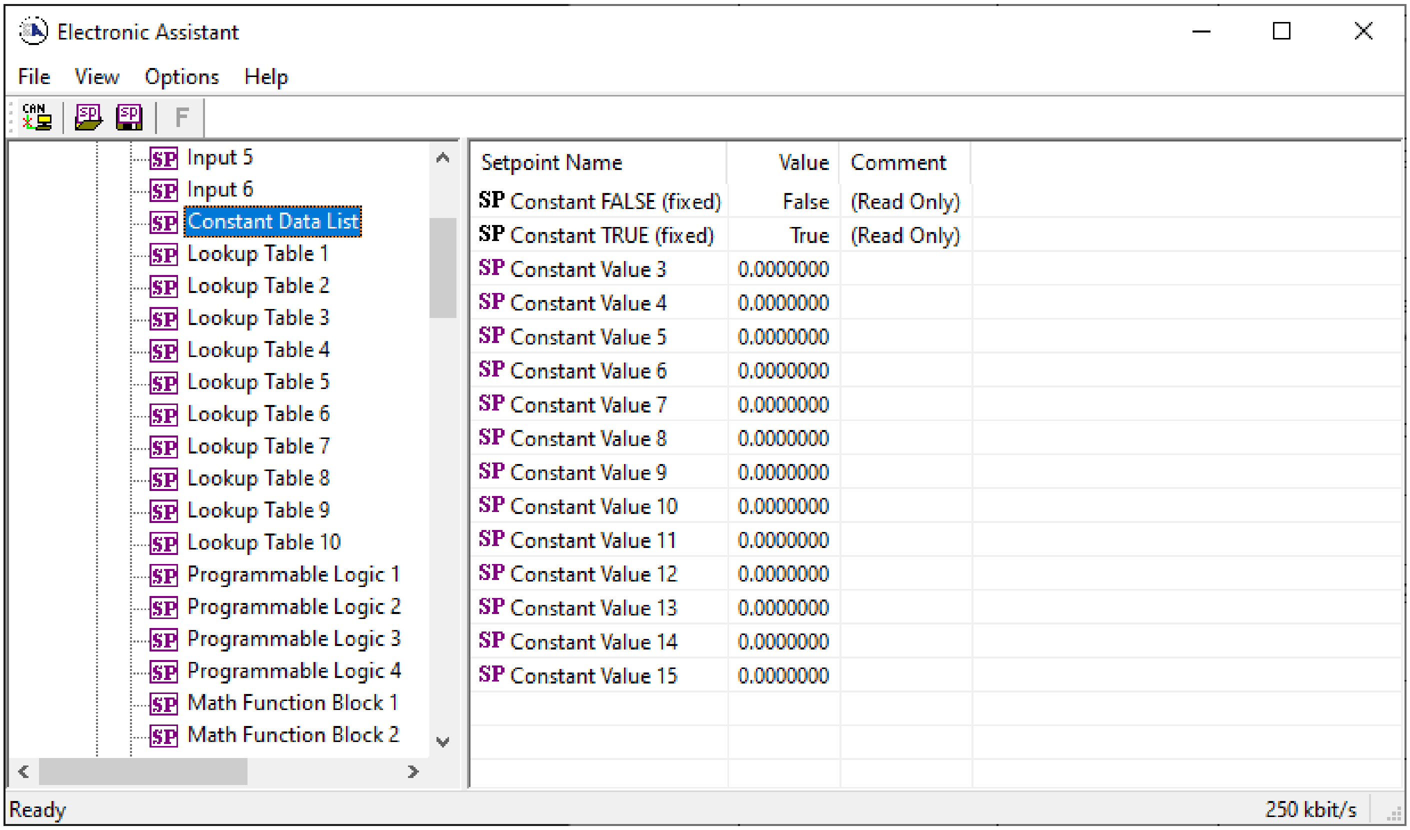
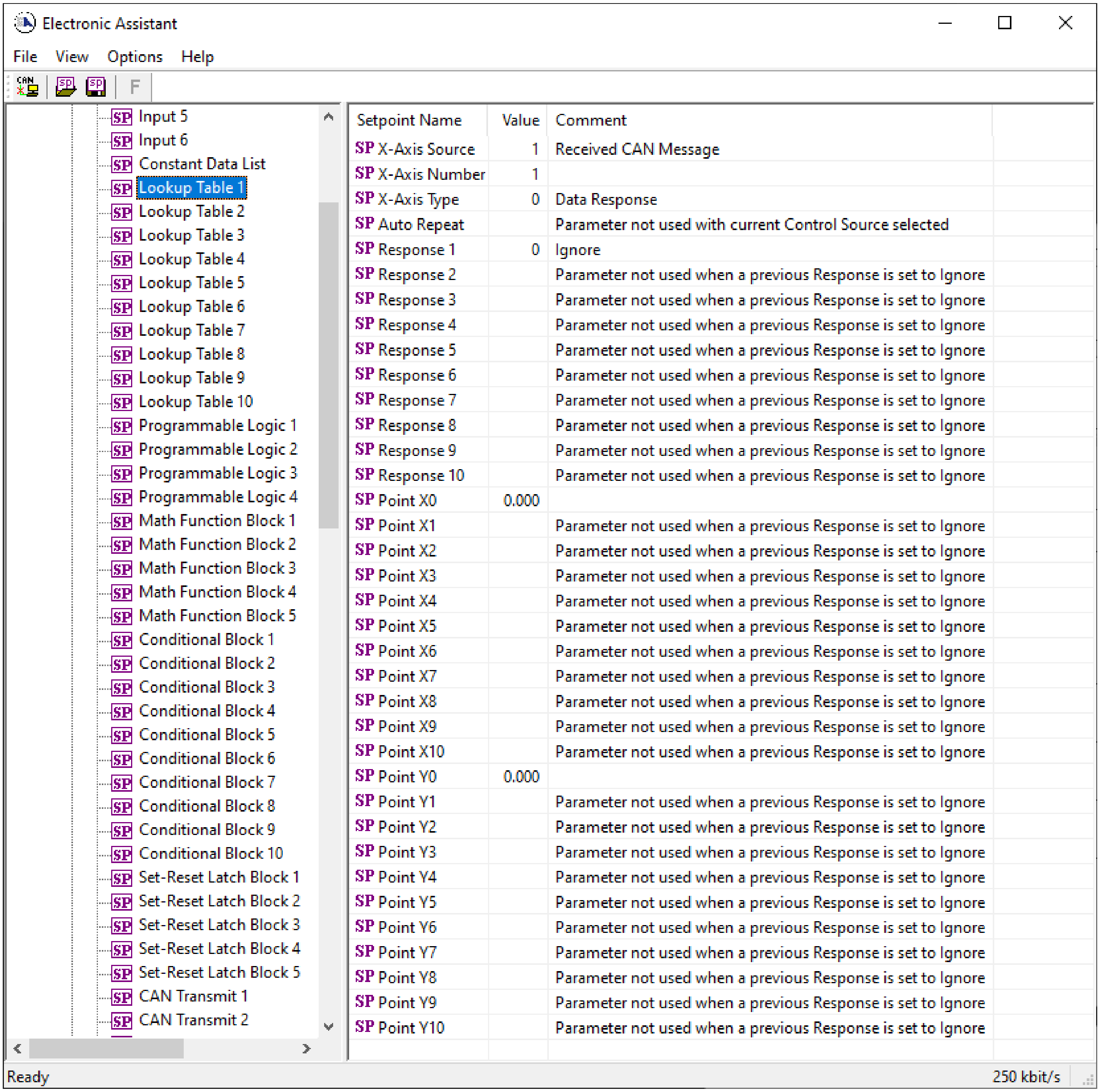


Figure 10 – Screen Capture of Constant Data List Setpoints

4.5. Lookup Table

The Lookup Table Function Block is defined in Section 0 Please refer there for detailed information about how all these setpoints are used. "**X-Axis Source**" is set to '*Control Not Used*' by default. To enable a Lookup Table select appropriate "**X-Axis Source**".



Setpoint Name	Value	Comment
SP X-Axis Source	1	Received CAN Message
SP X-Axis Number	1	
SP X-Axis Type	0	Data Response
SP Auto Repeat		Parameter not used with current Control Source selected
SP Response 1	0	Ignore
SP Response 2		Parameter not used when a previous Response is set to Ignore
SP Response 3		Parameter not used when a previous Response is set to Ignore
SP Response 4		Parameter not used when a previous Response is set to Ignore
SP Response 5		Parameter not used when a previous Response is set to Ignore
SP Response 6		Parameter not used when a previous Response is set to Ignore
SP Response 7		Parameter not used when a previous Response is set to Ignore
SP Response 8		Parameter not used when a previous Response is set to Ignore
SP Response 9		Parameter not used when a previous Response is set to Ignore
SP Response 10		Parameter not used when a previous Response is set to Ignore
SP Point X0	0.000	
SP Point X1		Parameter not used when a previous Response is set to Ignore
SP Point X2		Parameter not used when a previous Response is set to Ignore
SP Point X3		Parameter not used when a previous Response is set to Ignore
SP Point X4		Parameter not used when a previous Response is set to Ignore
SP Point X5		Parameter not used when a previous Response is set to Ignore
SP Point X6		Parameter not used when a previous Response is set to Ignore
SP Point X7		Parameter not used when a previous Response is set to Ignore
SP Point X8		Parameter not used when a previous Response is set to Ignore
SP Point X9		Parameter not used when a previous Response is set to Ignore
SP Point X10		Parameter not used when a previous Response is set to Ignore
SP Point Y0	0.000	
SP Point Y1		Parameter not used when a previous Response is set to Ignore
SP Point Y2		Parameter not used when a previous Response is set to Ignore
SP Point Y3		Parameter not used when a previous Response is set to Ignore
SP Point Y4		Parameter not used when a previous Response is set to Ignore
SP Point Y5		Parameter not used when a previous Response is set to Ignore
SP Point Y6		Parameter not used when a previous Response is set to Ignore
SP Point Y7		Parameter not used when a previous Response is set to Ignore
SP Point Y8		Parameter not used when a previous Response is set to Ignore
SP Point Y9		Parameter not used when a previous Response is set to Ignore
SP Point Y10		Parameter not used when a previous Response is set to Ignore

Figure 11 – Screen Capture of Lookup table Setpoints

Table 22 – Lookup Table Setpoints

Name	**Range**	**Default**	**Notes**
X-Axis Source	Drop List	Control Not Used	See Table 7
X-Axis Number	Depends on control source	1	See Table 7
X-Axis Type	Drop List	Data Response	See Table 15
Table Auto-Cycle	Drop List	0	
Point 1 - Response	Drop List	Ramp To	See Table 16
Point 2 - Response	Drop List	Ramp To	See Table 16
Point 3 - Response	Drop List	Ramp To	See Table 16
Point 4 - Response	Drop List	Ramp To	See Table 16
Point 5 - Response	Drop List	Ramp To	See Table 16
Point 6 - Response	Drop List	Ramp To	See Table 16
Point 7 - Response	Drop List	Ramp To	See Table 16
Point 8 - Response	Drop List	Ramp To	See Table 16
Point 9 - Response	Drop List	Ramp To	See Table 16
Point 10 - Response	Drop List	Ramp To	See Table 16
Point 1 - X Value	From X-Axis source minimum to Point 1 - X Value	X-Axis source minimum 0.000	See Section 1.7
Point 2 - X Value	From Point 0 - X Value to Point 2 - X Value	0.500	See Section 1.7
Point 3 - X Value	From Point 1 - X Value to Point 3 - X Value	1.000	See Section 1.7
Point 4 - X Value	From Point 2 - X Value to Point 4 - X Value	1.500	See Section 1.7
Point 5 - X Value	From Point 3 - X Value to Point 5 - X Value source	2.000	See Section 1.7
Point 6 - X Value	From Point 4 - X Value to Point 6 - X Value	2.500	See Section 1.7
Point 7 - X Value	From Point 5 - X Value to Point 7 - X Value	3.000	See Section 1.7
Point 8 - X Value	From Point 6 - X Value to Point 8 - X Value	3.500	See Section 1.7
Point 9 - X Value	From Point 7 - X Value to Point 9 - X Value	4.000	See Section 1.7
Point 10 - X Value	From Point 8 - X Value to Point 10 - X Value	4.500	See Section 1.7
Point 1 - Y Value	-10^6 to 10^6	0.000	
Point 2 - Y Value	-10^6 to 10^6	10.000	
Point 3 - Y Value	-10^6 to 10^6	20.000	
Point 4 - Y Value	-10^6 to 10^6	30.000	
Point 5 - Y Value	-10^6 to 10^6	40.000	
Point 6 - Y Value	-10^6 to 10^6	50.000	
Point 7 - Y Value	-10^6 to 10^6	60.000	
Point 8 - Y Value	-10^6 to 10^6	70.000	
Point 9 - Y Value	-10^6 to 10^6	80.000	
Point 10 - Y Value	-10^6 to 10^6	90.000	

4.6. Programmable Logic

The Programmable Logic function block is defined in Section 0. Please refer there for detailed information about how all these setpoints are used. "**Programmable Logic Enabled**" is '*False*' by default. To enable Logic set "**Programmable Logic Enabled**" to '*True*' and select appropriate "**Argument Source**".

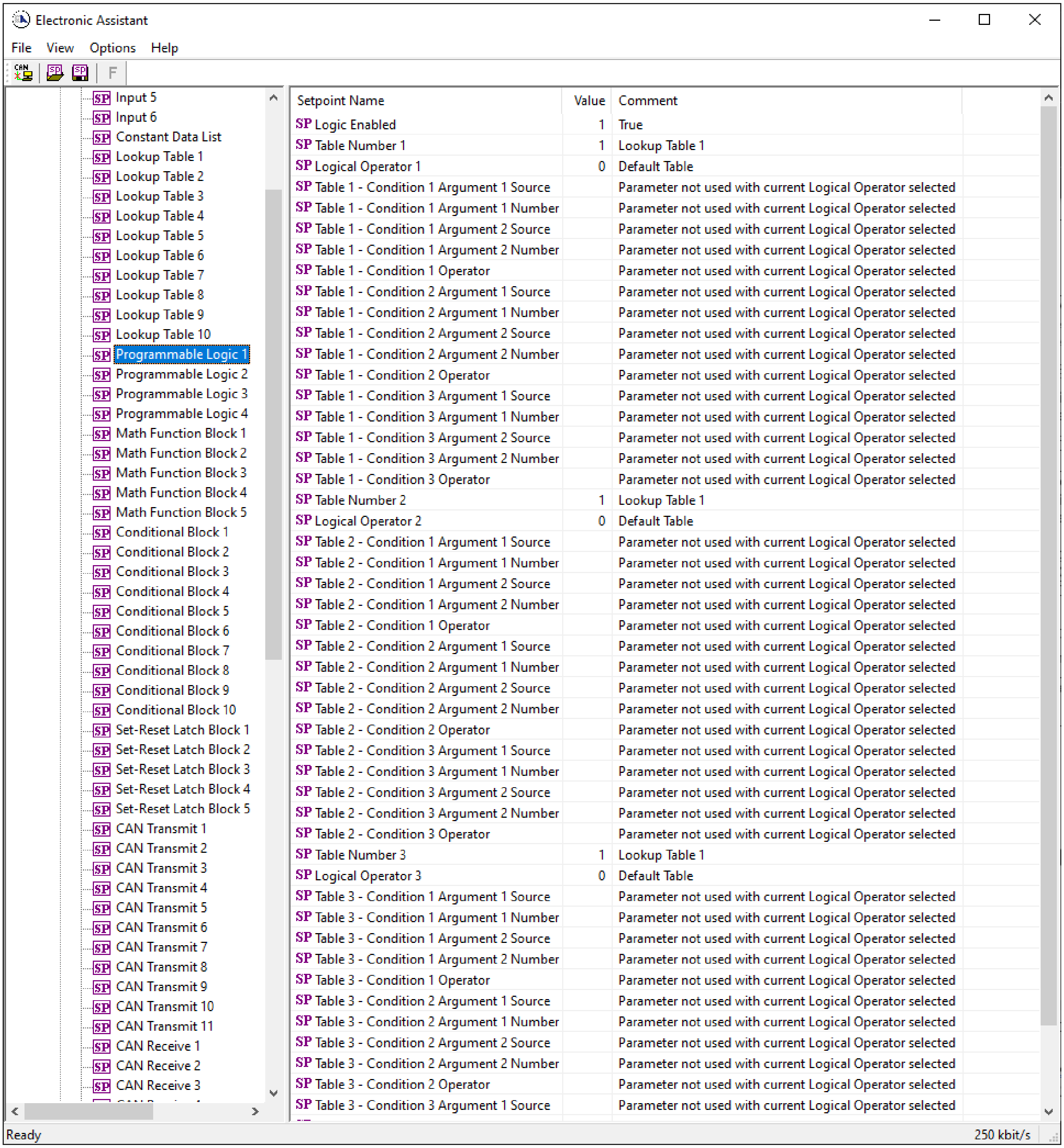


Figure 12 – Screen Capture of Programmable Logic Setpoints

Setpoint ranges and default values for Programmable Logic Blocs are listed in Table 23. Only “**Table1**” setpoint are listed, because other “**TableX**” setpoints are similar, except for the default value of the “**Lookup Table Block Number**” setpoint, which is X for “**TableX**”.

Table 23 – Programmable Logic Setpoints

Name	**Range**	**Default**	**Notes**
Programmable Logic Enabled	Drop List	False	
Table1 - Lookup Table Block Number	1 to 8	Look up Table 1	
Table1 - Conditions Logical Operation	Drop List	Default Table	See Table 18
Table1 - Condition1, Argument 1 Source	Drop List	Control Not Used	See Table 7
Table1 - Condition1, Argument 1 Number	Depends on control source	1	See Table 7
Table1 - Condition1, Operator	Drop List	=, Equal	See Table 17
Table1 - Condition1, Argument 2 Source	Drop List	Control Not Used	See Table 7
Table1 - Condition1, Argument 2 Number	Depends on control source	1	See Table 7
Table1 - Condition2, Argument 1 Source	Drop List	Control Not Used	See Table 7
Table1 - Condition2, Argument 1 Number	Depends on control source	1	See Table 7
Table1 - Condition2, Operator	Drop List	=, Equal	See Table 17
Table1 - Condition2, Argument 2 Source	Drop List	Control Not Used	See Table 7
Table1 - Condition2, Argument 2 Number	Depends on control source	1	See Table 7
Table1 - Condition3, Argument 1 Source	Drop List	Control Not Used	See Table 7
Table1 - Condition3, Argument 1 Number	Depends on control source	1	See Table 7
Table1 - Condition3, Operator	Drop List	=, Equal	See Table 17
Table1 - Condition3, Argument 2 Source	Drop List	Control Not Used	See Table 7
Table1 - Condition3, Argument 2 Number	Depends on control source	1	See Table 7

4.7. Math Function Block

The Math Function Block is defined in Section 0. Please refer there for detailed information about how all these setpoints are used. “**Math Function Enabled**” is ‘False’ by default. To enable a Math function Block, set “**Math Function Enabled**” to ‘True’ and select appropriate “**Input Source**”.

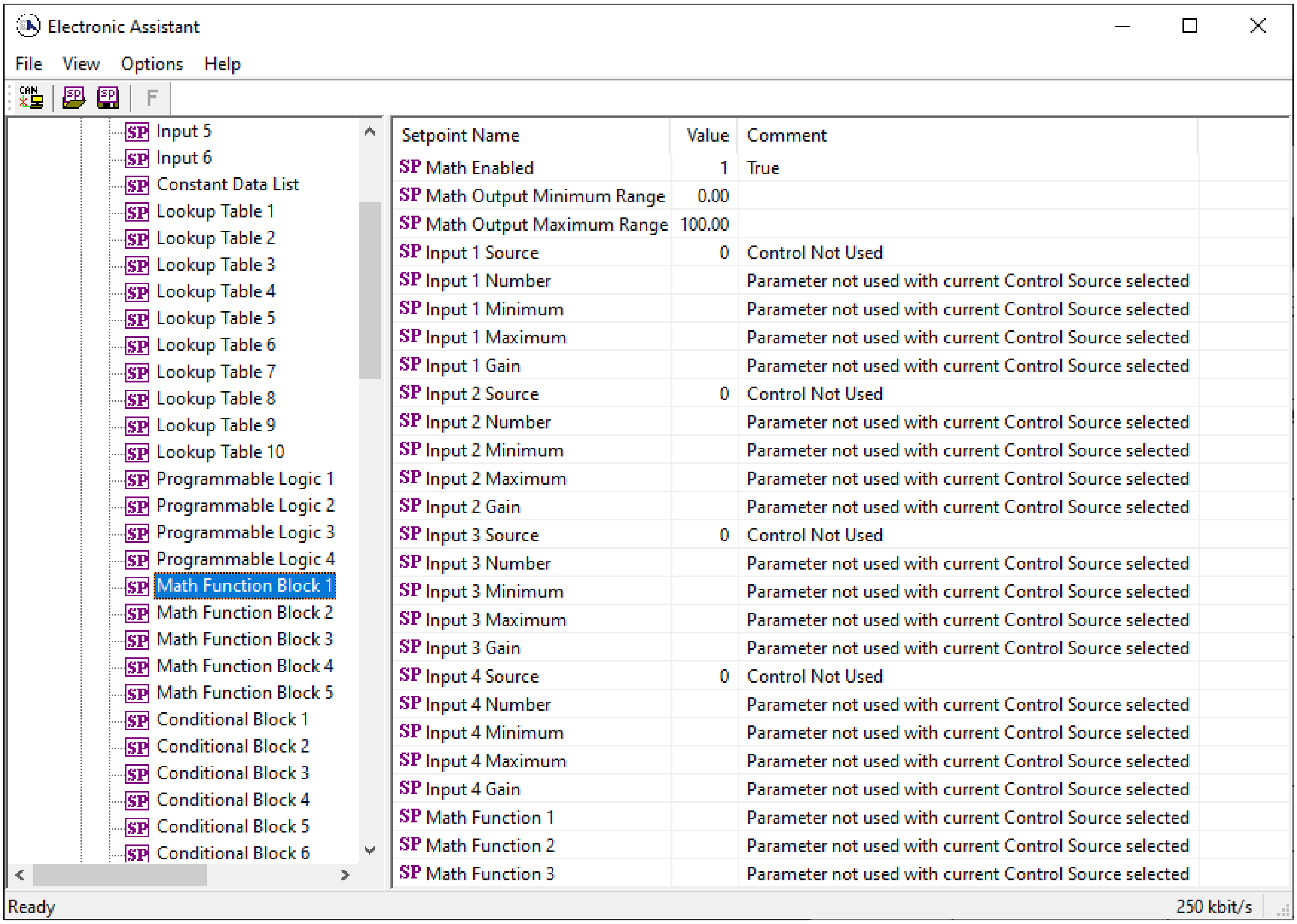


Figure 13 – Screen Capture of Math Function Block Setpoints

Table 24 – Math Function Setpoints

Name	**Range**	**Default**	**Notes**
Math Function Enabled	Drop List	False	
Function 1 Input A Source	Drop List	Control not used	See Table 7
Function 1 Input A Number	Depends on control source	1	See
Function 1 Input A Minimum	-10^6 to 10^6	0.0	
Function 1 Input A Maximum	-10^6 to 10^6	100.0	
Function 1 Input A Scaler	-1.00 to 1.00	1.00	
Function 1 Input B Source	Drop List	Control not used	See Table 7
Function 1 Input B Number	Depends on control source	1	See Table 7
Function 1 Input B Minimum	-10^6 to 10^6	0.0	
Function 1 Input B Maximum	-10^6 to 10^6	100.0	
Function 1 Input B Scaler	-1.00 to 1.00	1.00	
Math Function 1 Operation	Drop List	=, True when InA Equals InB	See Table 11
Function 2 Input B Source	Drop List	Control not used	See Table 7
Function 2 Input B Number	Depends on control source	1	See Table 7
Function 2 Input B Minimum	-10^6 to 10^6	0.0	
Function 2 Input B Maximum	-10^6 to 10^6	100.0	
Function 2 Input B Scaler	-1.00 to 1.00	1.00	
Math Function 3 Operation	Drop List	=, True when InA Equals InB	See Table 11
Function 3 Input B Source	Drop List	Control not used	See Table 7
Function 3 Input B Number	Depends on control source	1	See Table 7
Function 3 Input B Minimum	-10^6 to 10^6	0.0	
Function 3 Input B Maximum	-10^6 to 10^6	100.0	
Function 3 Input B Scaler	-1.00 to 1.00	1.00	
Math Function 3 Operation	Drop List	=, True when InA Equals InB	See Table 11
Function 4 Input B Source	Drop List	Control not used	See Table 7
Function 4 Input B Number	Depends on control source	1	See Table 7
Function 4 Input B Minimum	-10^6 to 10^6	0.0	
Function 4 Input B Maximum	-10^6 to 10^6	100.0	
Function 4 Input B Scaler	-1.00 to 1.00	1.00	
Math Function 4 Operation	Drop List	=, True when InA Equals InB	See Table 11
Math Output Minimum Range	-10^6 to 10^6	0.0	
Math Outptu Maximum Range	-10^6 to 10^6	100.0	

4.8. Conditional Logic Block Setpoints

The Conditional Block setpoints are defined in Section 0. Refer to that section for detailed information on how these setpoints are used. The screen capture in Figure 14 displays the available setpoints for each of the Conditional Blocks. The table below the screen capture highlights the allowable ranges for each setpoint.

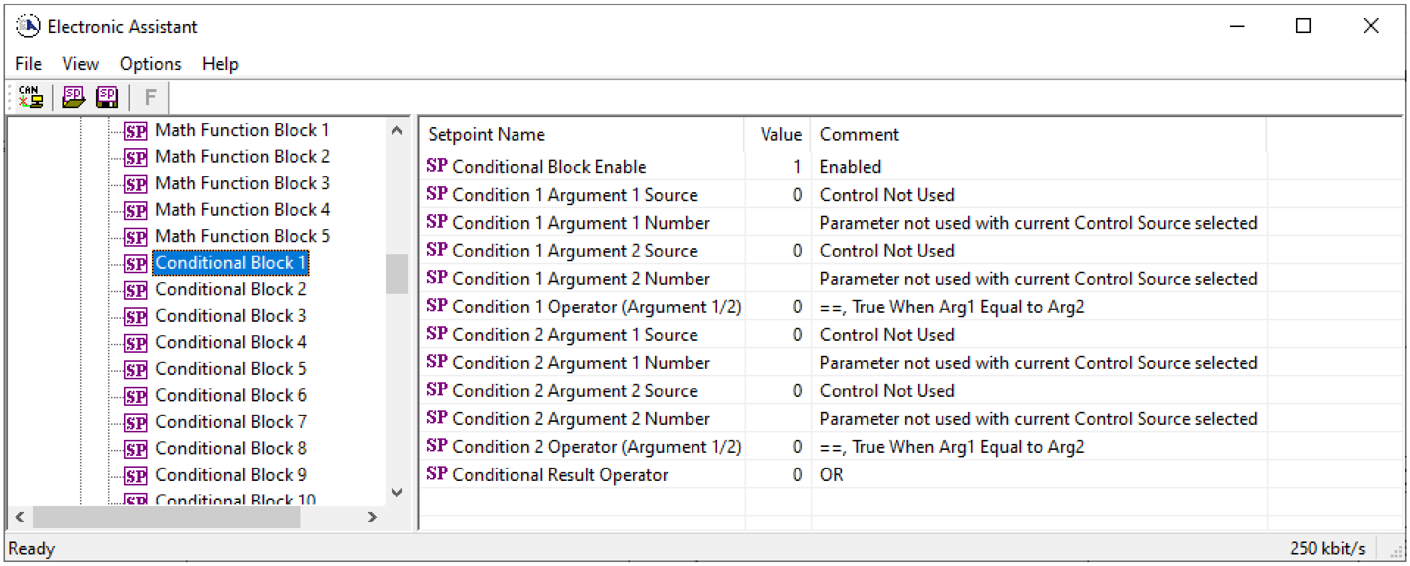


Figure 14: Screen Capture of Conditional Block Setpoints

Table 25. Default 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 7
Condition 1 Argument 1 Number	Depends on Source Selected	0	Refer to Table 7
Condition 1 Argument 2 Source	Drop List	Digital Input	Refer to Table 7
Condition 1 Argument 2 Number	Depends on Source Selected	0	Refer to Table 7
Condition 1 Operator (Argument 1/2)	Drop List	0	Refer to Table 12
Condition 2 Argument 1 Source	Drop List	Digital Input	Refer to Table 7
Condition 2 Argument 1 Number	Depends on Source Selected	0	Refer to Table 7
Condition 2 Argument 2 Source	Drop List	Digital Input	Refer to Table 7
Condition 2 Argument 2 Number	Depends on Source Selected	0	Refer to Table 7
Condition 2 Operator (Argument 1/2)	Drop List	0	Refer to Table 12
Conditional Result Operator	Drop List	OR	Refer to Table 13

4.9. Set-Reset Latch Block

The Set-Reset Latch Block setpoints are defined in Section 0. Refer to that section for detailed information on how these setpoints are used. The screen capture in Figure 15 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.

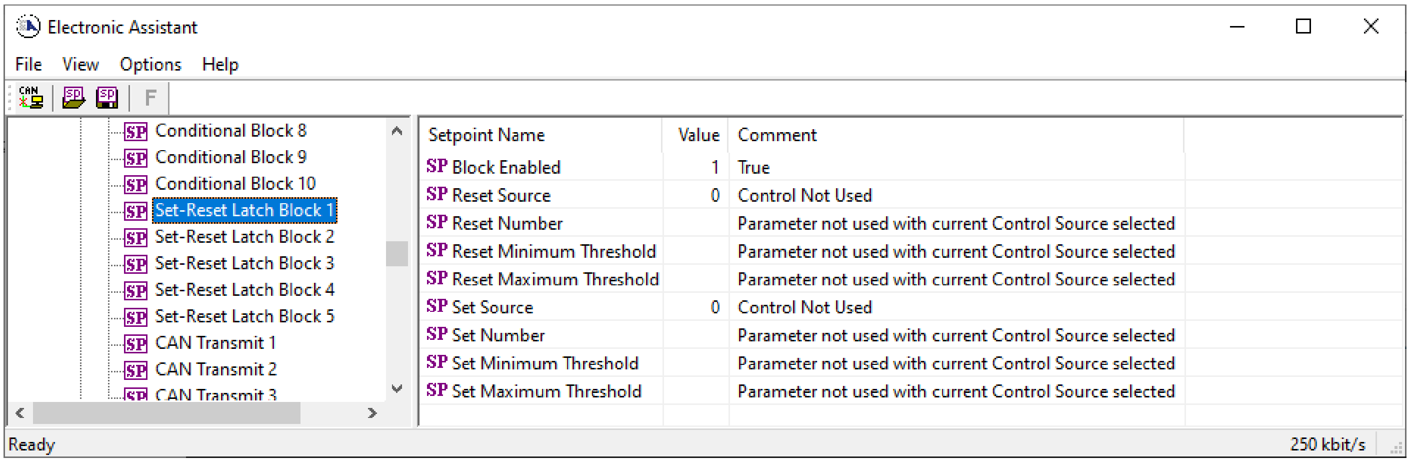


Figure 15: Screen Capture of Set-Reset Latch Block Setpoints

Table 26. Default Set-Reset Latch Block Setpoints

Name	Range	Default	Notes
Block Enabled	Drop List	False	
Reset Source	Drop List	Control Not Used	Refer to Section 1.2
Reset Number	Depends on Source Selected	1	Refer to Section 1.2
Reset Minimum Threshold	Drop List	0%	Refer to Section 1.6
Reset Maximum Threshold	Depends on Source Selected	100%	Refer to Section 1.6
Set Source	Drop List	Control Not Used	Refer to Section 1.2
Set Number	Drop List	1	Refer to Section 1.2
Set Minimum Threshold	Depends on Source Selected	0%	Refer to Section 1.6
Set Maximum Threshold	Drop List	100%	Refer to Section 1.6

4.10. CAN Transmit Setpoints

CAN Transmit Message Function Block be presented in section 1.11. Please refer there for detailed information on how these setpoints are used. "**Transmit Repetition Rate**" is 0ms by default, thus no message will be sent.

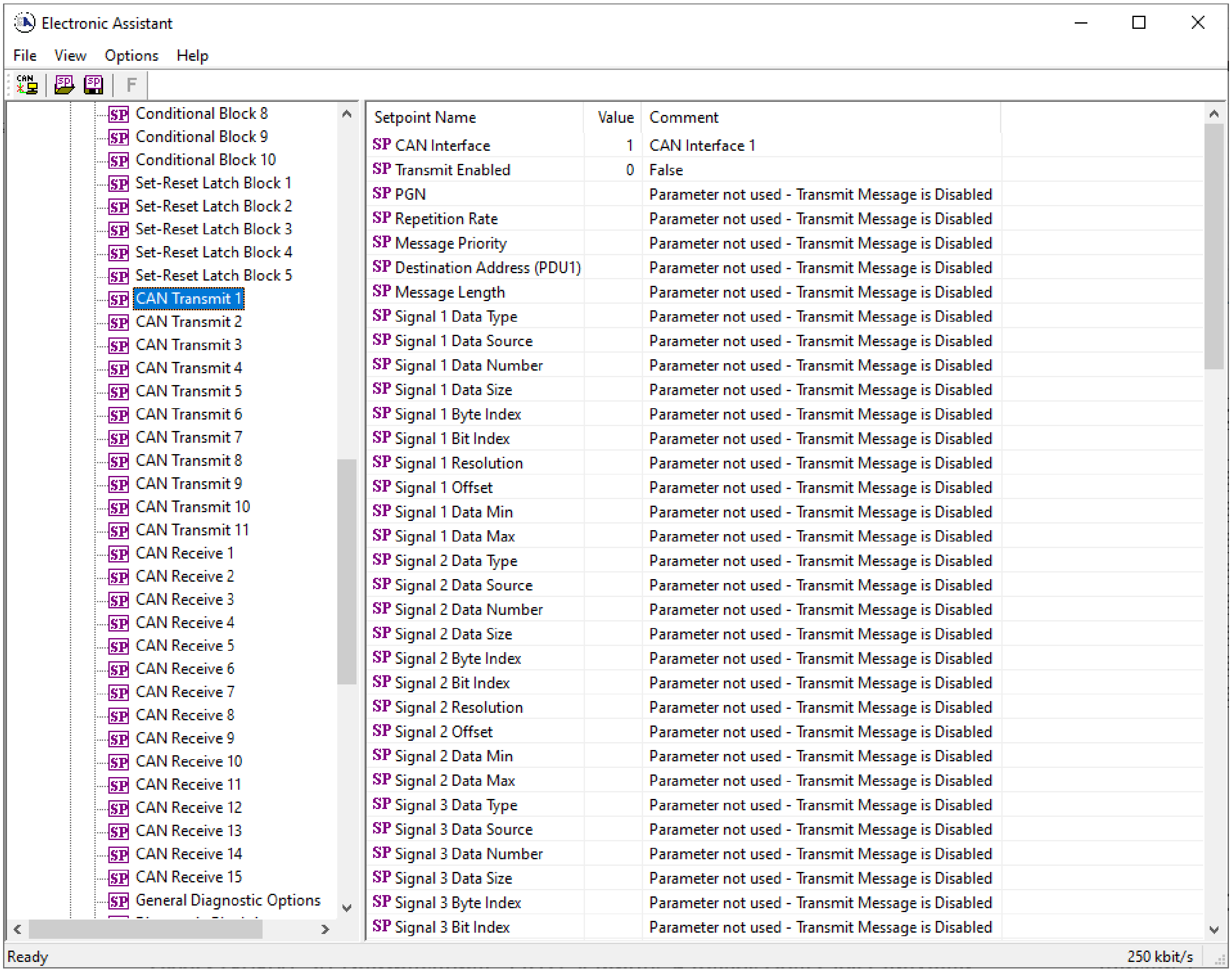


Figure 16 – Screen Capture of CAN Transmit Message Setpoints

Table 27 – CAN Transmit Message Setpoints

Name	Range	Default	Notes
CAN Interface	Drop List	CAN Interface #1	
Transmit Enabled	Drop List	0, False	
Transmit PGN	0xff00 … 0xffff	Different for each	See 1.11.1
Transmit Repetition Rate	0 … 65000 ms	0ms	0ms disables transmit
Transmit Message Priority	0...7	6	Proprietary B Priority
Destination Address	0...255	255	Not used by default
Signal X Control Source	Drop List	Different for each	See 1.2
Signal X Control Number	Drop List	Different for each	See 1.11.2
Signal X Transmit Data Size	Drop List	2 bytes	
Signal X Transmit Data Index in Array	0-7	0	
Signal X Transmit Bit Index In Byte	0-7	0	
Signal X Transmit Data Resolution	-100000.0 to 100000	1/bits	
Signal X Transmit Data Offset	-10000 to 10000	0.0	
Signal X Transmit Data Minimum	-100000.0 to 100000	0.0	
Signal X Transmit Data Maximum	-100000.0 to 100000	65535.0	

4.11. CAN Receive Setpoints

The CAN Receive Block is defined in section 0. Please refer there for detailed information about how these setpoints are used. "**Receive Message Timeout**" is set to 0ms by default. To enable Receive message set "**Receive Message Timeout**" that differs from zero.

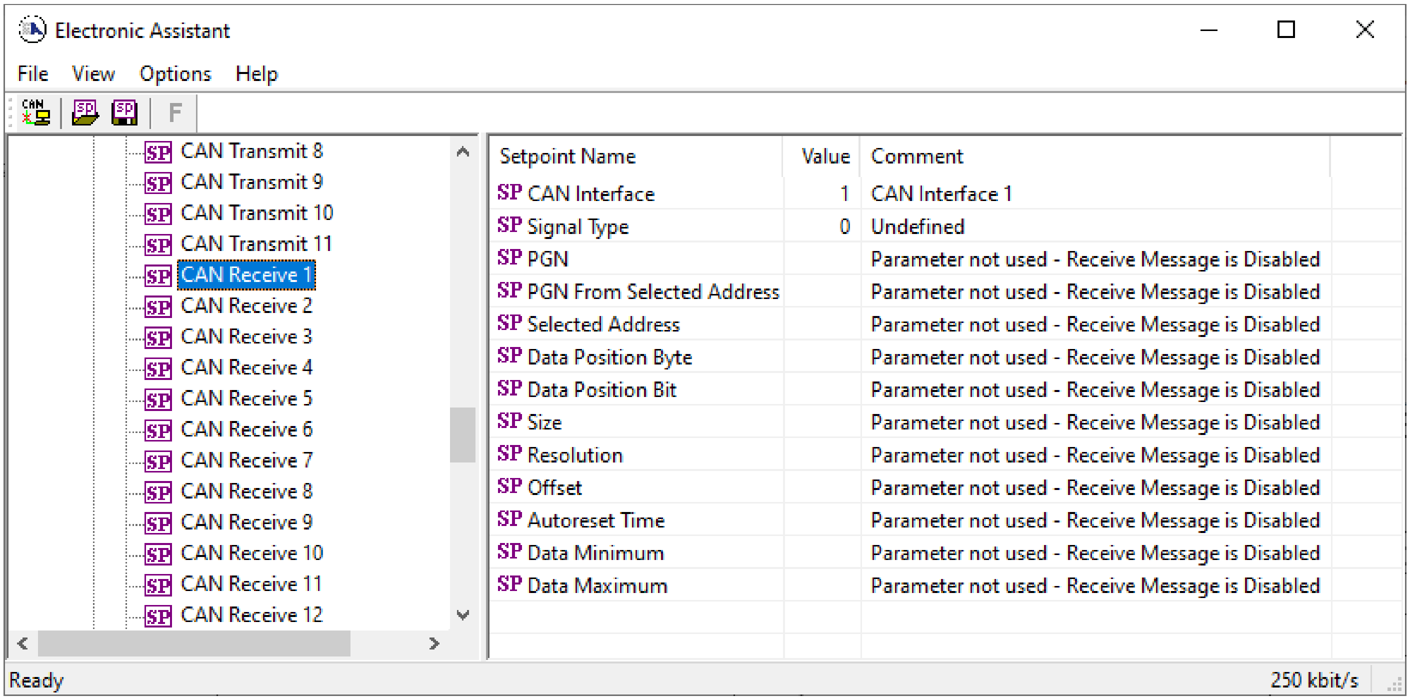


Figure 17 – Screen Capture of CAN Receive Message Setpoints

Table 28 – CAN Receive Setpoints

Name	**Range**	**Default**	**Notes**
CAN Interface	Drop List	CAN Interface #1	
Received Message Enabled	Drop List	False	
Received PGN	0 to 65536	Different for each	
Received Message Timeout	0 to 60 000 ms	0ms	
Specific Address that sends PGN	0 to 255	254 (0xFE, Null Addr)	
Receive Transmit Data Size	Drop List	2 bytes	
Receive Transmit Data Index in Array	0-7	4	
Receive Transmit Bit Index In Byte	0-7	0	
Receive Transmit Data Resolution	-100000.0 to 100000	0.001	
Receive Transmit Data Offset	-10000 to 10000	0.0	
Receive Data Min (Off Threshold)	-1000000 to Max	0.0	
Receive Data Max (On Threshold)	-100000 to 100000	2.0	

4.12. General Diagnostics Options

These setpoints control the shutdown of the ECU in case of a power supply or CPU temperature related errors. Refer to section 0 for more info.

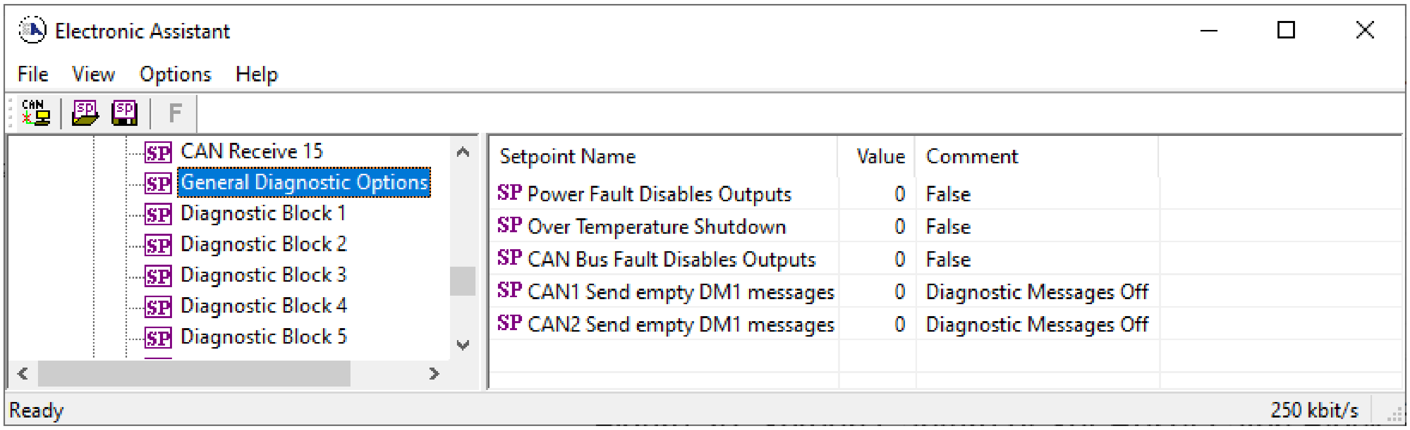


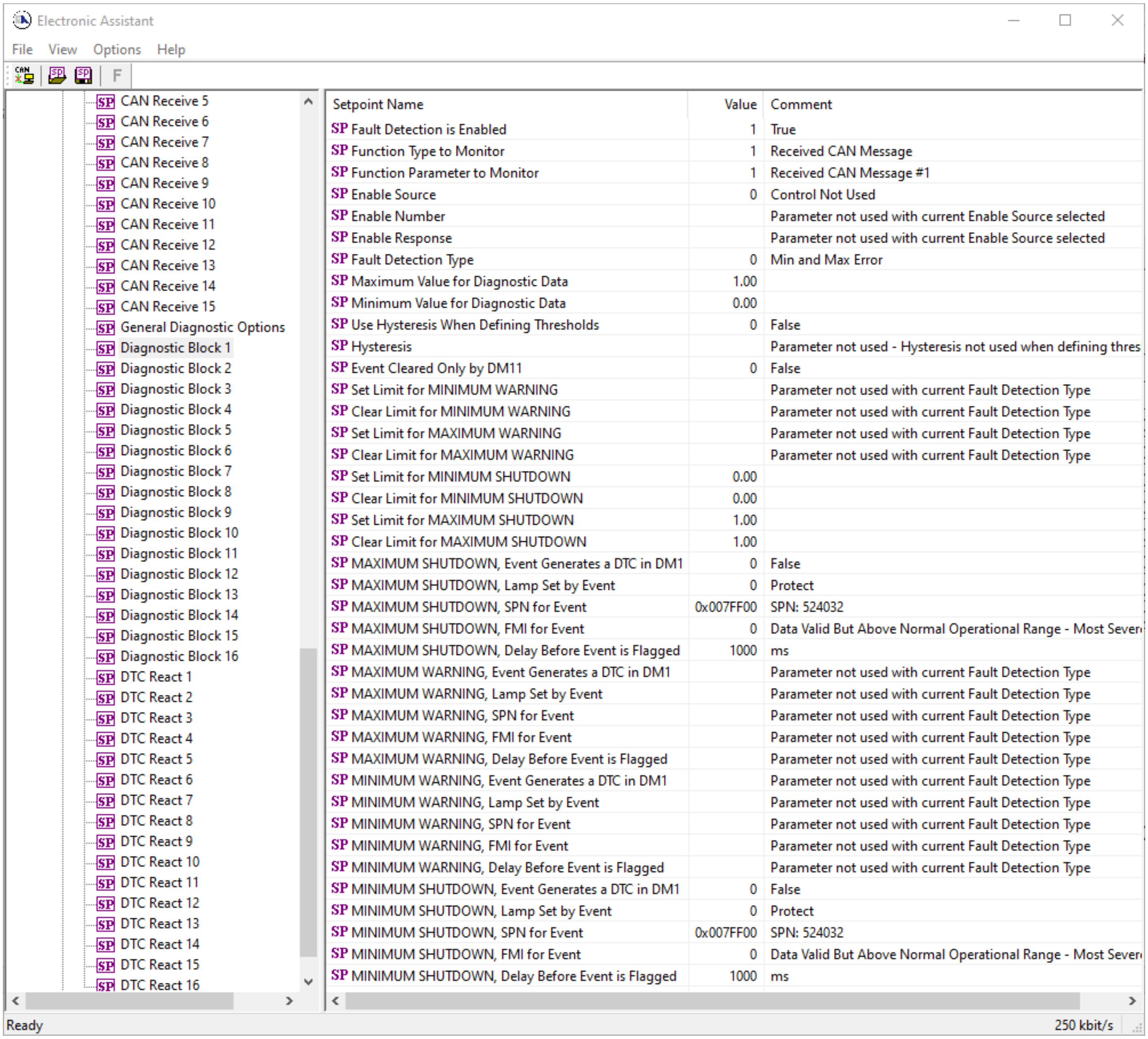
Figure 18 – Screen Capture of General Diagnostics Options Setpoints

Table 29 – General Diagnostics Options Setpoints

Name	**Range**	**Default**	**Notes**
Power Fault Disables Outputs	Drop List	0	
Over Temperature Shutdown	Drop List	0	

4.13. Diagnostics Blocks

There are 16 Diagnostics blocks that can be configured to monitor various parameters of the Controller. The Diagnostic Function Block is defined in section 0. Please refer there for detailed information on how these setpoints are used.



Setpoint Name	Value	Comment
SP Fault Detection is Enabled	1	True
SP Function Type to Monitor	1	Received CAN Message
SP Function Parameter to Monitor	1	Received CAN Message #1
SP Enable Source	0	Control Not Used
SP Enable Number		Parameter not used with current Enable Source selected
SP Enable Response		Parameter not used with current Enable Source selected
SP Fault Detection Type	0	Min and Max Error
SP Maximum Value for Diagnostic Data	1.00	
SP Minimum Value for Diagnostic Data	0.00	
SP Use Hysteresis When Defining Thresholds	0	False
SP Hysteresis		Parameter not used - Hysteresis not used when defining thres
SP Event Cleared Only by DM11	0	False
SP Set Limit for MINIMUM WARNING		Parameter not used with current Fault Detection Type
SP Clear Limit for MINIMUM WARNING		Parameter not used with current Fault Detection Type
SP Set Limit for MAXIMUM WARNING		Parameter not used with current Fault Detection Type
SP Clear Limit for MAXIMUM WARNING		Parameter not used with current Fault Detection Type
SP Set Limit for MINIMUM SHUTDOWN	0.00	
SP Clear Limit for MINIMUM SHUTDOWN	0.00	
SP Set Limit for MAXIMUM SHUTDOWN	1.00	
SP Clear Limit for MAXIMUM SHUTDOWN	1.00	
SP MAXIMUM SHUTDOWN, Event Generates a DTC in DM1	0	False
SP MAXIMUM SHUTDOWN, Lamp Set by Event	0	Protect
SP MAXIMUM SHUTDOWN, SPN for Event	0x007FF00	SPN: 524032
SP MAXIMUM SHUTDOWN, FMI for Event	0	Data Valid But Above Normal Operational Range - Most Sever
SP MAXIMUM SHUTDOWN, Delay Before Event is Flagged	1000	ms
SP MAXIMUM WARNING, Event Generates a DTC in DM1		Parameter not used with current Fault Detection Type
SP MAXIMUM WARNING, Lamp Set by Event		Parameter not used with current Fault Detection Type
SP MAXIMUM WARNING, SPN for Event		Parameter not used with current Fault Detection Type
SP MAXIMUM WARNING, FMI for Event		Parameter not used with current Fault Detection Type
SP MAXIMUM WARNING, Delay Before Event is Flagged		Parameter not used with current Fault Detection Type
SP MINIMUM WARNING, Event Generates a DTC in DM1		Parameter not used with current Fault Detection Type
SP MINIMUM WARNING, Lamp Set by Event		Parameter not used with current Fault Detection Type
SP MINIMUM WARNING, SPN for Event		Parameter not used with current Fault Detection Type
SP MINIMUM WARNING, FMI for Event		Parameter not used with current Fault Detection Type
SP MINIMUM WARNING, Delay Before Event is Flagged		Parameter not used with current Fault Detection Type
SP MINIMUM SHUTDOWN, Event Generates a DTC in DM1	0	False
SP MINIMUM SHUTDOWN, Lamp Set by Event	0	Protect
SP MINIMUM SHUTDOWN, SPN for Event	0x007FF00	SPN: 524032
SP MINIMUM SHUTDOWN, FMI for Event	0	Data Valid But Above Normal Operational Range - Most Sever
SP MINIMUM SHUTDOWN, Delay Before Event is Flagged	1000	ms

Figure 19 – Screen Capture of Diagnostic Block Setpoints

Table 30 – Diagnostic Block Setpoints

Name	Range	Default	Notes
Fault Detection is Enabled	Drop List	False	
Function Type to Monitor	Drop List	0 – Control not used	
Function parameter to Monitor	Drop List	0 – No selection	
Fault Detection Type	Drop List	0 – Min and Max Error	See section **1.3**
Maximum Value for Diagnostic Data	Minimum Value for Diagnostic Data … $4.28e^9$	5.0	
Minimum Value for Diagnostic Data	0.0 … Maximum Value for Diagnostic Data	0.0	
Use Hysteresis When Defining Thresholds	Drop List	False	
Hysteresis	0.0 … Maximum Value for Diagnostic Data	0.0	
Event Cleared only by DM11	Drop List	False	
Set Limit for MAXIMUM SHUTDOWN	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	4.8	
Clear Limit for MAXIMUM SHUTDOWN	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	4.6	
Set Limit for MAXIMUM WARNING	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.0	
Clear Limit for MAXIMUM WARNING	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.0	
Clear Limit for MINIMUM WARNING	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.0	
Set Limit for MINIMUM WARNING	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.0	
Clear Limit for MINIMUM SHUTDOWN	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.4	
Set Limit for MINIMUM SHUTDOWN	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.2	
MAXIMUM SHUTDOWN, Event Generates a DTC in DM1	Drop List	True	
MAXIMUM SHUTDOWN, Lamp Set by Event	Drop List	0 – Protect	See Table 8
MAXIMUM SHUTDOWN, SPN for Event	0…524287	520448 ($7F100)	It is the user's responsibility to select an SPN that will not violate the J1939 standard.

MAXIMUM SHUTDOWN, FMI for Event	Drop List	3, Voltage Above Normal	See Table 9
MAXIMUM SHUTDOWN, Delay Before Event is Flagged	0…60000 ms	1000	
MAXIMUM WARNING, Event Generates a DTC in DM1	Drop List	True	
MAXIMUM WARNING, Lamp Set by Event	Drop List	0 – Protect	See Table 8
MAXIMUM WARNING, SPN for Event	0…524287	520704 ($7F200)	It is the user's responsibility to select an SPN that will not violate the J1939 standard.
MAXIMUM WARNING, FMI for Event	Drop List	3, Voltage Above Normal	See Table 9
MAXIMUM WARNING, Delay Before Event is Flagged	0…60000 ms	1000	
MINIMUM WARNING, Event Generates a DTC in DM1	Drop List	True	
MINIMUM WARNING, Lamp Set by Event	Drop List	0 – Protect	See Table 8
MAXIMUM WARNING, SPN for Event	0…524287	520960 ($7F300)	It is the user's responsibility to select an SPN that will not violate the J1939 standard.
MINIMUM WARNING, FMI for Event	Drop List	4, Voltage Below Normal	See Table 9
MINIMUM WARNING, Delay Before Event is Flagged	0…60000 ms	1000	
MINIMUM SHUTDOWN, Event Generates a DTC in DM1	Drop List	True	
MINIMUM SHUTDOWN, Lamp Set by Event	Drop List	Amber Warning	See Table 8
MINIMUM SHUTDOWN, SPN for Event	0…524287	521216 ($7F400)	It is the user's responsibility to select an SPN that will not violate the J1939 standard.
MINIMUM SHUTDOWN, FMI for Event	Drop List	4, Voltage Below Normal	See Table 9
MINIMUM SHUTDOWN, Delay Before Event is Flagged	0…60000 ms	1000	

4.14. DTC React Function Block

The DTC React function block is described in Section 0. The Figure below shows the DTC React function block setpoints. The Table below shows the default values. Please note: *The setpoint "DTC React is Enabled" was changed to 1, True.*

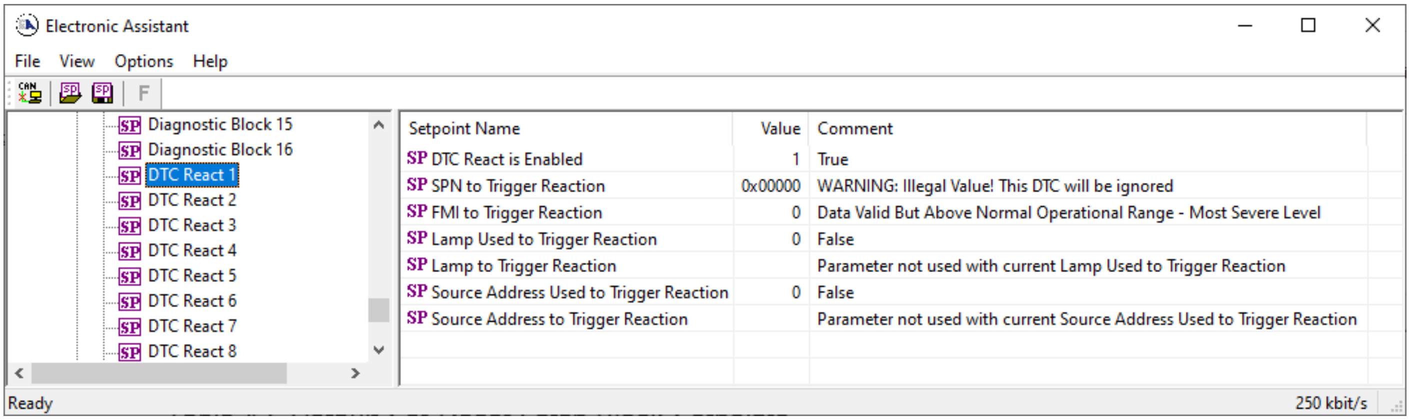


Figure 20 DTC React Setpoints

Table 31 – DTC React Setpoints

Name	Range	Default	Notes
DTC React is Enabled	Drop List	0, False	
SPN to Trigger Reaction	0x00 to 0x3FFFF	0	
FMI to Trigger Reaction	Drop List	0	
Lamp Used to Trigger Reaction	Drop list	0, False	
Lamp to Trigger Reaction	Drop List	0, Protect	
Source Address Used to Trigger Reaction	Drop list	0, False	
Source Address to Trigger Reaction	0x00 to 0xFF	0	

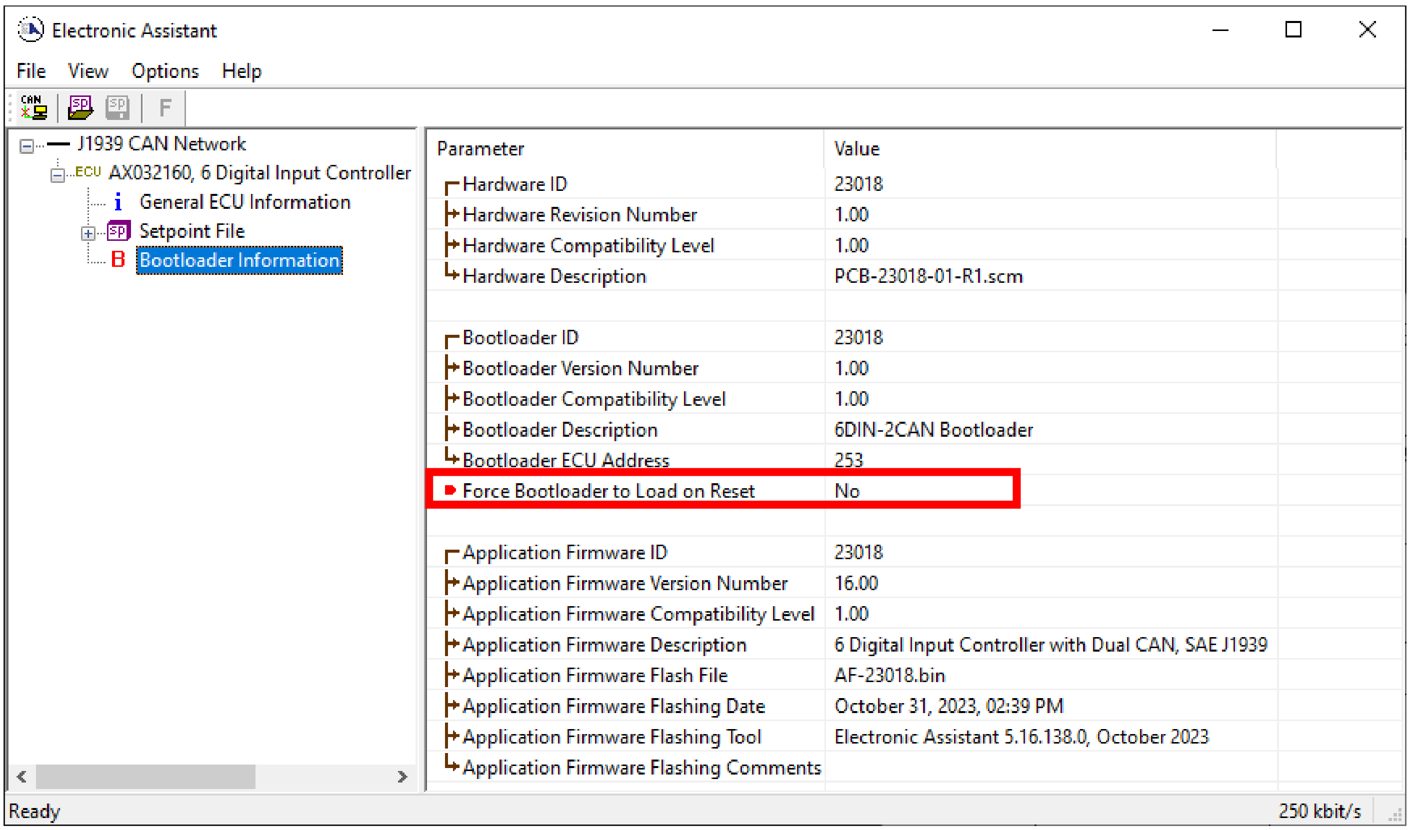
5. REFLASHING OVER CAN WITH THE AXIOMATIC EA BOOTLOADER

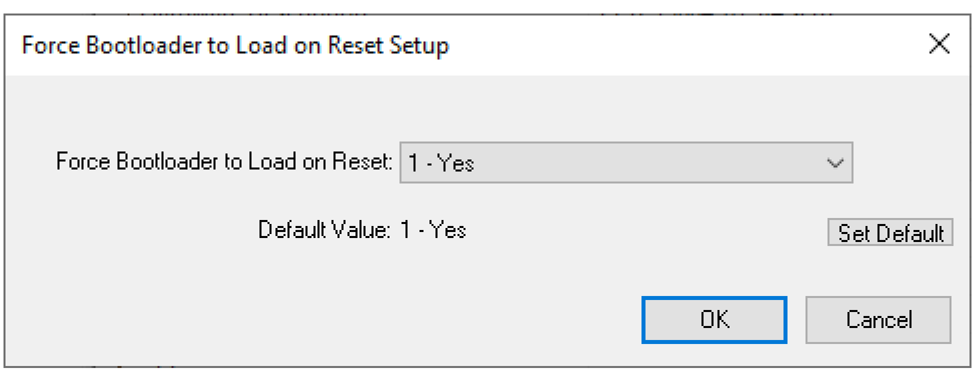
The AX032160 can be upgraded with new application firmware using the **Bootloader Information** section. This section details the simple step-by-step instructions to upload new firmware provided by Axiomatic onto the unit via CAN, without requiring it to be disconnected from the J1939 network.

Note: To upgrade the firmware, use Axiomatic Electronic Assistant V4.5.53.0 or higher.

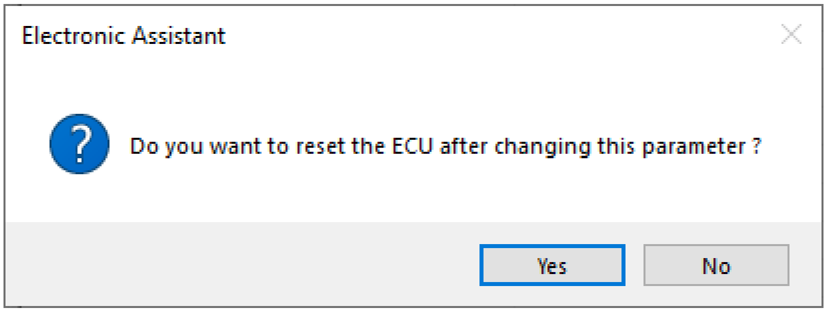
1. When the Axiomatic EA first connects to the ECU, the **Bootloader Information** section will display the following information.

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

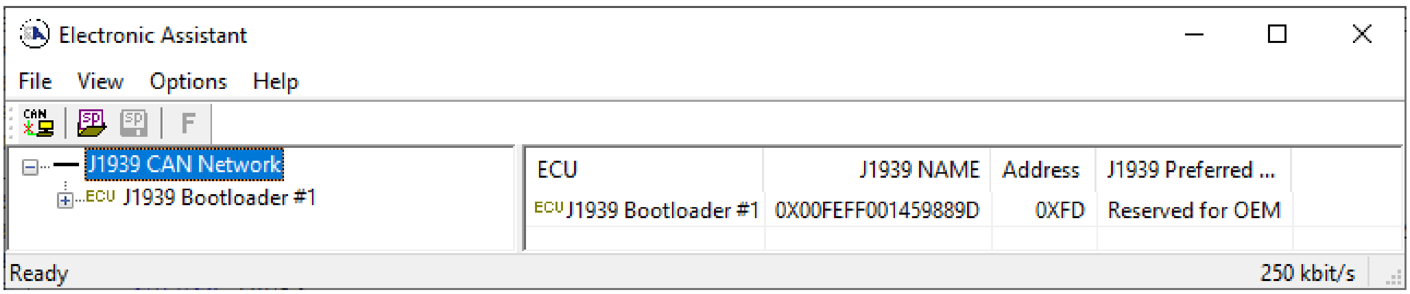


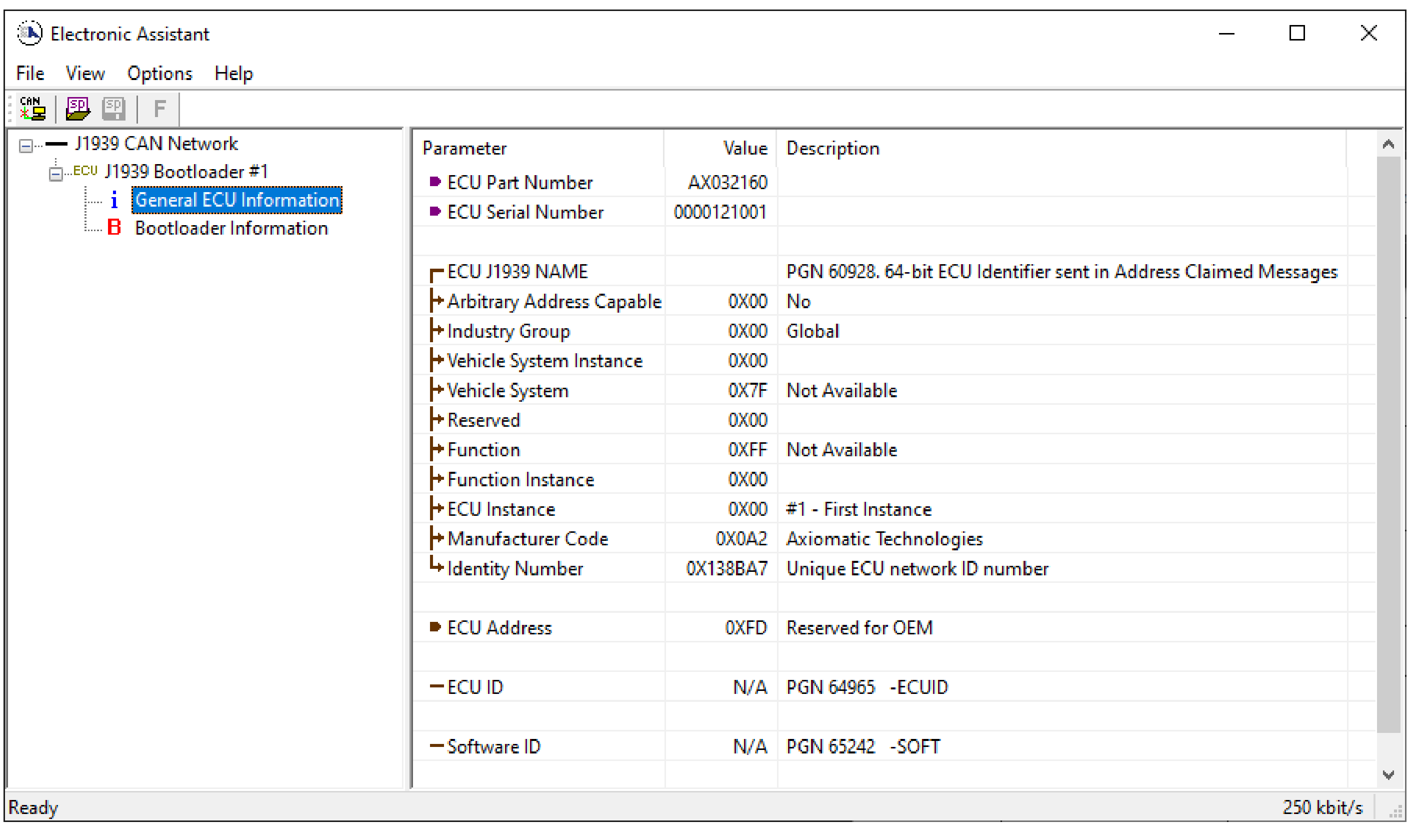


3. When the prompt box asks if you want to reset the ECU, select *Yes*.



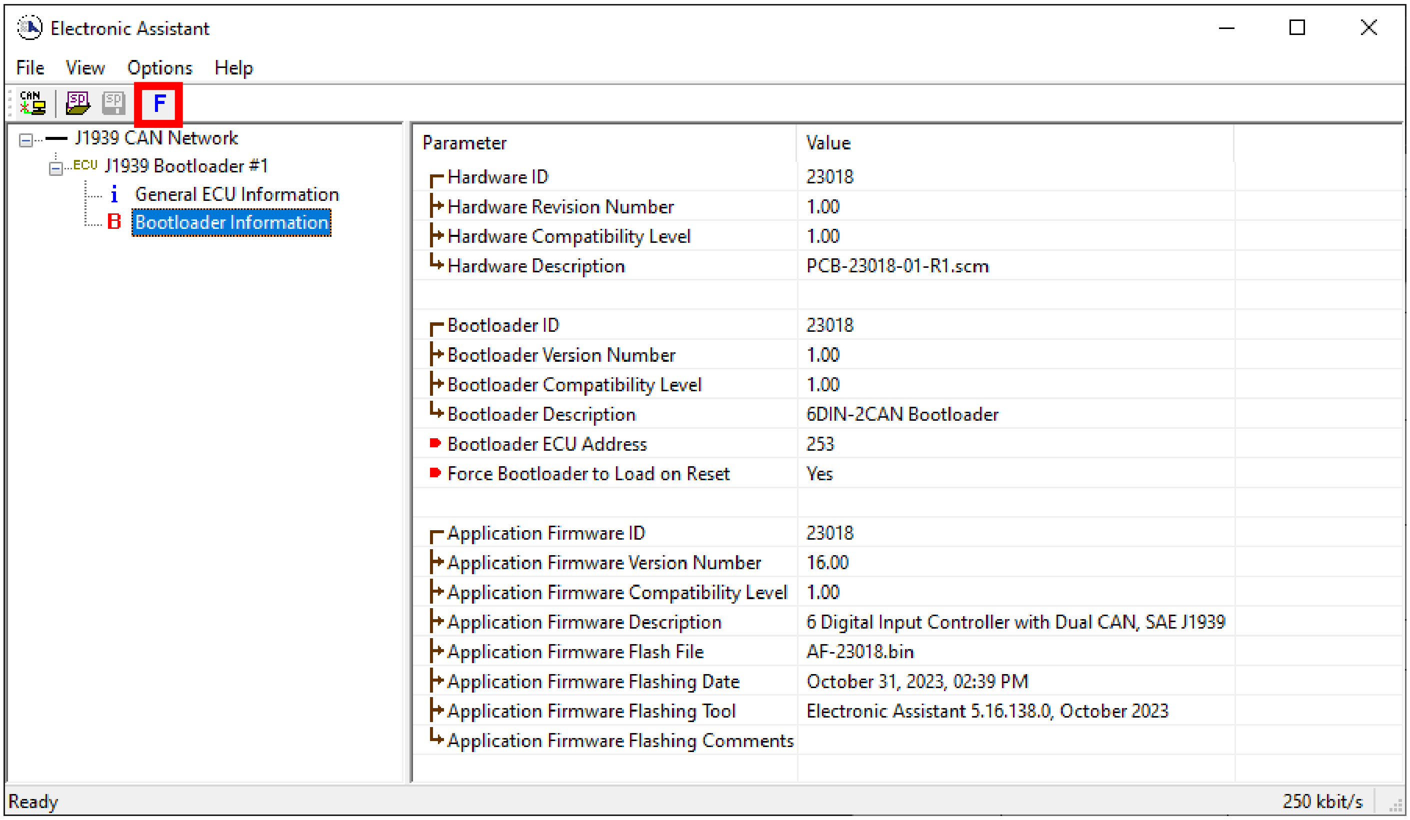
4. Upon reset, the ECU will no longer show up on the J1939 network as an AX032160 but rather as **J1939 Bootloader #1**.





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.

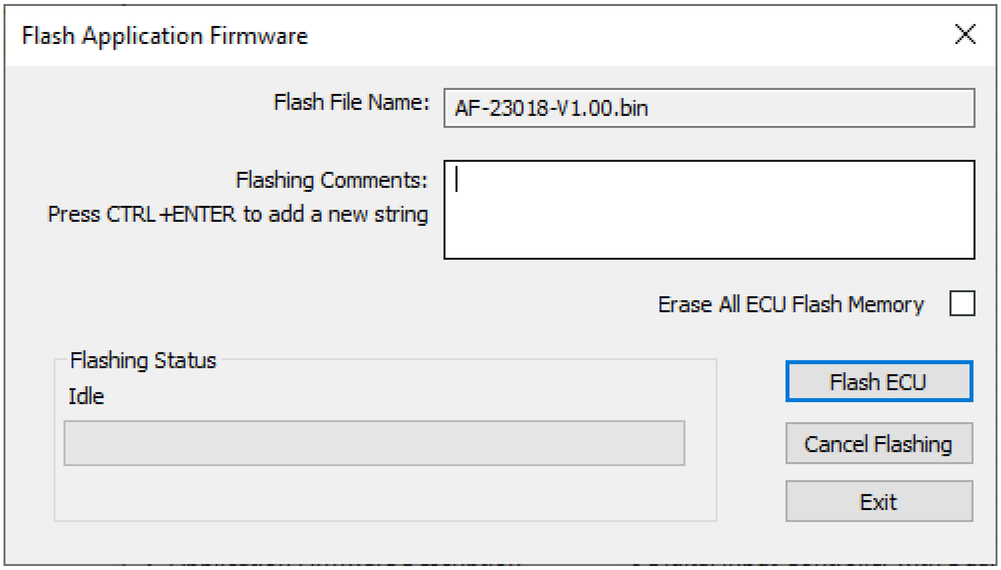
5. When the **Bootloader Information** section is selected, the same information is shown as when it was running the AX032160 firmware, but in this case the **F**lashing feature has been enabled.



6. Select the **F**lashing button and navigate to where you had saved the **AF-23018-VX.XX.bin** file sent from Axiomatic. (Note: only binary (.bin) files can be flashed using the Axiomatic EA tool.)

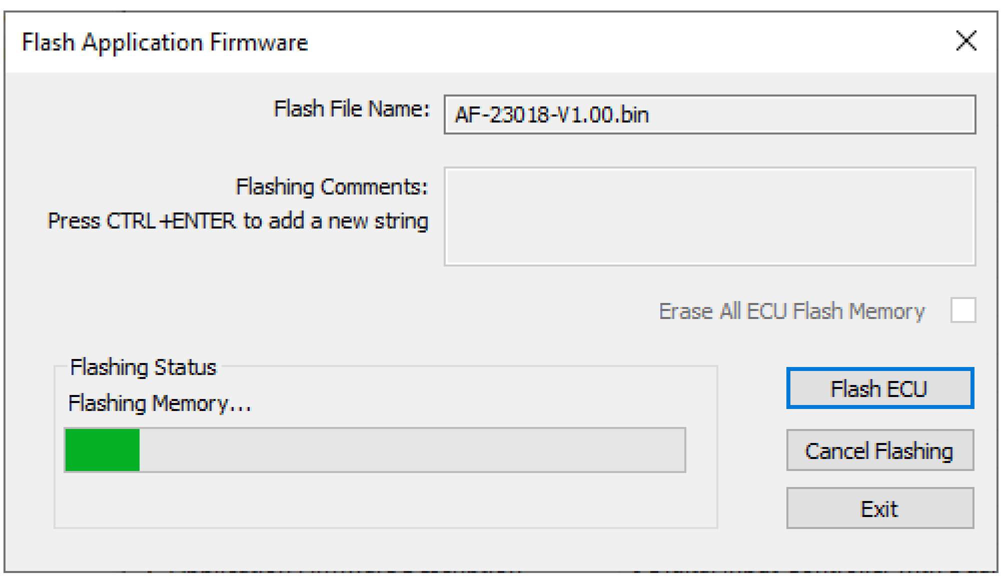
7. Once the Flash Application Firmware window opens, you can enter comments such as "Firmware upgraded by [Name]" if you so desire. This is not required, and you can leave the field blank if you do not want to use it.

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

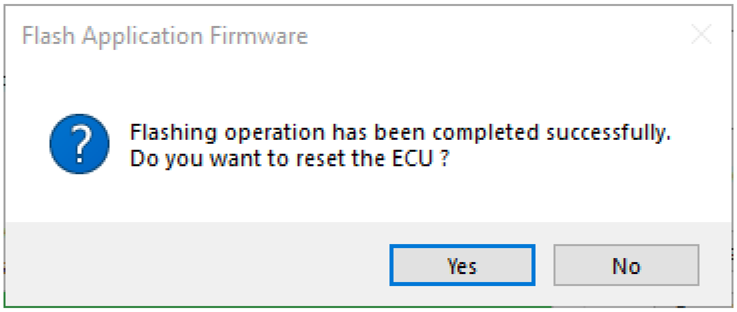


WARNING: Do not check the "Erase All ECU Flash Memory" box unless instructed to do so by your Axiomatic contact. Selecting this will erase ALL data stored in non-volatile flash, including the calibration done by Axiomatic during factory testing. It will also erase any configuration of the setpoints that 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.

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.



Once the firmware has finished uploading, a message will pop up indicating the successful operation. If you select to reset the ECU, the new version of the AX032160 application will start running, and the ECU will be identified as such by the Axiomatic EA. Otherwise, the next time the ECU is power cycled, the AX032160 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.

APPENDIX A - TECHNICAL SPECIFICATION

Specifications are indicative and subject to change. Actual performance will vary depending on the application and operating conditions. Users should satisfy themselves that the product is suitable for use in the intended application.
All our products carry a limited warranty against defects in material and workmanship. Please refer to our Warranty, Application Approvals/ Limitations and Return Materials Process as described on https://www.axiomatic.com/service/.

Input

Power Supply Input	12Vdc, 24Vdc, or 48Vdc nominal (8 to 36 VDC)
Quiescent Current	54 mA @ 12 V; 27.5 mA @ 24 V; 16.2 mA at 48 V typical
Protection	Reverse polarity protection is provided. Surge and transient protection is provided. Under-voltage protection is provided with hardware shutdown at 6V. Over-voltage protection is provided with hardware shutdown at 63V.
Digital Inputs	6 digital signal inputs: PWM Duty, Frequency, or Digital Type Low level max. 1V High level min. 4V Selectable as 10 kΩ pull-up or pull-down Frequency Type Resolution: 0.01% Accuracy: ±0.1% Range: 1 to 10 kHz PWM Duty Type Resolution: 0.02% Accuracy: ±0.2% Frequency: 1 to 10 kHz PWM Duty Cycle: 0 to 100% Digital Type Active High or Active Low Amplitude: up to 43V
Input Grounds	Provided Inputs referenced to Power -

General Specifications

Microcontroller	STM32H725RGV3, 32-bit, 1 MByte flash memory
Communications	2 galvanically isolated CAN ports (SAE J1939) 1 Mbit/sec max. Auto-baud-rate detection
Software Reflashing	Axiomatic Electronic Assistant Configuration KIT, P/Ns: **AX070502** or **AX070506K**
User Interface	The Electronic Assistant KITs, P/Ns: **AX070502** or **AX070506K** for *Windows* operating systems come with a royalty-free license for use on multiple computers. They include an Axiomatic USB-CAN converter to link the device's CAN port to a *Windows*-based PC. The controller is also configurable via the Ethernet.
Compliance	RoHS
Vibration	MIL-STD-202H, method 204, test condition C 10g peak (Sine) MIL-STD-202H, method 214A, test condition I/B 7.56 Grms (Random)
Shock	MIL-STD-202H, method 213B, test condition A 50g peak
Operating Conditions	-40°C to 85°C (-40 to 185°F)
Storage Temperature	-55°C to 125°C (-67 to 257°F)
Weight	0.20 lb. (0.0907 kg)
Protection	IP67
Enclosure and Dimensions	Molded enclosure, integral connector Nylon 6/6, 30% glass, laser welded 4.28 in x 3.69 in x 1.43 in (108.6 mm x 94 mm x 36 mm) Note: L x W x H includes the integral connector. Refer to Dimensional Drawing. Flammability rating: UL 94 HB
Electrical Connections	Integral 12-pin receptacle (equivalent TE Deutsch P/N: DTM04-12PA) Mates with PL-DTM06-12SA Mating Plug Kit (includes 1 DTM06-12S, 1 WM-12S, 12 0462-201-20141, 6 0413-204-2005 Sealing Plug)
Network Termination	It is necessary to terminate the network with external termination resistors. The resistors are 120 Ohm, 0.25W minimum, metal film or similar type. They should be placed between CAN_H and CAN_L terminals at both ends of the network.
Mounting	Mounting holes are sized for #10 or M5 bolts. The bolt length will be determined by the end-user's mounting plate thickness. The mounting flange of the controller is 0.47 inches (12 mm) thick. If the module is mounted without an enclosure, it should be mounted vertically with connectors facing left or right to reduce likelihood of moisture entry. The CAN wiring is considered intrinsically safe. The power wires are not considered intrinsically safe and so in hazardous locations, they need to be located in conduit or conduit trays at all times. The module must be mounted in an enclosure in hazardous locations for this purpose. No wire or cable harness should exceed 30 meters in length. The power input wiring should be limited to 10 meters. All field wiring should be suitable for the operating temperature range. Install the unit with appropriate space available for servicing and for adequate wire harness access (6 inches or 15 cm) and strain relief (12 inches or 30 cm).

AXIOMATIC
Global Electronic Solutions

OUR PRODUCTS

AC/DC Power Supplies

Actuator Controls/Interfaces

Automotive Ethernet Interfaces

Battery Chargers

CAN Controls, Routers, Repeaters

CAN/WiFi, CAN/Bluetooth, Routers

Current/Voltage/PWM Converters

DC/DC Power Converters

Engine Temperature Scanners

Ethernet/CAN Converters, Gateways, Switches

Fan Drive Controllers

Gateways, CAN/Modbus, RS-232

Gyroscopes, Inclinometers

Hydraulic Valve Controllers

Inclinometers, Triaxial

I/O Controls

LVDT Signal Converters

Machine Controls

Modbus, RS-422, RS-485 Controls

Motor Controls, Inverters

Power Supplies, DC/DC, AC/DC

PWM Signal Converters/Isolators

Resolver Signal Conditioners

Service Tools

Signal Conditioners, Converters

Strain Gauge CAN Controls

Surge Suppressors

OUR COMPANY

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

QUALITY DESIGN AND MANUFACTURING

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

WARRANTY, APPLICATION APPROVALS/LIMITATIONS

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

COMPLIANCE

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

SAFE USE

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

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

SERVICE

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

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

DISPOSAL

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

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