



USER MANUAL UMAX030460
Version 1.0.1

32x Inputs CAN Controller

SAE J1939

USER MANUAL

P/N: AX030460

VERSION HISTORY

Version	Date	Author	Modification
1.0.0	Apr. 30, 2026	Jordan Wilbur	Initial draft
1.0.1	Jun. 2, 2026	M Ejaz	Reformatting Updated title Updated dimensional drawing and pinout Updated technical specifications

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 used to measure active high or low signals
DM	Diagnostic Message (from SAE J1939 standard)
DTC	Diagnostic Trouble Code (from SAE J1939 standard)
EA	The 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 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: AX070506K

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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
TDAX030460	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 Electronic Control Unit (ECU) is a device that measures numerous types of input signals as well as 3 CAN interfaces, which can be used to forward messages from one CAN network to another. It has 24 Universal inputs, 4 Digital Inputs, 2 Encoder Inputs, and 2 RTD Inputs. Flexible circuit design gives the user a wide range of configurable input types. The sophisticated control algorithms allow the user to program the controller for a wide range of applications without the need for custom software. It has an auto baud-rate feature and supports 125kbps, 250 kbps, 500 kbps and 1000 kbps baud rates in SAE J1939. The ECU contains 10 configurable Red/Green LEDs which can be used to monitor any internal control signals, including diagnostics.

The Axiomatic Electronic Assistant is used to configure the 32-In CAN 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 AX030460 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 '*Voltage 0 to 5V*'.

In this document the configurable properties of the ECU are divided into function blocks, namely input function block, diagnostic function block, LED Control 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 next subchapters.

Figure 1 – The Block Diagram (TBD)

1.1. Available Control Sources

Many of the Function Blocks have selectable input signals, which are determined with “[Name] Source” and “[Name] Number” setpoints. Together, these setpoints uniquely select how the I/O of the various function blocks are linked together. “[Name] Source” setpoint determines the type of the source and “[Name] Number” selects the actual source if there is more than one of the same type. Available “[Name] Source” options and associated “[Name] Number” ranges are listed in Table 1. All sources, except “CAN message reception timeout”, are available for all blocks, including output control blocks and CAN Transmit messages. Thought input Sources are freely selectable, not all options would make sense for any particular input, and it is up to the user to program the controller in a logical and functional manner.

Table 1 – Available Control Sources and Numbers

Control Source	Number Range	Notes
<i>0: Control Not Used</i>	N/A	When this is selected, it disables all other setpoints associated with the signal in question.
<i>1: Received CAN Message</i>	1 to 15	
<i>2: Universal Input Measured</i>	1 to 24	
<i>3: Digital Input Measured</i>	1 to 4	
<i>4: Encoder Input Measured</i>	1 to 2	
<i>5: Encoder Direction</i>	1 to 2	
<i>6: RTD Temperature</i>	1 to 2	
<i>7: RTD Resistance</i>	1 to 2	
<i>8: Lookup Table</i>	1 to 10	
<i>9: Programmable Logic</i>	1 to 4	
<i>10: Math Logic</i>	1 to 5	
<i>11: Conditional Logic</i>	1 to 10	
<i>12: Set-Reset Latch</i>	1 to 5	
<i>13: Constant Data</i>	1 to 15	
<i>14: VPS Measured</i>	N/A	
<i>15: Processor Temperature Measured</i>	0 to 255	Measured processor temperature in °C. The Parameter sets the threshold in Celsius to compare with.
<i>16: CAN Reception Timeout</i>	N/A	
<i>17: DTC React</i>	1 to 16	
<i>18: Diagnostic Active</i>	1 to 16	

1.2. Input Function Blocks

The controller has altogether thirty two inputs. The twenty four Universal Inputs are the most configurable ones. They can be configured to measure voltage, current, frequency, pulse width (PWM) or digital signal.

Please note that some inputs share the timers and, in a case, if both inputs are set to a *Frequency* or *PWM* mode, the dependent input will be able to read signal only in the same frequency range as the main input.

1.2.1. Universal Input

The Universal Input function block translates physical input signals into the internal function block output signal that can be used by other function blocks of the controller.

There are 24 independent Universal Input function blocks presenting their own universal physical inputs.

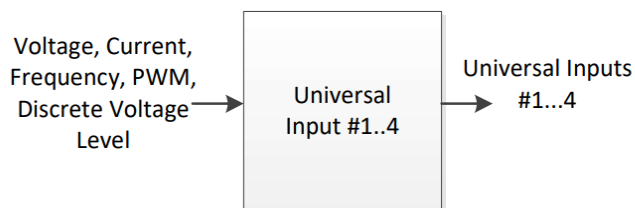


Figure 2 – Universal Input Function Block

The internal function block output signal type and units of measurement are presented below.

Table 2 – Universal Input Function Block Signal Types

Input Parameter	Type	Units
Voltage	Continuous	V
Current	Continuous	mA
Discrete Voltage Level	Discrete	{0,1}
Frequency	Continuous	Hz
PWM Duty Cycle	Continuous	%

Each Universal Input function block has the following configuration parameters.

Table 3 – Universal Input Function Block Configuration Parameters

Parameter	Default Value	Range	Units	Description
Input Type	0 - Input Disabled	0 - Input Disabled, 1 - Voltage, 2 - Current, 3 - Discrete Voltage Level, 4 - Frequency, 5 - PWM Duty Cycle	–	Defines the input physical parameter that will be measured by the function block.
Input Voltage Range	0 - 0...5V	0 - 0...5 V, 1 - 0...10 V	V	Used in the "Voltage" mode
Input Current Range	0 - 0...20 mA	0 - 0...20mA, 1 - 4...20 mA	mA	Used in the "Current" mode
Input Range Min	0	0...100	-	Depends on the Input Parameter. Used for diagnostic purposes
Input Range Max	5	0...100	-	Depends on the Input Parameter. Used for diagnostic purposes
Analog Input Filter	0 - Disabled	0 - Disabled, 1 - 50Hz Noise Rejection, 2 - 60Hz Noise Rejection, 3 - Both: 60Hz and 50Hz Noise Rejection	–	Noise Rejection in "Voltage", "Current" and "Resistance" modes
Pull-Up/Pull-Down Resistor	0 - Disabled	0 - Disabled, 1 - 10kOhm Pull-Up, 2 - 10kOhm Pull-Down	–	Used in "Discrete Voltage Level", "Frequency", and "PWM Duty Cycle" modes.
Input Polarity	0 - Active High	0 - Active High, 1 - Active Low	–	Used in "Discrete Voltage Level", "Frequency", and "PWM Duty Cycle" modes.
Discrete Input Debounce Time	50ms	0...1000	ms	Used in "Discrete Voltage Level" mode. If 0 - no debouncing.
Frequency Range	0 - 1Hz...10kHz	0 – 1kHz...10kHz, 1 – 10Hz...1kHz 2 – 1Hz...100Hz 3 – Auto-Range	Hz	A 16-bit counter is used. Used in "Frequency", and "PWM Duty Cycle" modes.
Frequency/PWM Debounce Filter ³	0 - Disabled	0 - Disabled, 1 - 142ns, 2 - 1.14us, 3 - 6.10us	–	Used in "Frequency", and "PWM Duty Cycle" modes.
Frequency/PWM Averaging	0 - No Averaging	0 - No Averaging, 1 - 3 Readings, 2 - 5 Readings, 3 - 10 Readings	–	Defines a moving average filter used in "Frequency", and "PWM Duty Cycle" modes.

Input currents below 3mA are output as 0mA when 4...20 mA current range is set.

1.2.2. Voltage Measurements

The Universal Inputs can measure voltages in voltage ranges set by the Voltage Range configuration parameter.

To avoid an influence of ghost voltages, the pull-down resistor can be activated. This will reduce the accuracy of voltage measurements due to the influence of the 10kOhm pull-down shunt resistor and should be used only after careful consideration of the shunt resistor influence on the measured circuit.

The user can set the Analog Input Filter configuration parameter to reduce noise in voltage and other analog signal measurements. The filter is designed to suppress noise from industrial offline voltages. Even when the analog input filter is disabled, the minimum signal filtering is performed by the function block. The parameters of the analog input filter are presented below.

Table 4 – Universal Input Analog Input Filter Parameters

Analog Input Filter	Cut-off Frequency (at -3dB)	Settling Time (to 100% of Final Value)	Output Signal Update Rate
Disabled ¹	70Hz	10ms	1.67ms
50Hz Noise Rejection	12Hz	76.7ms	3.33ms
60Hz Noise Rejection	14Hz	63.3ms	3.33ms
Both: 60Hz and 50Hz Noise Rejection	2.3Hz	396.7ms	16.67ms

¹ Minimum filtering is still performed.

1.2.3. Current Measurements

There are two standard current ranges available for current measurements. When the current is below 3mA in the “4...20mA” current range, the output will be forced to zero to facilitate detection of an open circuit condition on the Universal Input.

The Analog Input Filter can be set to reduce the input noise.

1.2.4. Discrete Voltage Level

The Universal Inputs can accept discrete voltage levels. The user should specify the input polarity and define whether the pull-up/pull-down resistor is necessary on the input.

When the “10kOhm Pull-Up” is selected, the pull-up resistor is connected to the internal +5V power supply.

The input states are sampled every 1ms. If debouncing is required, it is set by the Discrete Input Debounce Time configuration parameter. If the Discrete Input Debounce Time is zero, the discrete voltage level input is not debounced.

1.2.5. Frequency and PWM

The frequency and PWM duty cycle measurements are performed by counting high-frequency internal clock pulses on every period of the input signal. The universal input channels have different internal organization due to limited hardware resources.

All universal inputs use 16-bit counters with the constant frequency range of 1...10kHz.

Table 5 – Universal Input Function Block Counters

Function Block	Counter	Frequency Range	Counter Base
Universal Input #1	16-bit	1Hz...10kHz	Shared with Universal Input 2, 4
Universal Input #2			Shared with Universal Input 1, 4
Universal Input #3			Dedicated counter
Universal Input #4			Shared with Universal Input 1, 2
Universal Input #5			Shared with Universal Input 7, 17
Universal Input #6			Dedicated counter
Universal Input #7			Shared with Universal Input 5, 17
Universal Input #8			Dedicated counter
Universal Input #9			Shared with Universal Input 22
Universal Input #10			Shared with Universal Input 19, 21
Universal Input #11			Dedicated counter
Universal Input #12			Dedicated counter
Universal Input #13			Shared with Universal Input 14, 20, 24
Universal Input #14			Shared with Universal Input 13, 20, 24
Universal Input #15			Dedicated counter
Universal Input #16			Shared with Universal Input 23
Universal Input #17			Shared with Universal Input 5, 7
Universal Input #18			Dedicated counter
Universal Input #19			Shared with Universal Input 10, 21
Universal Input #20			Shared with Universal Input 13, 14, 24
Universal Input #21			Shared with Universal Input 10, 19
Universal Input #22			Shared with Universal Input 9
Universal Input #23			Shared with Universal Input 16
Universal Input #24			Shared with Universal Input 13, 14, 20
Digital Input #1			Shared with Digital Input 2, 3, 4
Digital Input #2			Shared with Digital Input 1, 3, 4
Digital Input #3			Shared with Digital Input 1, 2, 4
Digital Input #4			Shared with Digital Input 1, 2, 3

There are some inputs that share a counter base, see Table 5 above. The range of inputs associated with the shared counter is determined by the **“Frequency Range”** setpoint of the input with the lower index. For instance, if Input 1 and Input 2 are used to measure PWM, the range controlled by the shared counter will be dictated by the signal on Input 1. When only one of the shared inputs is using the timer in frequency/PWM mode, the timer will automatically be Auto-ranging, and this setpoint is ignored.

To measure frequency or PWM duty cycle, the user should first select the Frequency Range parameter and then define how the “**Pull-Up/Pull-Down Resistor**”, “**Frequency/PWM Debounce Filter**”, and the “**Frequency/PWM Averaging**” parameters should be set.

The Input Polarity defines the active edge of the input signal. The Pull-Up/Pull-Down Resistor can be used to pull the input to a no-signal state to avoid an undefined input condition when the signal source is disconnected. The Input Polarity and Pull-Up/Pull-Down Resistor are normally set the following way.

Table 6 – Setting Pull-Up/Pull-Down Resistor for Selected Input Polarity. Universal Inputs

Input Polarity	Pull-Up/Pull-Down Resistor
Active High	“Disabled” or “10kOhm Pull-Down”
Active Low	“Disabled” or “10kOhm Pull-Up”

The frequency/PWM debounce filter is used to filter out parasitic spikes that can be present in a noisy input signal. It can be helpful to prevent the input from going into the Recovery state (see Section 1.2.7) when, for example, mechanical switches are used to commutate the input signal.

The debounce filter should be used with caution since it can reduce the accuracy and resolution of frequency and PWM measurements if the debouncing time is not significantly less than the period of the input signal.

When a frequency or PWM signal presents a slowly changing parameter, setting an additional moving average filter using the Frequency/PWM Averaging configuration parameter can be helpful in smoothing the results of the input measurements.

1.2.6. Software Filtering

There are three options under “**Software Filter Type**” with two actual types of software filtering: ‘*Moving Average*’ and ‘*Repeating Average*’. Both are used to smoothen the actual sampling and provide more precise data.

If customer use the ‘*Moving Average*’ type under the “**Software Filter Type**” setpoint the unit will collect the number of samples equal to the value under the “**Software Filter Constant**” setpoint and then calculate the average. Each new sample will replace the oldest sample, and the average will be recalculated during each new iteration. The algorithm is shown below:

Moving Average:

1. Calculating the first average:

$$N_{avg} = \frac{\sum_{i=0}^C N_i}{C} (1), \text{ where}$$

C – *Software Filter Constant value*;

N_i – *the number of current value*;

N_{avg} – *Average sample*.

2. Replacing the latest item and recalculating the average using formula (1):

$$N_{avg}^{(i)} = \frac{N_{avg}^{(i-1)} - N_l + N_{new}}{C} (2), \text{ where}$$

C – Software Filter Constant value;

$N_{avg}^{(i)}$ – the new average sample;

$N_{avg}^{(i-1)}$ – a previous average sample;

N_l – the oldest sample;

N_{new} – a current sample.

After first average has been calculated by using formula (1), the second formula is applied during each iteration.

Repeating Average:

The repeating average method is similar to the moving average except that instead of recalculating the average after each new sample, the unit will gather the required number of samples each time instead.

1.2.7. Special Conditions

Even though the Frequency range is 1Hz...10kHz, each Universal Input can measure frequency within the range of 0.8Hz to 12.5kHz.

When the PWM signal is absent, the duty cycle is measured as 0 or 100% based on the voltage level on the input and the selected Input Polarity. The voltage level is sampled on the counter saturation events until the PWM signal is back on the input.

The transient time between the PWM signal duty cycle and the duty cycle of the DC level when the signal disappears can be up to the Maximum Recovery Time. During the transient time, the measured value will stay equal to the last measured value of the PWM signal duty cycle.

The PWM input signal with a frequency above zero but below the Minimum Frequency value is not allowed. The duty cycle will not be measured, instead, it will be jumping between 0% and 100% depending on the voltage level at the input on the counter saturation events.

When the PWM input signal frequency exceeds the Maximum Frequency value, the input goes into the Recovery state and the PWM duty cycle is measured as 0%. Similar to frequency measurements, the input will stay in the Recovery state for up to the Maximum Recovery Time before the duty cycle is measured again.

1.3. Digital Input

The four Digital Inputs measure digital voltage with 3V threshold. The possible input types are listed below.

Table 7 – Digital Input Function Block Signal Types

Input Parameter	Type	Units
Input Disabled		
Digital ON/OFF	Discrete	{0,1}
Digital Frequency	Continuous	Hz
Digital PWM	Continuous	%DC

The input logic can be modified by changing the “Input Polarity” setpoint. This setpoint has more setting than the same setpoint in Universal and Analog Input function blocks. Beside Normal Logic and Inversed Logic there is third option: Toggle Logic. If Toggle Logic is chosen, the ECU will toggle its state each time when input is high. The available options are listed in Table 11.

Table 8 – Input Polarity Function Block Options

Value	Parameter
0	Normal Logic
1	Inverse Logic
2	Toggle Logic

1.4. Encoder Input Function Block

The controller provides two Encoder inputs, each of them has two physical inputs for connection A and B, as well as an optional Z signal. These inputs can be configured to measure digital signals generated by up to two incremental encoders.

The input type of the Encoder can be changed with the setpoint **Input Type**. The options for this setpoint are shown in Table 9.

Value	Meaning
0	Input Disabled
1	Encoder Input

Table 9 – Input Type options for Encoder Inputs

The controller has two inputs for detecting the pulses generated by an incremental encoder. The two measurements, step count and direction, are determined using these two input signals.

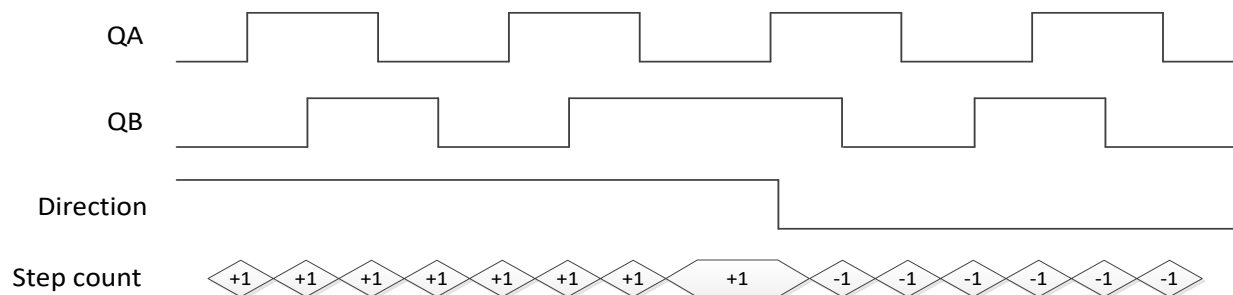


Figure 3 – Incremental Decoder Signals (QA&QB) and resulting Direction and Step count

A positive direction is indicated when the edge of signal A rises before the edge of signal B is rising. If the encoder rotates in a positive direction, the **Encoder Counter value** increases. In case the signal changes and input B becomes the leading signal, the counter value decreases, and the direction is indicated as negative.

1.4.1. Encoder Stationary Delay

The **Encoder Stationary Delay** parameter decides after how many milliseconds the direction is set to stationary (0) if no rising edge or falling edge is detected on signal A or B on the encoder input. This way, the performance of the encoder input can be adjusted for slower and faster rotating encoders. The default value for this parameter is set to 100[ms].

1.4.2. Encoder Counter Up/Down Limits

The ECU provides a feature that allows resetting the encoder's counter value at the required and adjustable point. There are two limits available to separate backward and forward directions. If the **Encoder Counter Up/Down Limit** is set to a value different from a zero, the reset will happen as soon as the counter reaches the number under this setpoint.

If the Encoder has support for a Z signal (zero position), the **Z Signal In Use** setpoint can be set to *True*. In this case, the encoder count will be reset upon detecting a rising edge on the Encoder Z pin.

1.4.3. Input Filter

Regardless of type selected, all inputs can be further filtered once the raw data has been measured. Setpoint **Data Filter Type** determines what kind of filter is used per Table 10. By default, additional software filtering is disabled.

*Note: Even though the **Data Filter Type** is available for all Inputs, the **Data Filter Constant** is unchangeable for the Encoder Input Function Block and always equal to 10.*

Value	Meaning
0	No Filter
1	Moving Average
2	Repeating Average

Table 10 – Data Filter Type Options

Setpoint **Data Filter Constant** is used with all three types of filters as per the formulas below:

Calculation with no filter:

Value = Input

The data is simply a 'snapshot' of the latest value measured by the ADC or timer.

Calculation with the moving average filter:

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

This filter is called every 1ms. The value **Data Filter Constant** is 10 by default.

Calculation with the repeating average filter:

$$\text{Value} = \frac{\sum \text{Input}_N}{N}$$

At every reading of the input value, it is added to the sum. At every Nth read, the sum is divided by N, and the result is the new input value. The value and counter will be set to zero for the next read. The value of N refers to **Data Filter Constant** and is set to 10 by default. This filter is called every 1ms.

1.4.4. 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 100 RPM and **Maximum Range** is set to 1900 RPM, the overall useful range (0-100%) is between 100 to 1900 RPM. Anything below the **Minimum Range** will saturate at **Minimum Range**. Similarly, anything above the **Maximum Range** will saturate at **Maximum Range**.

1.5. RTD Input Function Block

The RTD Input Function Block reads analog signals from two RTD sensor inputs and converts them into temperature data. The temperature data, as well as measured resistance data can be used as a control source to other function blocks. When measured temperature is used as a source to another function block, the **High/Low Warning Temperature** setpoints are used as the max/min. When measured resistance is used as a source to another function block, the **High/Low Warning Resistance** setpoints are used as the max/min.

Users can configure the sensor connection type (either 2-wire or 3-wire) and set approximation parameters for each sensor through the Axiomatic EA software. These configuration parameters are stored in the non-volatile memory of the RTD unit and automatically load upon power-up.

The AX030460 supports PT100 sensors in both 2-wire and 3-wire configurations, with supported sensor connections detailed in the table below.

Value	Description
0	RTD Disabled
1	Two Wires
2	Three Wires

Table 11 – The Types of RTD Connections

1.5.1. RTD Coefficients

The customer can set the specific coefficients within ranges. By default, the values for Callendar - Van Dusen Coefficient A, B, and C are standard (IEC 0.00385), and can be seen on the table below.

Name	Default Value	Range	Units	Description
Callendar – Van Dusen coefficient A	3.908300	-100...100	–	Callendar – Van Dusen coefficient A for the selected standard coefficient set. Editable, if the coefficient set is “User Defined”.
Callendar – Van Dusen coefficient B	-5.77500	-100...100	–	Callendar – Van Dusen coefficient B for the selected standard coefficient set. Editable, if the coefficient set is “User Defined”.
Callendar – Van Dusen coefficient C	-4.183010	-100...100	–	Callendar – Van Dusen coefficient C for the selected standard coefficient set. Editable, if the coefficient set is “User Defined”.

Table 12 – The Default Value of Coefficients

The Callendar Van Dusen coefficients can be modified to fit the PT100 used.

1.6. Diagnostic Function Blocks

The AX030460 ECU supports diagnostic messaging. A 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 15)
CM	Conversion Method	(always set to 0)
OC	Occurrence Count	(number of times the fault has happened)

In addition to supporting the DM1 message, AX030460 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 AX030460 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 4 below.

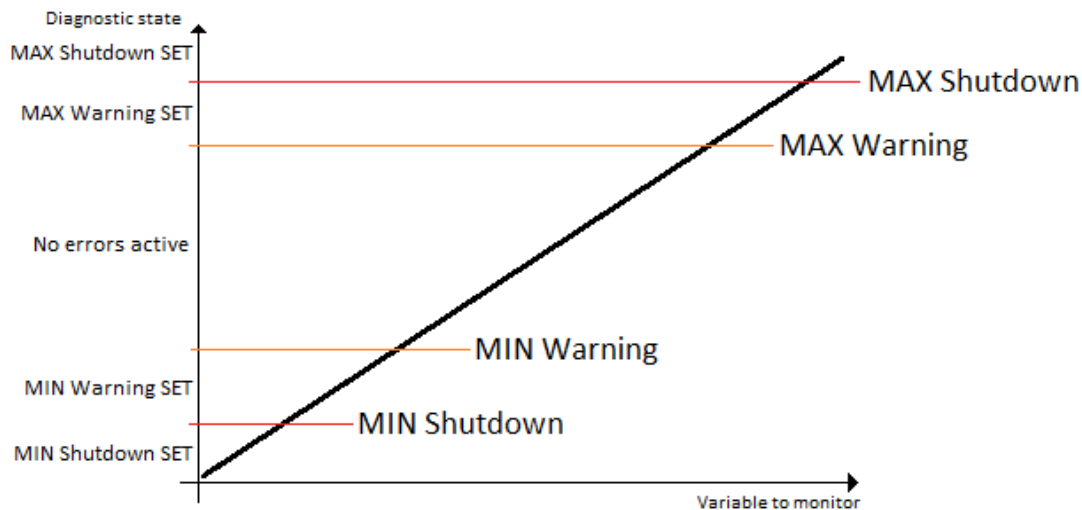


Figure 4 – Double Minimum and Maximum Error Thresholds

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 AX030460 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 13. By default, the ‘*Amber, Warning*’ lamp is typically the one set be any active fault.

Table 13 – Lamp Set by Event in DM1 Options

0	<i>Protect</i>
1	<i>Amber Warning</i>
2	<i>Red Stop</i>
3	<i>Malfunction</i>

“**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 14 – FMI for Event Options

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

Every fault has associated a default FMI with them. The used FMI can be configured with “**FMI for Event**” setpoint, presented in Table 14. When an FMI is selected from Low Fault FMIs in

Table 15 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 15. There is no automatic setting of High and Low FMIs in the firmware, the user can configure these freely.

Table 15 – Low Fault FMIs and corresponding High Fault FMIs

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

In addition to the Diagnostic messaging, the Diagnostic block indicates if it has triggered, and this True/False data can be used as an internal signal for other functional blocks. Notably, this can be used to control the LED functional block to indicate a particular fault visually. See the LED Control functional block for further detail.

1.7. LED Control Function Blocks

The AX030460 unit has ten configurable three-state LEDs to represent information required for the application. Each LED has 4 separate stages that can be configured independently, as well as a default state. The control of each LED is carried out through a unique list of control sources shown in Table 1.

The **Stage Control Source** setpoint should be configured depending on the severity/importance of what is needed to be displayed by the LED for the different stages. By default, all stage control sources are set to 0 - Control Not Used. In this case, all other setpoints correlated with the corresponding stage are not used.

Each stage provides a separate configuration for one LED with a different priority level: from the most urgent (Stage 1) to the least urgent (Stage 4). If all stages are inactive, the default stage will be active. In this case, the LED can be configured to represent a status of needed parameters in a suitable manner.

Besides **Stage Control Source**, these are the setpoints for each stage:

- **Stage Control Number.** This setpoint is used to connect the LED to required control parameter. For example, if under **Stage Control Source** Universal Input is selected and the **Stage Control Number** is equal to 1, that means that the current stage is controlled by Universal Input 1.
- **Stage Output Type.** This setpoint is responsible for setting the color of the LED. All four options are listed below.

Value	Meaning
0	<i>LEDs Disabled</i>
1	Green
2	<i>Yellow</i>
3	<i>Red</i>

Table 16 – Stage Output Type Options

- **Stage Output Response Type.** This setpoint determines one of three possible LED response patterns. All of them are listed below.

Value	Meaning
0	Normal On/Off
1	<i>Blink Logic</i>

Table 17 – Stage Output Response Type Options

- **Stage Blink Rate.** Can be configured only if “*Blink Logic*” is selected under the **Stage Output Response Type** setpoint. It determines the blinking rate in milliseconds.

All setpoints except **Stage Control Source** and **Stage Control Number** are applicable for a default stage. Initially the default stage is turned on, and it signals that all other control stages are inactive.

1.8. 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 18. 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.

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

Table 18 – 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) or 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.

1.9. 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 5 demonstrates the connections between all parameters.

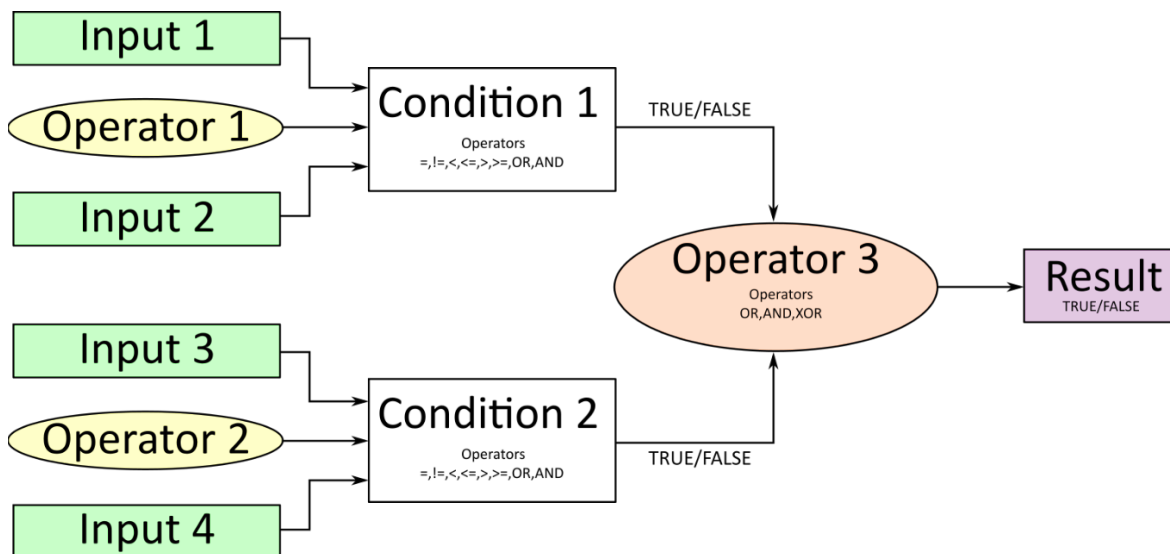


Figure 5 – Conditional Block Diagram

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.

The value of each source will then be compared to each other with an operator of Table 19. If no source is selected, the output value of an Input will be zero.

Table 19 – 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

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 20.

Table 20 – 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.

1.10. 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 21 below.

Table 21 – 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 21 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'.

1.11. 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 1.12.

Lookup tables have two differing modes defined by “X-Axis Type” setpoint, given in Table 22. 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 22 – 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 type of the slope from preceding point to the point in question. Response options are given in Table 23. ‘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 point and all the following points to be ignored.

Table 23 – PointN – Response Options

0	Ignore
1	Ramp To
2	Jump To

The X values are limited by minimum and maximum range of the selected input source if the source is a Math Function Block. For the fore 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 Xmin and Xmax are -100000 and 1000000. The X-Axis is constraint to be in rising order, thus value of the next index is greater than or equal to preceding one. Therefore, when adjusting the X-Axis data, it is recommended that X10 is changed first, then lower indexes in descending order.

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

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.

1.12. 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 24. 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 24 – 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 25, the associated Lookup Table is selected as output of the Logical block. Option ‘0 – Default Table’ selects associated Lookup Table in all conditions.

Table 25 – 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. In addition, if none of the logical operations is satisfied the Lookup Table associated with Table1 gets selected.

1.13. 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.

1.14. 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 will be 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:

- SPN 1213 and Lamp Status 0x40;
- SPN623 and Lamp Status 0x10;
- SPN624 and Lamp Status 0x04;
- SPN987 and Lamp Status 0x01;

In case if the SPNs above are chosen, the DTC React function block will set the output to HIGH if SPN and Lamp Status matches 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.

1.15. 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 AX030460 ECU has eleven CAN Transmit Messages and each message has four completely user defined signals.

1.15.1. CAN Transmit Message Setpoints

Each CAN Transmit Message setpoint group includes setpoints that effect 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 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. **User 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 case of a shared PGN repetition rate of the LOWEST numbered message are used to send the message ‘bundle’.



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.

1.15.2. 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 Table 1. 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.

1.16. 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 bus within the “**Receive Message Timeout**” period. This could trigger a Lost Communication event as described in section 1.6. 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 AX030460 Controller on Proprietary B PGNs. However, should a PDU1 message be selected, the AX030460 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 AX030460 Controller supports up to nine unique CAN Receive Messages. Defaults setpoint values are listed in section 4.15.

2. INSTALLATION INSTRUCTIONS

2.1. Dimensions and Pinout

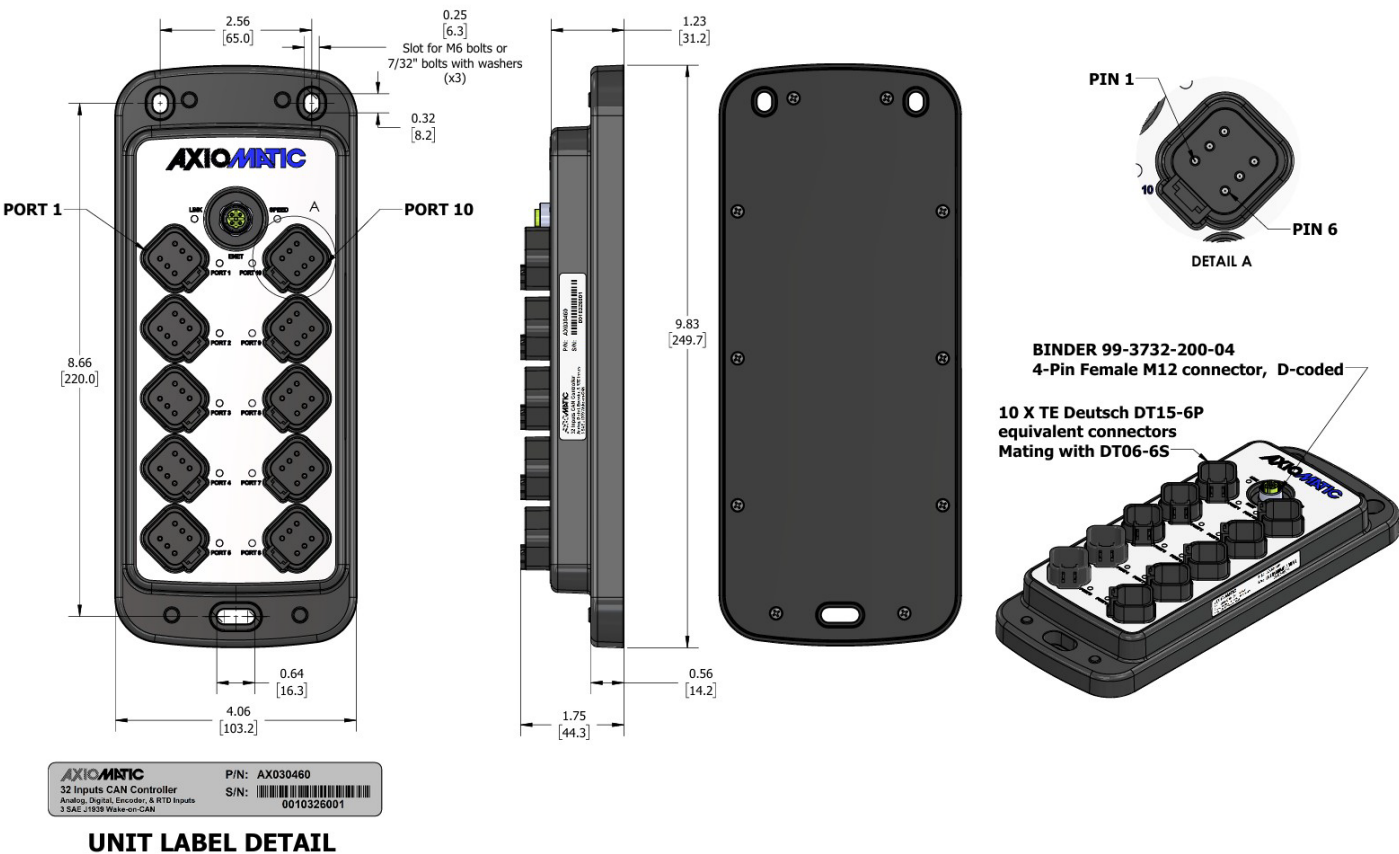


Figure 6 – AX030460 Dimensional Drawing

10x connectors, 6-pin, male, TE Deutsch equivalent P/N: DT15-6P (mates with P/N: DT06-6S)

Pin	Port 1	Port 2	Port 3	Port 4	Port 5
1	Encoder Input 1 A	RTD 1 A	Universal Input 1	Universal Input 13	Universal Input 17
2	Encoder Input 1 B	RTD 1 C	Universal Input 2	Universal Input 14	Universal Input 18
3	Encoder Input 1 Z	RTD 1 Ground	Universal Input 3	Universal Input 15	Universal Input 19
4	Encoder Input 2 Z	RTD 2 Ground	Universal Input 4	Universal Input 16	Universal Input 20
5	Encoder Input 2 B	RTD 2 C	Signal Return	Signal Return	Signal Return
6	Encoder Input 2 A	RTD 2 A	+5 V Reference	+5 V Reference	+5 V Reference

Note: Connect one wire of the same colored wire pair of the 3-wire RTD to RTD C pin and the other to RTD Ground pin.

Pin	Port 6	Port 7	Port 8	Port 9	Port 10
1	Universal Input 5	Universal Input 9	Universal Input 21	CAN 1 High	Battery +
2	Universal Input 6	Universal Input 10	Universal Input 22	CAN 2 High	Digital Input 1
3	Universal Input 7	Universal Input 11	Universal Input 23	CAN 3 High	Digital Input 2
4	Universal Input 8	Universal Input 12	Universal Input 24	CAN 3 Low	Digital Input 4
5	Signal Return	Signal Return	Signal Return	CAN 2 Low	Digital Input 3
6	+5 V Reference	+5 V Reference	+5 V Reference	CAN 1 Low	Battery -

1x M12 connector, 4-pin, D-coded, female, Binder P/N: 99-3732-200-04

Pin	ENET
1	TX +
2	RX +
3	TX -
4	RX -

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 AX030460 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	124, I/O Controller
Function Instance	7, Axiomatic AX030460
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 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 AX030460 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.

3.3. Auto Baud Rate

In the Network function block the ECU has an option to configure the auto baud-rate setting. It can be done by using the “**CAN Interface Baud-Rate**” setpoint. By default, this parameter is set to 0, *Auto Baud-Rate*. In this case, the unit will be able to reconfigure on the fly to communicate at any supported baud-rate. At power up, the ECU will listen to the bus before starting the communication. Also, the user is able to select the desired baud-rate from the drop list. In the table below, all the options are listed.

Table 26 – CAN Interface Baud-Rate Setpoint Options

Value	Description
0	Auto Baud-Rate
1	1000 kb/s
2	667 kb/s
3	500 kb/s
4	250 kb/s
5	125 kb/s

3.4. CAN Interface Enabled

In the Network function block the ECU has an option to disable CAN2 and CAN3 interfaces. It can be done by using the “**CAN Interface Enabled**” setpoint. When disabled, the specified CAN peripheral will remain active until disconnected. Once the CAN is disconnected, the ECU will not attempt to recover the CAN communication. Leaving a CAN peripheral disconnected, but enabled, will lead to the unit continuously attempting to restart the CAN, which may cause timing issues. It is therefore recommended that only the CANs which are in use are enabled. CAN1 cannot be disabled, as it is assumed to be the default.

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)*				

Parameter	Value	Description
ECU Part Number	AX030460	
ECU Serial Number	0000121001	
ECU J1939 NAME		PGN 60928, 64-bit ECU Identifier sent in Address Claimed Messages
Arbitrary Address Capable	0X01	Yes
Industry Group	0X00	Global
Vehicle System Instance	0X00	
Vehicle System	0X00	Non-specific system
Reserved	0X00	
Function	0X7C	Axiomatic IO Controller
Function Instance	0X07	
ECU Instance	0X00	#1 - First Instance
Manufacturer Code	0X0A2	Axiomatic Technologies
Identity Number	0X138AA4	Unique ECU network ID number
ECU Address	0X80	Reserved for future assignment by SAE, but available for use by self configurable ECUs
ECU ID		PGN 64965 -ECUID
ECU Part Number	AX030460	
ECU Serial Number	0000121001	
ECU Type	Controller	
ECU Manufacturer Name	Axiomatic	
Software ID		PGN 65242 -SOFT
Field #1	32 Input, 3 CAN, Ethernet Controller, SAE J1939	
Field #2	Firmware: V99.99, September 2025	

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 AX030460 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

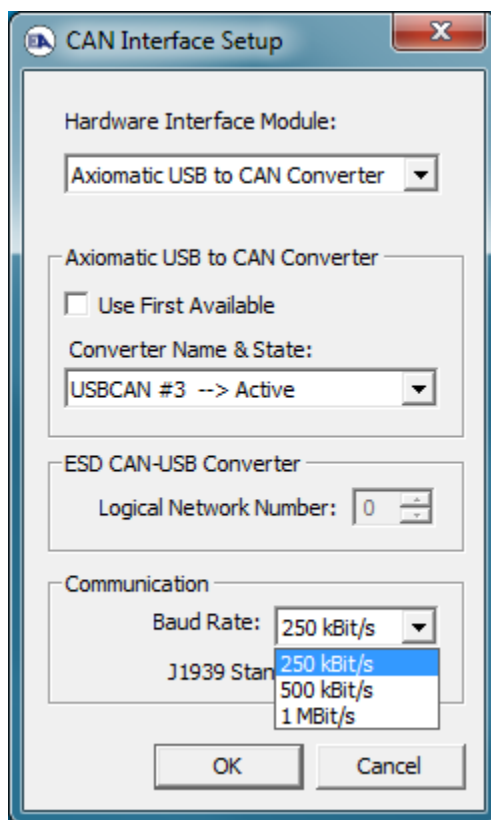
PGN 65259		Component Identification		-CI
Transmission Repetition Rate:		On request		
Data Length:		Variable		
Extended Data Page:		0		
Data Page:		0		
PDU Format:		254		
PDU Specific:		235 PGN Supporting Information:		
Default Priority:		6		
Parameter Group Number:		65259 (0x00FEEB)		
Start Position	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, refer to the relevant section in this user manual.

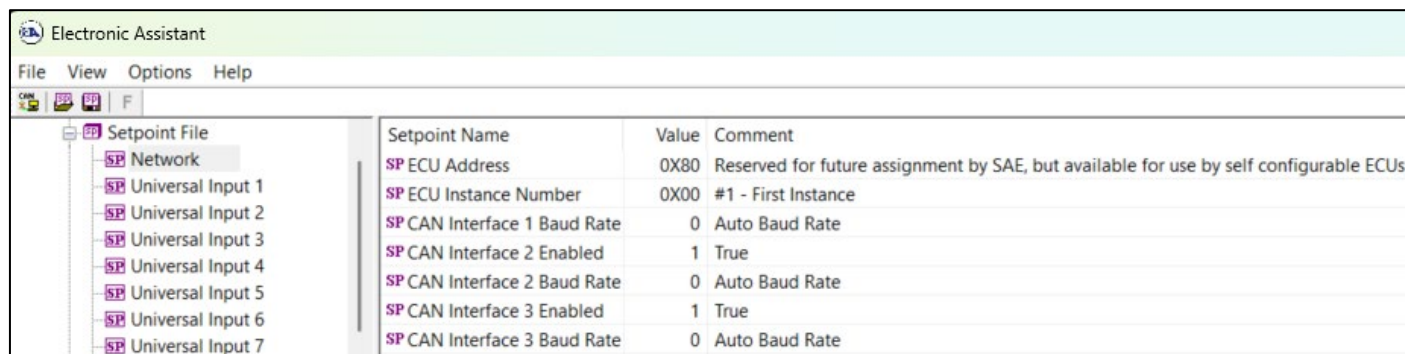
4.1. Accessing the ECU Using the Axiomatic Electronic Assistant

ECU with P/N AX030460 does not need any specific setup for the Axiomatic EA. The CAN Interface Setup can be found from “Options” menu in the Axiomatic EA. Please refer 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.



Setpoint Name	Value	Comment
SP ECU Address	0X80	Reserved for future assignment by SAE, but available for use by self configurable ECUs
SP ECU Instance Number	0X00	#1 - First Instance
SP CAN Interface 1 Baud Rate	0	Auto Baud Rate
SP CAN Interface 2 Enabled	1	True
SP CAN Interface 2 Baud Rate	0	Auto Baud Rate
SP CAN Interface 3 Enabled	1	True
SP CAN Interface 3 Baud Rate	0	Auto Baud Rate

Figure 8 – Screen Capture of J1939 Setpoints

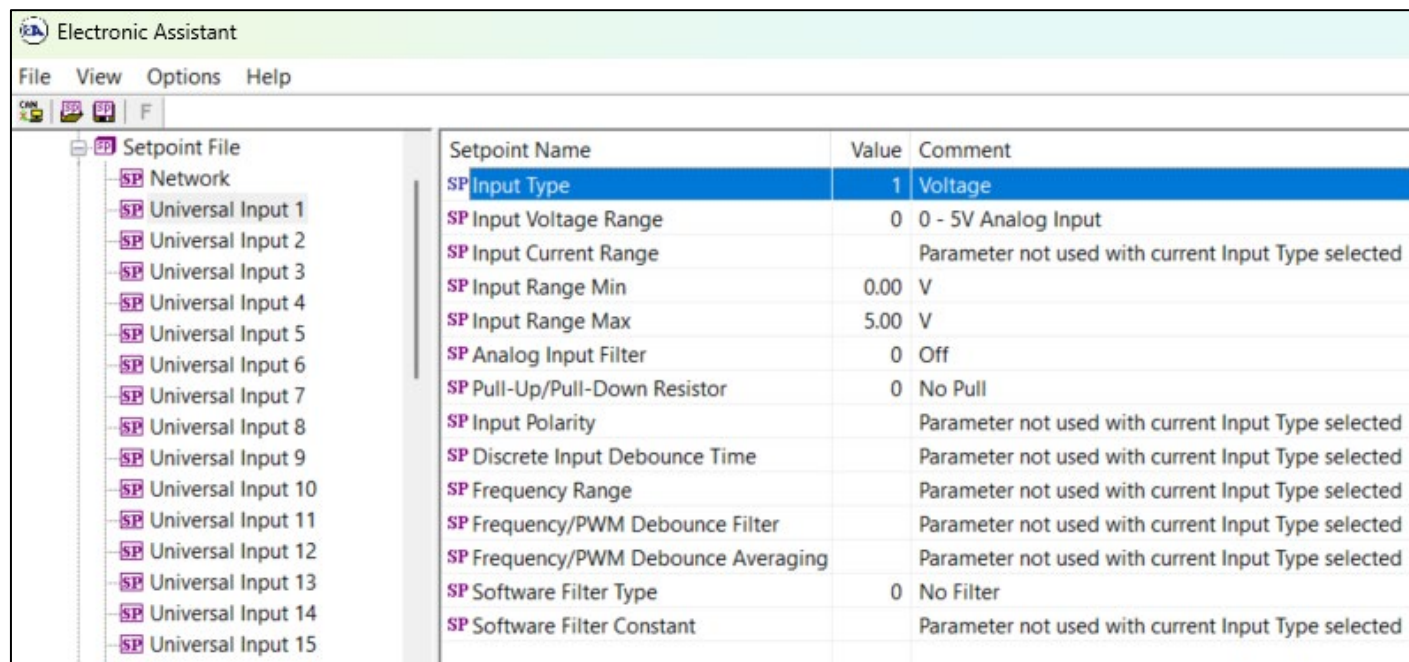
Table 27 – J1939 Network Setpoints

Name	Range	Default	Notes
ECU Address	0x80	0-253	Preferred address for a self-configurable ECU
ECU Instance	0-7	0x00	Per J1939-81
CAN Interface 1 Baud Rate	Drop List	0, Auto Baud Rate	
CAN Interface 2 Enabled	0-1	1, True	
CAN Interface 2 Baud Rate	Drop List	0, Auto Baud Rate	
CAN Interface 3 Enabled	0-1	1, True	
CAN Interface 3 Baud Rate	Drop List	0, Auto Baud Rate	

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. Universal Input Setpoints

The Universal Inputs are defined in section 1.2.



Setpoint Name	Value	Comment
SP Input Type	1	Voltage
SP Input Voltage Range	0	0 - 5V Analog Input
SP Input Current Range		Parameter not used with current Input Type selected
SP Input Range Min	0.00	V
SP Input Range Max	5.00	V
SP Analog Input Filter	0	Off
SP Pull-Up/Pull-Down Resistor	0	No Pull
SP Input Polarity		Parameter not used with current Input Type selected
SP Discrete Input Debounce Time		Parameter not used with current Input Type selected
SP Frequency Range		Parameter not used with current Input Type selected
SP Frequency/PWM Debounce Filter		Parameter not used with current Input Type selected
SP Frequency/PWM Debounce Averaging		Parameter not used with current Input Type selected
SP Software Filter Type	0	No Filter
SP Software Filter Constant		Parameter not used with current Input Type selected

Figure 9 – Screen Capture of Universal Input Setpoints

Table 28 – Universal Input Setpoints

Name	Range	Default	Notes
Input Type	Drop List	Input Disabled	See Section 1.2
Input Voltage Range	Drop List	0, 0-5V Analog Input	See Section 1.2
Input Current Range	Drop List	0, 0-20mA Current Input	See Section 1.2
Input Range Min	0..100	0	See Section 1.2
Input Range Max	0..100	5	See Section 1.2
Analog Input Filter	Drop List	0, Off	See Section 1.2
Pullup/Pulldown Resistor	Drop List	0, No Pull	See Section 1.2
Input Polarity	Drop List	0, Active High	See Section 1.2
Discrete Input Debounce Time	0..60000	50 ms	See Section 1.2
Frequency Range	Drop List	1kHz to 10kHz	See Section 1.2
Frequency/PWM Debounce Filter	Drop List	0, No Filter	See Section 1.2
Frequency/PWM Debounce Averaging	Drop List	0, No Averaging	See Section 1.2
Software Filter Type	Drop List	0, Disabled	See Section 1.2
Software Filter Constant	0..60000	10	See Section 1.2

4.4. Digital Input Setpoints

The Digital Inputs are defined in section 1.3.

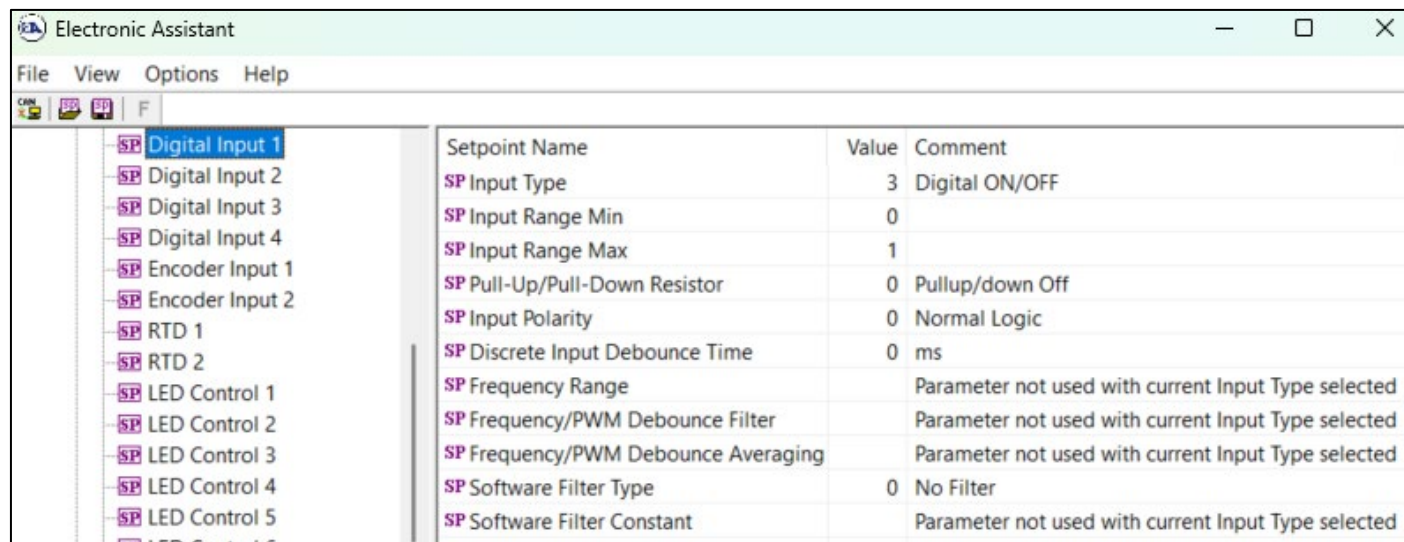


Figure 10 – Screen Capture of Digital Input Setpoints

Table 29 – Digital Input Setpoints

Name	Range	Default	Notes
Input Type	Drop List	1, Digital ON/OFF	See Section 1.3
Input Range Min	0-1	0	
Input Range Max	0-1	1	
Pullup/Pulldown Resistor	Drop List	0, Pullup/down Off	See Section 1.2.4
Input Polarity	Drop List	0, Nirmal Logic	
Discrete Input Debounce Time	0..60000	50 ms	See Section 1.2.4
Frequency Range	Drop List	1kHz to 10kHz	See Section 1.3
Frequency/PWM Debounce Filter	Drop List	0, No Filter	See Section 1.3
Frequency/PWM Debounce Averaging	Drop List	0, No Averaging	See Section 1.3
Software Filter Type	Drop List	0, Disabled	See Section 1.3
Software Filter Constant	0...60000	10	See Section 1.3

4.5. Encoder Input Setpoints

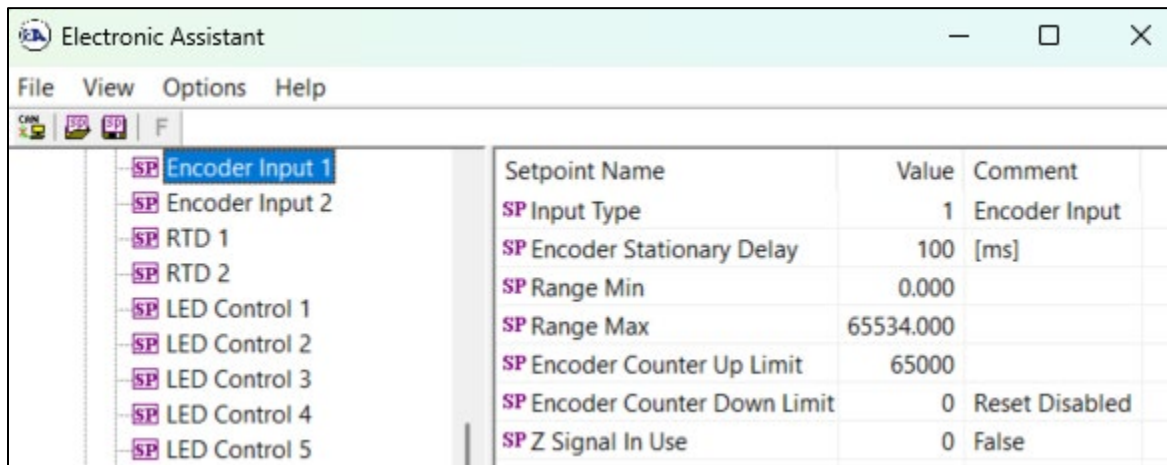


Figure 11 – Screen Capture of Encoder Setpoints

Table 30 – Proportional Output Setpoints

Name	Range	Default	Notes
Input Type	Drop List	Input Disabled	
Encoder Stationary Delay	0 to 65000	100	milliseconds
Range Min	0 to 65534	0	
Range Max	0 to 65534	65534	
Encoder Counter Up Limit	0 to 86400000	65000	
Encoder Counter Down Limit	0 to 86400000	0	
Z Signal In Use	Drop List	False	

4.6. RTD Input Setpoints

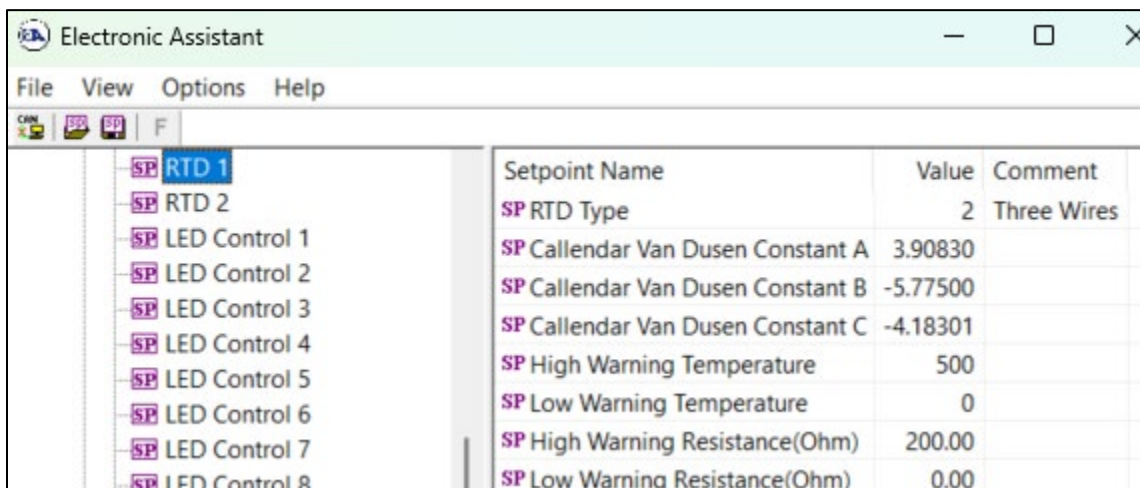
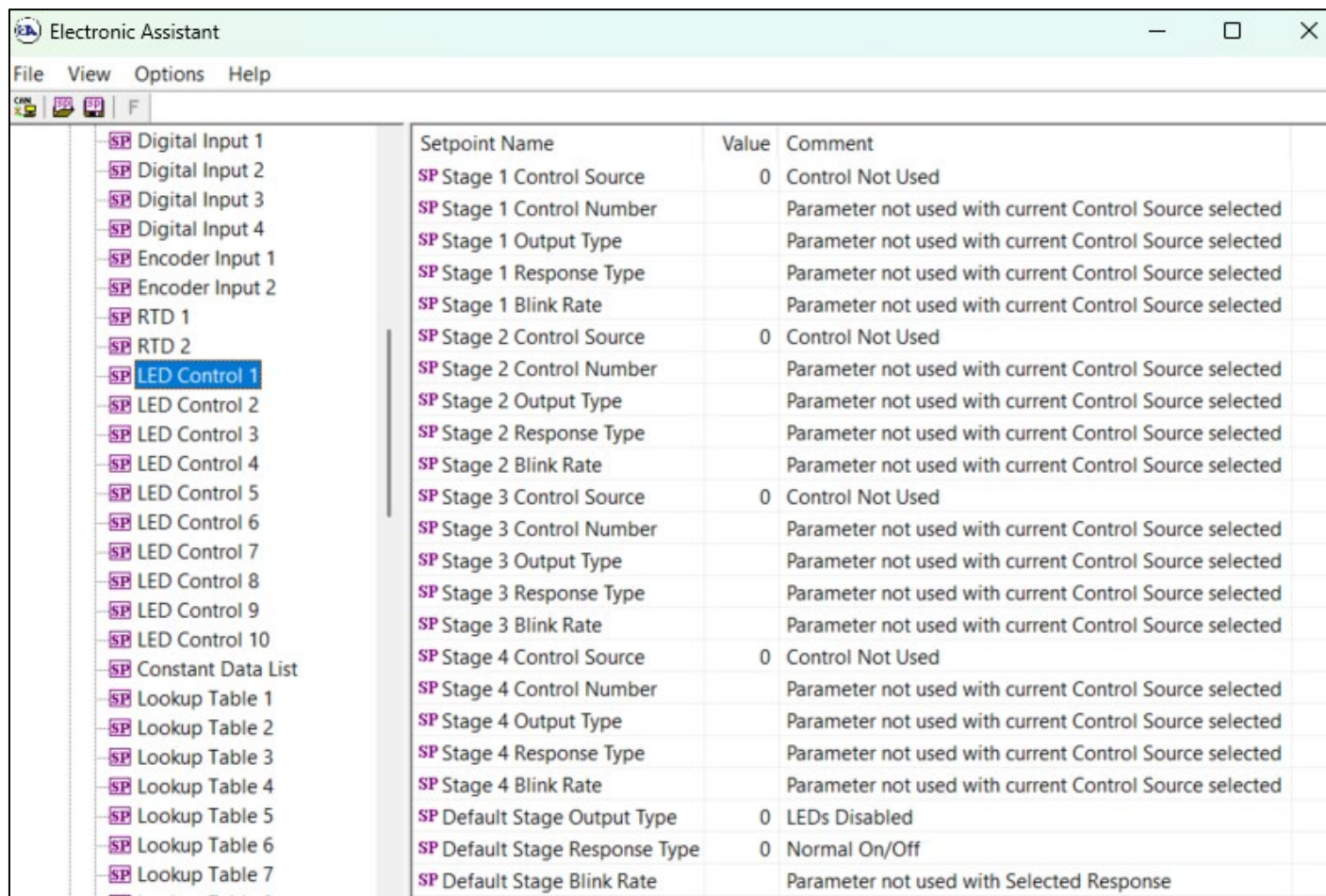


Figure 12 – Screen Capture of RTD Setpoints

Table 31 – Proportional Output Setpoints

Name	Range	Default	Notes
RTD Type	Drop List	2 – Three Wire RTD	
Callendar Van Dusen Constant A	-100 to 100	3.90830	
Callendar Van Dusen Constant B	-100 to 100	-5.77500	
Callendar Van Dusen Constant C	-100 to 100	-4.18301	
High Warning Temperature	500		
Low Warning Temperature	0		
High Warning Resistance	200		
Low Warning Resistance	0		

4.7. LED Control Setpoints



Setpoint Name	Value	Comment
SP Stage 1 Control Source	0	Control Not Used
SP Stage 1 Control Number		Parameter not used with current Control Source selected
SP Stage 1 Output Type		Parameter not used with current Control Source selected
SP Stage 1 Response Type		Parameter not used with current Control Source selected
SP Stage 1 Blink Rate		Parameter not used with current Control Source selected
SP Stage 2 Control Source	0	Control Not Used
SP Stage 2 Control Number		Parameter not used with current Control Source selected
SP Stage 2 Output Type		Parameter not used with current Control Source selected
SP Stage 2 Response Type		Parameter not used with current Control Source selected
SP Stage 2 Blink Rate		Parameter not used with current Control Source selected
SP Stage 3 Control Source	0	Control Not Used
SP Stage 3 Control Number		Parameter not used with current Control Source selected
SP Stage 3 Output Type		Parameter not used with current Control Source selected
SP Stage 3 Response Type		Parameter not used with current Control Source selected
SP Stage 3 Blink Rate		Parameter not used with current Control Source selected
SP Stage 4 Control Source	0	Control Not Used
SP Stage 4 Control Number		Parameter not used with current Control Source selected
SP Stage 4 Output Type		Parameter not used with current Control Source selected
SP Stage 4 Response Type		Parameter not used with current Control Source selected
SP Stage 4 Blink Rate		Parameter not used with current Control Source selected
SP Default Stage Output Type	0	LEDs Disabled
SP Default Stage Response Type	0	Normal On/Off
SP Default Stage Blink Rate		Parameter not used with Selected Response

Figure 13 – Screen Capture of LED Setpoints

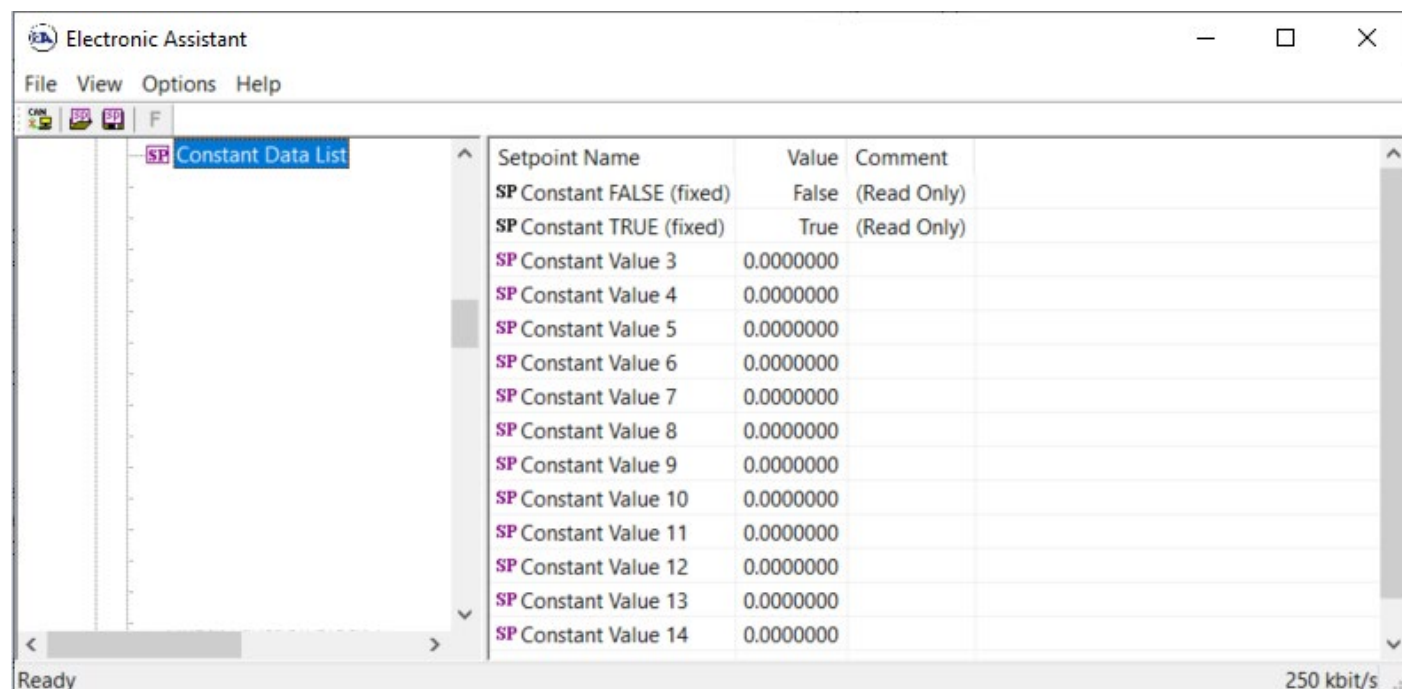
Table 32 – Proportional Output Setpoints

Name	Range	Default	Notes
Stage 1...4 Control Source	Drop List	Control Not Used	See Table 1
Stage 1...4 Control Number	Depends on control source	1	See Table 1
Stage 1...4 Output Type	Drop List	0 – LED Disabled	
Stage 1...4 Response	Drop List	0 – Normal On/Off	
Stage 1...4 Blink Rate	0 to 60000	0 ms	
Default Output Type	Drop List	0 – LED Disabled	
Default Response	Drop List	0 – Normal On/Off	
Default Blink Rate	0 to 60000	0 ms	

4.8. Constant Data List

The Constant Data List Function Block is provide 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 14) are arbitrary and should be configured by the user as appropriate for their application.



The screenshot shows the 'Electronic Assistant' window with a menu bar (File, View, Options, Help) and a toolbar. The main area displays a table titled 'Constant Data List' with the following data:

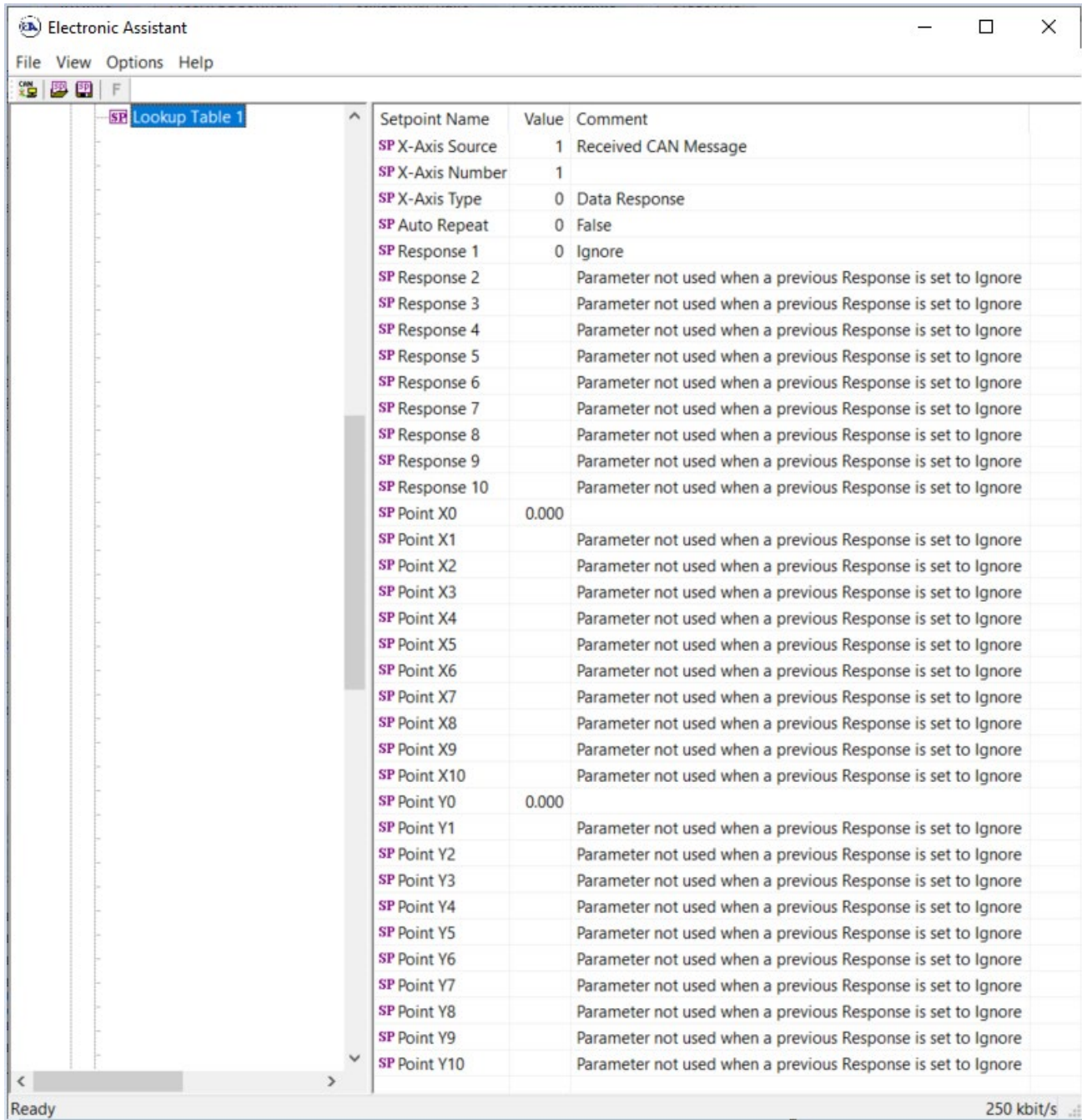
Setpoint Name	Value	Comment
SP Constant FALSE (fixed)	False	(Read Only)
SP Constant TRUE (fixed)	True	(Read Only)
SP Constant Value 3	0.0000000	
SP Constant Value 4	0.0000000	
SP Constant Value 5	0.0000000	
SP Constant Value 6	0.0000000	
SP Constant Value 7	0.0000000	
SP Constant Value 8	0.0000000	
SP Constant Value 9	0.0000000	
SP Constant Value 10	0.0000000	
SP Constant Value 11	0.0000000	
SP Constant Value 12	0.0000000	
SP Constant Value 13	0.0000000	
SP Constant Value 14	0.0000000	

The status bar at the bottom indicates 'Ready' and '250 kbit/s'.

Figure 14 – Screen Capture of Constant Data List Setpoints

4.9. Lookup Table

The Lookup Table Function Block is defined in Section 1.11 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	0	False
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

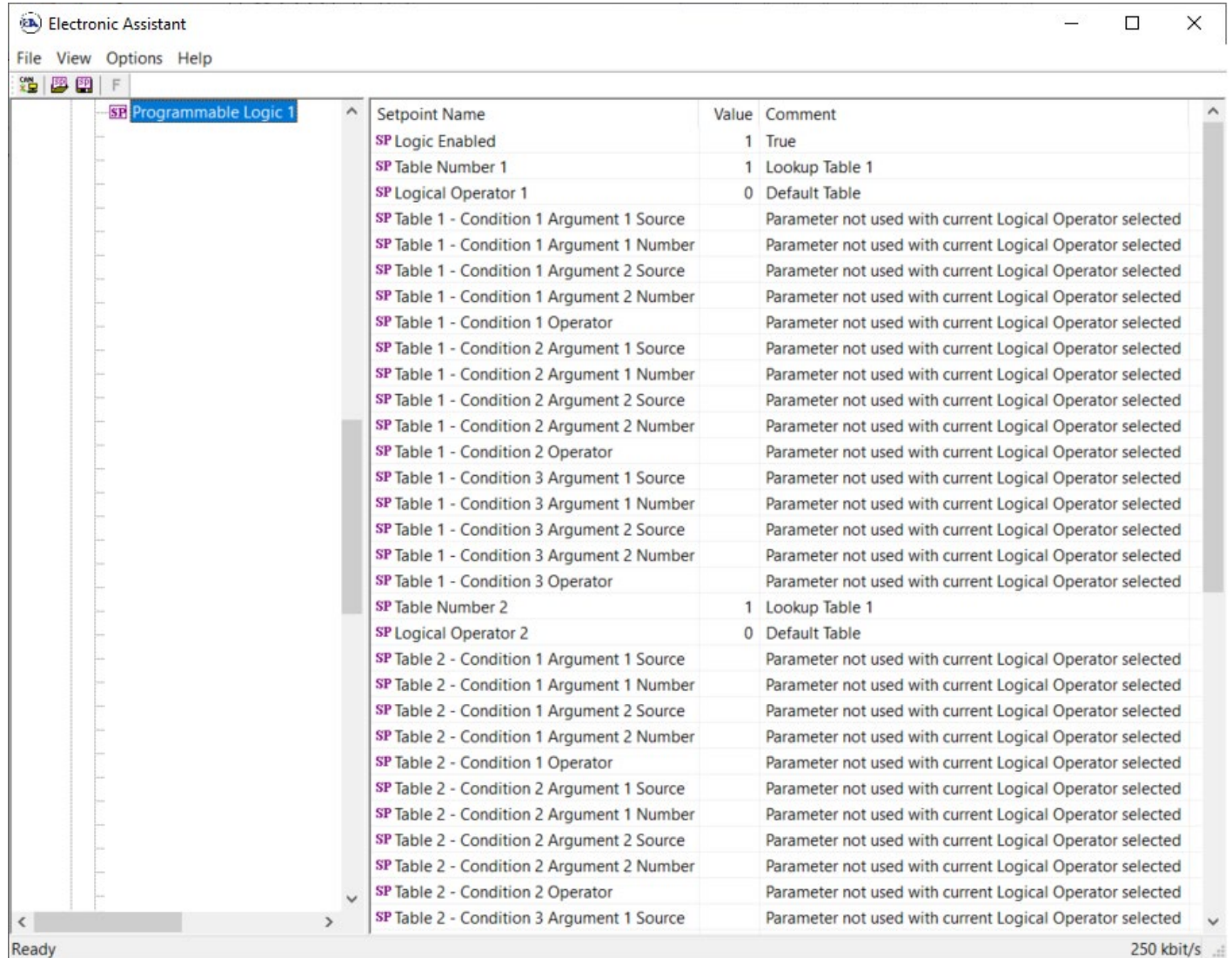
Figure 15 – Screen Capture of Lookup table Setpoints

Table 33 – Lookup Table Setpoints

Name	Range	Default	Notes
X-Axis Source	Drop List	Control Not Used	See Table 1
X-Axis Number	Depends on control source	1	See Table 1
X-Axis Type	Drop List	Data Response	See Table 22
Table Auto-Cycle	Drop List	0	
Point 1 - Response	Drop List	Ramp To	See Table 23
Point 2 - Response	Drop List	Ramp To	See Table 23
Point 3 - Response	Drop List	Ramp To	See Table 23
Point 4 - Response	Drop List	Ramp To	See Table 23
Point 5 - Response	Drop List	Ramp To	See Table 23
Point 6 - Response	Drop List	Ramp To	See Table 23
Point 7 - Response	Drop List	Ramp To	See Table 23
Point 8 - Response	Drop List	Ramp To	See Table 23
Point 9 - Response	Drop List	Ramp To	See Table 23
Point 10 - Response	Drop List	Ramp To	See Table 23
Point 1 - X Value	From X-Axis source minimum to Point 1 - X Value	X-Axis source minimum 0.000	See Section 1.11
Point 2 - X Value	From Point 0 - X Value to Point 2 - X Value	0.500	See Section 1.11
Point 3 - X Value	From Point 1 - X Value to Point 3 - X Value	1.000	See Section 1.11
Point 4 - X Value	From Point 2 - X Value to Point 4 - X Value	1.500	See Section 1.11
Point 5 - X Value	From Point 3 - X Value to Point 5 - X Value source	2.000	See Section 1.11
Point 6 - X Value	From Point 4 - X Value to Point 6 - X Value	2.500	See Section 1.11
Point 7 - X Value	From Point 5 - X Value to Point 7 - X Value	3.000	See Section 1.11
Point 8 - X Value	From Point 6 - X Value to Point 8 - X Value	3.500	See Section 1.11
Point 9 - X Value	From Point 7 - X Value to Point 9 - X Value	4.000	See Section 1.11
Point 10 - X Value	From Point 8 - X Value to Point 10 - X Value	4.500	See Section 1.11
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	

4.10. Programmable Logic

The Programmable Logic function block is defined in Section 1.12. 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**”.



The screenshot shows the 'Electronic Assistant' window with a menu bar (File, View, Options, Help) and a toolbar. The main area displays a table of setpoints for 'Programmable Logic 1'. The table has three columns: Setpoint Name, Value, and Comment. The setpoints are organized into two main sections: Table 1 and Table 2, each with its own Logical Operator and multiple conditions. Most values are set to 0 (Default Table), while 'SP Logic Enabled' is set to 1 (True). Comments for most setpoints indicate they are 'Parameter not used with current Logical Operator selected'.

Setpoint Name	Value	Comment
SP Logic Enabled	1	True
SP Table Number 1	1	Lookup Table 1
SP Logical Operator 1	0	Default Table
SP Table 1 - Condition 1 Argument 1 Source		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 1 Argument 1 Number		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 1 Argument 2 Source		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 1 Argument 2 Number		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 1 Operator		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 2 Argument 1 Source		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 2 Argument 1 Number		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 2 Argument 2 Source		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 2 Argument 2 Number		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 2 Operator		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 3 Argument 1 Source		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 3 Argument 1 Number		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 3 Argument 2 Source		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 3 Argument 2 Number		Parameter not used with current Logical Operator selected
SP Table 1 - Condition 3 Operator		Parameter not used with current Logical Operator selected
SP Table Number 2	1	Lookup Table 1
SP Logical Operator 2	0	Default Table
SP Table 2 - Condition 1 Argument 1 Source		Parameter not used with current Logical Operator selected
SP Table 2 - Condition 1 Argument 1 Number		Parameter not used with current Logical Operator selected
SP Table 2 - Condition 1 Argument 2 Source		Parameter not used with current Logical Operator selected
SP Table 2 - Condition 1 Argument 2 Number		Parameter not used with current Logical Operator selected
SP Table 2 - Condition 1 Operator		Parameter not used with current Logical Operator selected
SP Table 2 - Condition 2 Argument 1 Source		Parameter not used with current Logical Operator selected
SP Table 2 - Condition 2 Argument 1 Number		Parameter not used with current Logical Operator selected
SP Table 2 - Condition 2 Argument 2 Source		Parameter not used with current Logical Operator selected
SP Table 2 - Condition 2 Argument 2 Number		Parameter not used with current Logical Operator selected
SP Table 2 - Condition 2 Operator		Parameter not used with current Logical Operator selected
SP Table 2 - Condition 3 Argument 1 Source		Parameter not used with current Logical Operator selected

Figure 16 – Screen Capture of Programmable Logic Setpoints

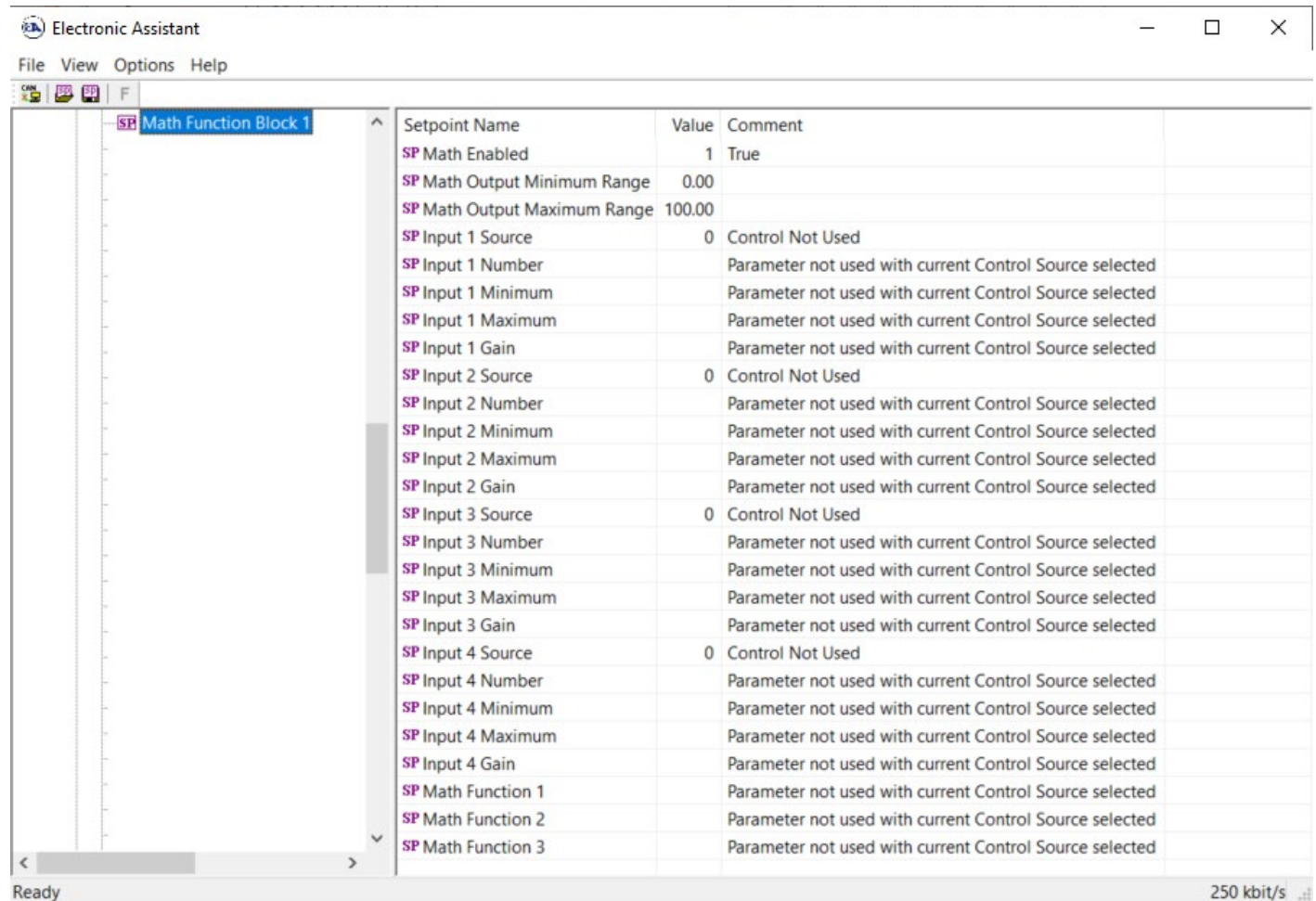
Setpoint ranges and default values for Programmable Logic Blocs are listed in Table 34. Only “**Table1**” setpoint are listed, because other “**TableX**” setpoints are similar, except for the default value of the “**Lookup Table Block Number**” setpoint, which is X for “**TableX**”.

Table 34 – 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 25
Table1 - Condition1, Argument 1 Source	Drop List	Control Not Used	See Table 1
Table1 - Condition1, Argument 1 Number	Depends on control source	1	See Table 1
Table1 - Condition1, Operator	Drop List	=, Equal	See Table 24
Table1 - Condition1, Argument 2 Source	Drop List	Control Not Used	See Table 1
Table1 - Condition1, Argument 2 Number	Depends on control source	1	See Table 1
Table1 - Condition2, Argument 1 Source	Drop List	Control Not Used	See Table 1
Table1 - Condition2, Argument 1 Number	Depends on control source	1	See Table 1
Table1 - Condition2, Operator	Drop List	=, Equal	See Table 24
Table1 - Condition2, Argument 2 Source	Drop List	Control Not Used	See Table 1
Table1 - Condition2, Argument 2 Number	Depends on control source	1	See Table 1
Table1 - Condition3, Argument 1 Source	Drop List	Control Not Used	See Table 1
Table1 - Condition3, Argument 1 Number	Depends on control source	1	See Table 1
Table1 - Condition3, Operator	Drop List	=, Equal	See Table 24
Table1 - Condition3, Argument 2 Source	Drop List	Control Not Used	See Table 1
Table1 - Condition3, Argument 2 Number	Depends on control source	1	See Table 1

4.11. Math Function Block

The Math Function Block is defined in Section 1.8. 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**”.



Setpoint Name	Value	Comment
SP Math Enabled	1	True
SP Math Output Minimum Range	0.00	
SP Math Output Maximum Range	100.00	
SP Input 1 Source	0	Control Not Used
SP Input 1 Number		Parameter not used with current Control Source selected
SP Input 1 Minimum		Parameter not used with current Control Source selected
SP Input 1 Maximum		Parameter not used with current Control Source selected
SP Input 1 Gain		Parameter not used with current Control Source selected
SP Input 2 Source	0	Control Not Used
SP Input 2 Number		Parameter not used with current Control Source selected
SP Input 2 Minimum		Parameter not used with current Control Source selected
SP Input 2 Maximum		Parameter not used with current Control Source selected
SP Input 2 Gain		Parameter not used with current Control Source selected
SP Input 3 Source	0	Control Not Used
SP Input 3 Number		Parameter not used with current Control Source selected
SP Input 3 Minimum		Parameter not used with current Control Source selected
SP Input 3 Maximum		Parameter not used with current Control Source selected
SP Input 3 Gain		Parameter not used with current Control Source selected
SP Input 4 Source	0	Control Not Used
SP Input 4 Number		Parameter not used with current Control Source selected
SP Input 4 Minimum		Parameter not used with current Control Source selected
SP Input 4 Maximum		Parameter not used with current Control Source selected
SP Input 4 Gain		Parameter not used with current Control Source selected
SP Math Function 1		Parameter not used with current Control Source selected
SP Math Function 2		Parameter not used with current Control Source selected
SP Math Function 3		Parameter not used with current Control Source selected

Figure 17 – Screen Capture of Math Function Block Setpoints

Table 35 – 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 1
Function 1 Input A Number	Depends on control source	1	See Table 1
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 1
Function 1 Input B Number	Depends on control source	1	See Table 1
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 18
Function 2 Input B Source	Drop List	Control not used	See Table 1
Function 2 Input B Number	Depends on control source	1	See Table 1
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 18
Function 3 Input B Source	Drop List	Control not used	See Table 1
Function 3 Input B Number	Depends on control source	1	See Table 1
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 18
Function 4 Input B Source	Drop List	Control not used	See Table 1
Function 4 Input B Number	Depends on control source	1	See Table 1
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 18
Math Output Minimum Range	-10^6 to 10^6	0.0	
Math Output Maximum Range	-10^6 to 10^6	100.0	

4.12. Conditional Logic 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 Figure 18 displays the available setpoints for each of the Conditional Blocks. The table below the screen capture highlights the allowable ranges for each setpoint.

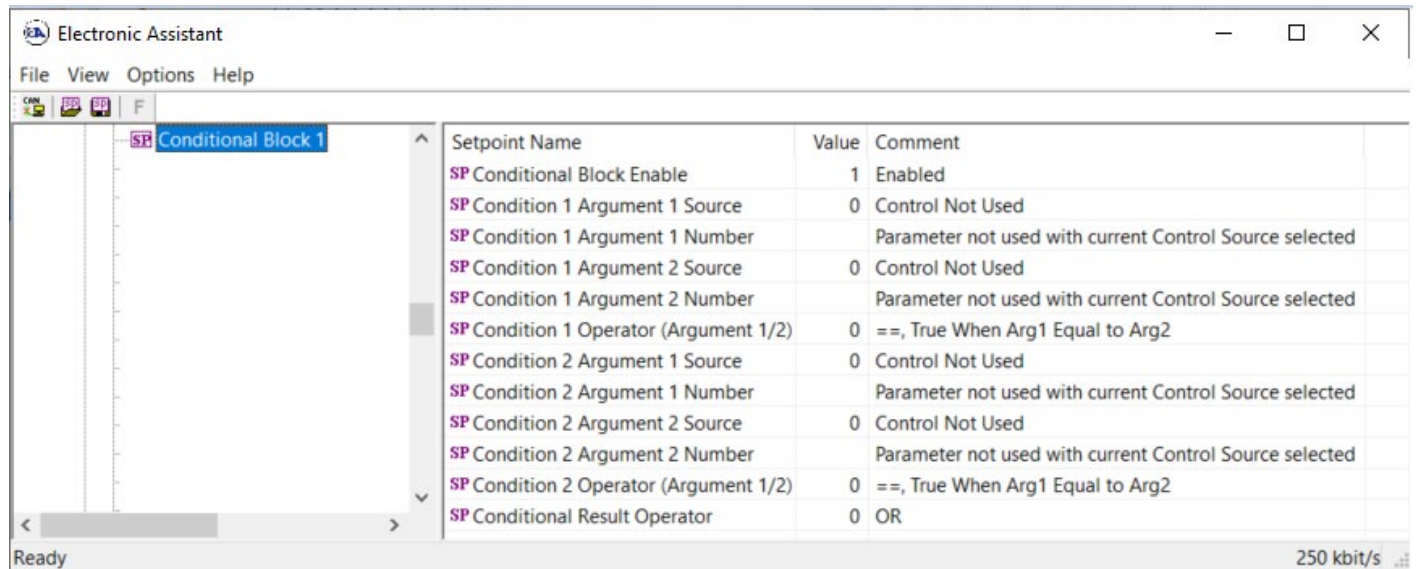


Figure 18 – Screen Capture of Conditional Block Setpoints

Table 36 – Default Conditional Block Setpoints

Name	Range	Default	Notes
Conditional Function Enabled	Drop List	Disabled	
Condition 1 Argument 1 Source	Drop List	Digital Input	See Table 1
Condition 1 Argument 1 Number	Depends on Source Selected	0	See Table 1
Condition 1 Argument 2 Source	Drop List	Digital Input	See Table 1
Condition 1 Argument 2 Number	Depends on Source Selected	0	See Table 1
Condition 1 Operator (Argument 1/2)	Drop List	0	Refer to Table 19
Condition 2 Argument 1 Source	Drop List	Digital Input	See Table 1
Condition 2 Argument 1 Number	Depends on Source Selected	0	See Table 1
Condition 2 Argument 2 Source	Drop List	Digital Input	See Table 1
Condition 2 Argument 2 Number	Depends on Source Selected	0	See Table 1
Condition 2 Operator (Argument 1/2)	Drop List	0	Refer to Table 19
Conditional Result Operator	Drop List	OR	Refer to Table 20

4.13. 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 Figure 19 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.

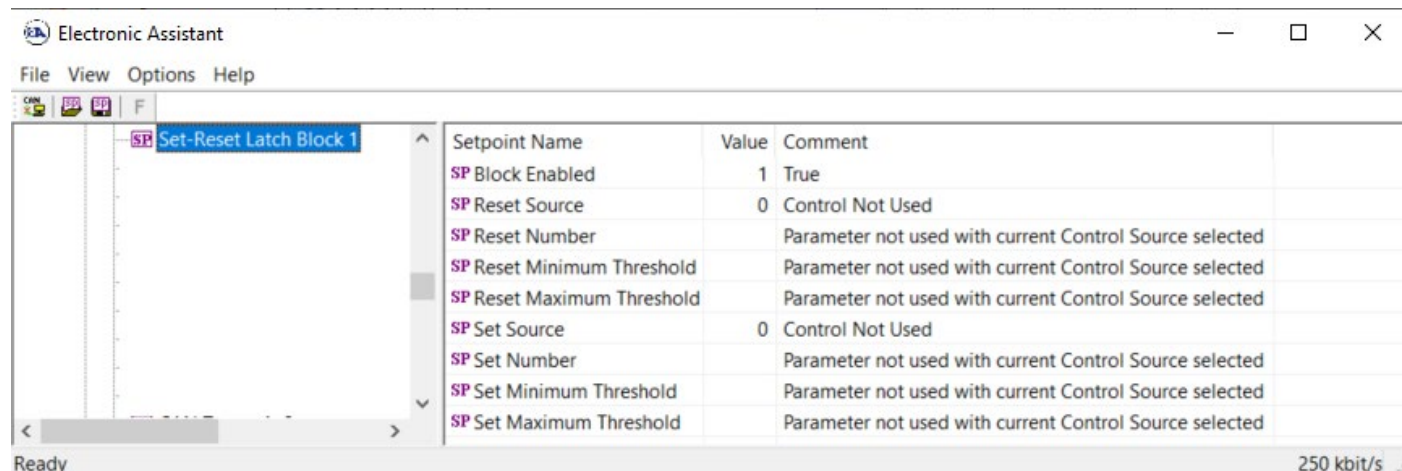


Figure 19 – Screen Capture of Set-Reset Latch Block Setpoints

Table 37 – Default Set-Reset Latch Block Setpoints

Name	Range	Default	Notes
Block Enabled	Drop List	False	
Reset Source	Drop List	Control Not Used	See Table 1
Reset Number	Depends on Source Selected	1	See Table 1
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	See Table 1
Set Number	Drop List	1	See Table 1
Set Minimum Threshold	Depends on Source Selected	0%	Refer to Section 1.10
Set Maximum Threshold	Drop List	100%	Refer to Section 1.10

4.14. CAN Transmit Setpoints

CAN Transmit Message Function Block is presented in section 1.15. Please refer there for detailed information how these setpoints are used. **“Transmit Repetition Rate”** is 0ms by default, thus no message will be sent.

The screenshot shows the 'Electronic Assistant' window with the 'CAN' tab selected. The left pane lists various setpoint blocks, with 'CAN Transmit 1' highlighted. The right pane displays a table of setpoint parameters for 'CAN Transmit 1'.

Setpoint Name	Value	Comment
SP CAN Interface	1	CAN Interface 1
SP Transmit Enabled	0	False
SP PGN		Parameter not used - Transmit Message is Disabled
SP Repetition Rate		Parameter not used - Transmit Message is Disabled
SP Message Priority		Parameter not used - Transmit Message is Disabled
SP Destination Address (PDU1)		Parameter not used - Transmit Message is Disabled
SP Message Length		Parameter not used - Transmit Message is Disabled
SP Signal 1 Data Type		Parameter not used - Transmit Message is Disabled
SP Signal 1 Data Source		Parameter not used - Transmit Message is Disabled
SP Signal 1 Data Number		Parameter not used - Transmit Message is Disabled
SP Signal 1 Data Size		Parameter not used - Transmit Message is Disabled
SP Signal 1 Byte Index		Parameter not used - Transmit Message is Disabled
SP Signal 1 Bit Index		Parameter not used - Transmit Message is Disabled
SP Signal 1 Resolution		Parameter not used - Transmit Message is Disabled
SP Signal 1 Offset		Parameter not used - Transmit Message is Disabled
SP Signal 1 Data Min		Parameter not used - Transmit Message is Disabled
SP Signal 1 Data Max		Parameter not used - Transmit Message is Disabled
SP Signal 2 Data Type		Parameter not used - Transmit Message is Disabled
SP Signal 2 Data Source		Parameter not used - Transmit Message is Disabled
SP Signal 2 Data Number		Parameter not used - Transmit Message is Disabled
SP Signal 2 Data Size		Parameter not used - Transmit Message is Disabled
SP Signal 2 Byte Index		Parameter not used - Transmit Message is Disabled
SP Signal 2 Bit Index		Parameter not used - Transmit Message is Disabled
SP Signal 2 Resolution		Parameter not used - Transmit Message is Disabled
SP Signal 2 Offset		Parameter not used - Transmit Message is Disabled
SP Signal 2 Data Min		Parameter not used - Transmit Message is Disabled
SP Signal 2 Data Max		Parameter not used - Transmit Message is Disabled
SP Signal 3 Data Type		Parameter not used - Transmit Message is Disabled
SP Signal 3 Data Source		Parameter not used - Transmit Message is Disabled
SP Signal 3 Data Number		Parameter not used - Transmit Message is Disabled
SP Signal 3 Data Size		Parameter not used - Transmit Message is Disabled
SP Signal 3 Byte Index		Parameter not used - Transmit Message is Disabled
SP Signal 3 Bit Index		Parameter not used - Transmit Message is Disabled

The status bar at the bottom indicates 'Ready' and '250 kbit/s'.

Figure 20 – Screen Capture of CAN Transmit Message Setpoints

Table 38 – 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 section 1.15.1
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 Table 1
Signal X Control Number	Drop List	Different for each	See 1.15.2
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	

4.15. CAN Receive Setpoints

The CAN Receive Block is defined in section 1.16. 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.

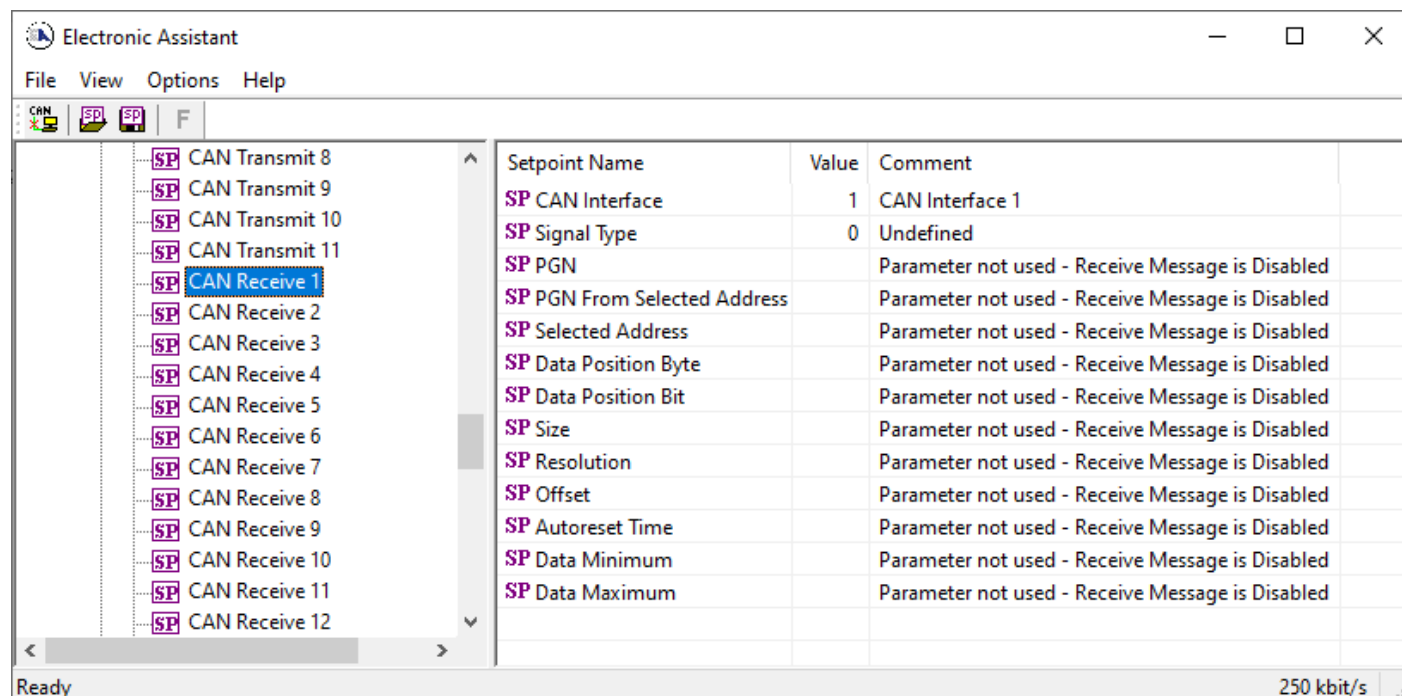


Figure 21 – Screen Capture of CAN Receive Message Setpoints

Table 39 – 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	

4.16. 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 1.6 for more info.

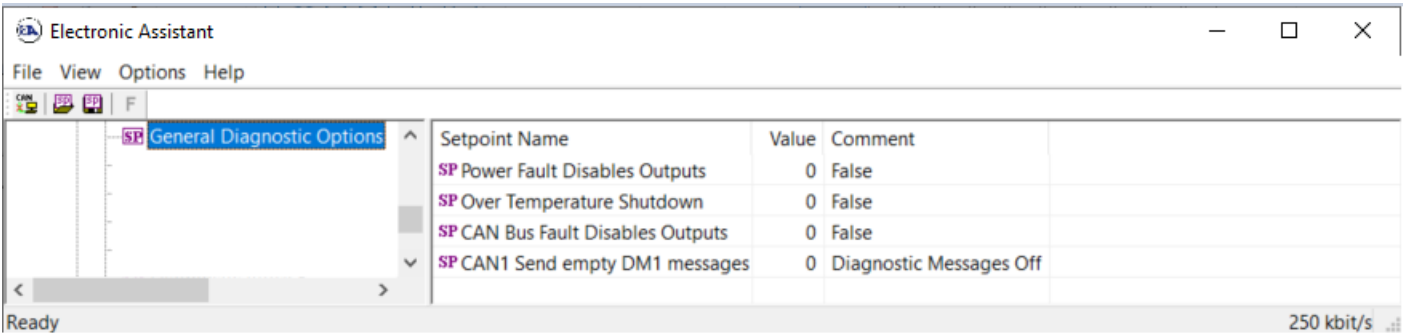


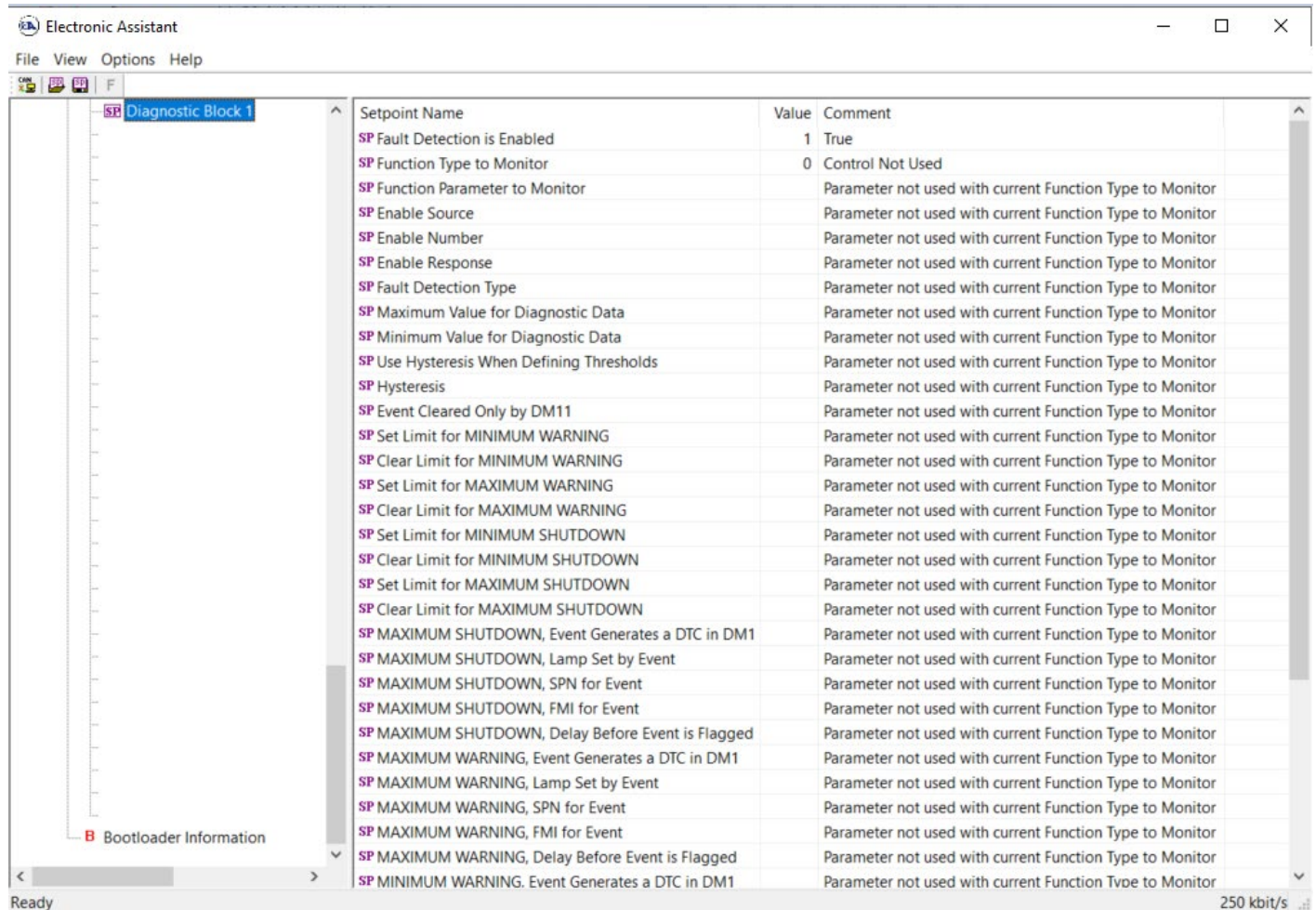
Figure 22 – Screen Capture of General Diagnostics Options Setpoints

Table 40 – General Diagnostics Options Setpoints

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

4.17. 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 1.6. Please refer there for detailed information how these setpoints are used.



Setpoint Name	Value	Comment
SP Fault Detection is Enabled	1	True
SP Function Type to Monitor	0	Control Not Used
SP Function Parameter to Monitor		Parameter not used with current Function Type to Monitor
SP Enable Source		Parameter not used with current Function Type to Monitor
SP Enable Number		Parameter not used with current Function Type to Monitor
SP Enable Response		Parameter not used with current Function Type to Monitor
SP Fault Detection Type		Parameter not used with current Function Type to Monitor
SP Maximum Value for Diagnostic Data		Parameter not used with current Function Type to Monitor
SP Minimum Value for Diagnostic Data		Parameter not used with current Function Type to Monitor
SP Use Hysteresis When Defining Thresholds		Parameter not used with current Function Type to Monitor
SP Hysteresis		Parameter not used with current Function Type to Monitor
SP Event Cleared Only by DM11		Parameter not used with current Function Type to Monitor
SP Set Limit for MINIMUM WARNING		Parameter not used with current Function Type to Monitor
SP Clear Limit for MINIMUM WARNING		Parameter not used with current Function Type to Monitor
SP Set Limit for MAXIMUM WARNING		Parameter not used with current Function Type to Monitor
SP Clear Limit for MAXIMUM WARNING		Parameter not used with current Function Type to Monitor
SP Set Limit for MINIMUM SHUTDOWN		Parameter not used with current Function Type to Monitor
SP Clear Limit for MINIMUM SHUTDOWN		Parameter not used with current Function Type to Monitor
SP Set Limit for MAXIMUM SHUTDOWN		Parameter not used with current Function Type to Monitor
SP Clear Limit for MAXIMUM SHUTDOWN		Parameter not used with current Function Type to Monitor
SP MAXIMUM SHUTDOWN, Event Generates a DTC in DM1		Parameter not used with current Function Type to Monitor
SP MAXIMUM SHUTDOWN, Lamp Set by Event		Parameter not used with current Function Type to Monitor
SP MAXIMUM SHUTDOWN, SPN for Event		Parameter not used with current Function Type to Monitor
SP MAXIMUM SHUTDOWN, FMI for Event		Parameter not used with current Function Type to Monitor
SP MAXIMUM SHUTDOWN, Delay Before Event is Flagged		Parameter not used with current Function Type to Monitor
SP MAXIMUM WARNING, Event Generates a DTC in DM1		Parameter not used with current Function Type to Monitor
SP MAXIMUM WARNING, Lamp Set by Event		Parameter not used with current Function Type to Monitor
SP MAXIMUM WARNING, SPN for Event		Parameter not used with current Function Type to Monitor
SP MAXIMUM WARNING, FMI for Event		Parameter not used with current Function Type to Monitor
SP MAXIMUM WARNING, Delay Before Event is Flagged		Parameter not used with current Function Type to Monitor
SP MINIMUM WARNING, Event Generates a DTC in DM1		Parameter not used with current Function Type to Monitor

Figure 23 – Screen Capture of Diagnostic Block Setpoints

Table 41 – 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 1.6
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 13
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 14
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 13
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 14
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 13

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 14
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 13
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 14
MINIMUM SHUTDOWN, Delay Before Event is Flagged	0...60000 ms	1000	

4.18. DTC React Function Block

The DTC React function block is described in Section 1.14. The Figure below shows the DTC React function block setpoints. The Table below show the default values. Please note: *The setpoint “DTC React is Enabled” was changed to 1, True.*

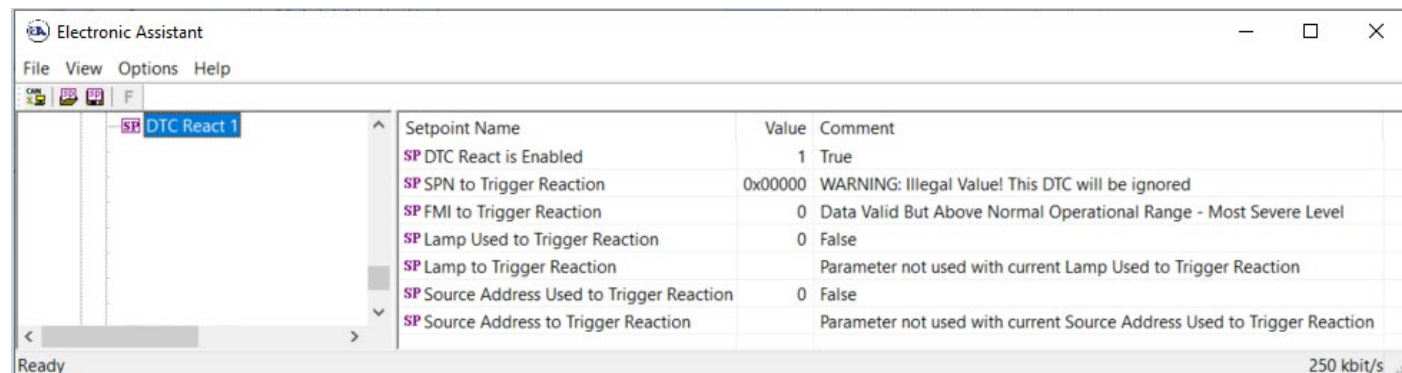


Figure 24 – DTC React Setpoints

Table 42 – DTC React Setpoints

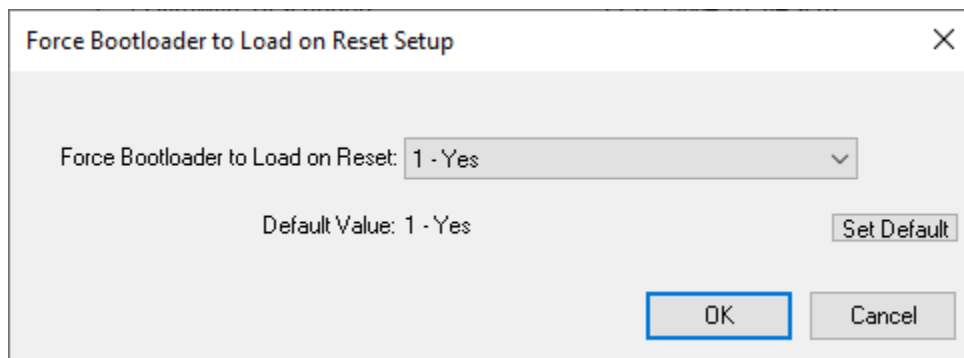
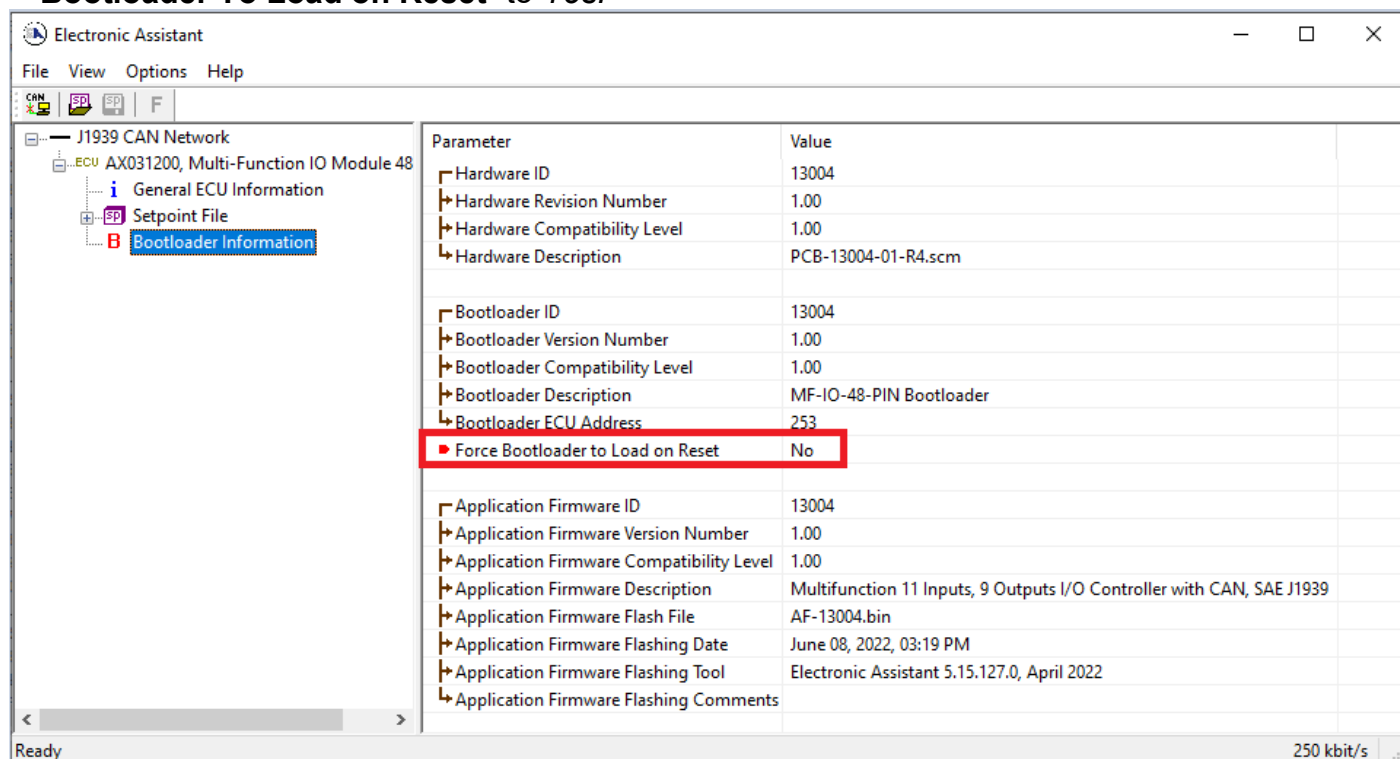
Name	Range	Default	Notes
DTC React is Enabled	Drop List	0, False	
SPN to Trigger Reaction	0x00 to 0x3FFFF	0	
FMI to Trigger Reaction	Drop List	0	
Lamp Used to Trigger Reaction	Drop list	0, False	
Lamp to Trigger Reaction	Drop List	0, Protect	
Source Address Used to Trigger Reaction	Drop list	0, False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

5. REFLASHING OVER CAN WITH THE AXIOMATIC EA BOOTLOADER

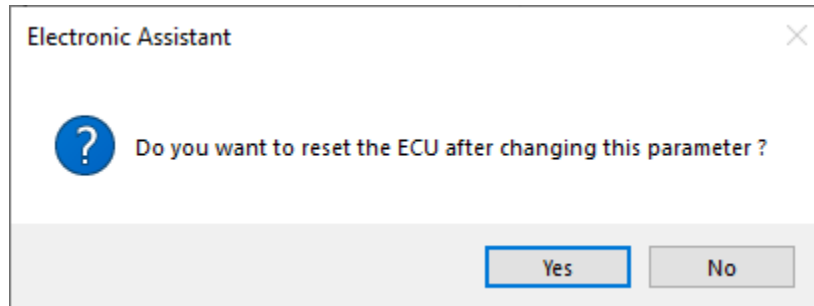
The AX030460 can be upgraded with new application firmware using the **Bootloader Information** section. This section details the simple step-by-step instructions to upload new firmware provided by Axiomatic onto the unit via CAN, without requiring it to be disconnected from the J1939 network.

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

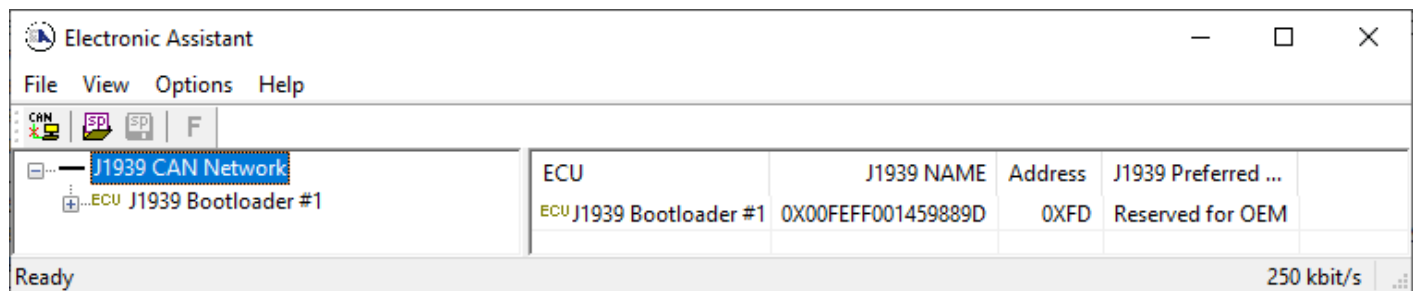
1. When the Axiomatic EA first connects to the ECU, the **Bootloader Information** section will display the following information.
2. To use the bootloader to upgrade the firmware running on the ECU, change the variable “**Force Bootloader To Load on Reset**” to Yes.



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 AX030460 but rather as **J1939 Bootloader #1**.



Electronic Assistant

File View Options Help

CAN J1939 SP1 SP2 F

J1939 CAN Network

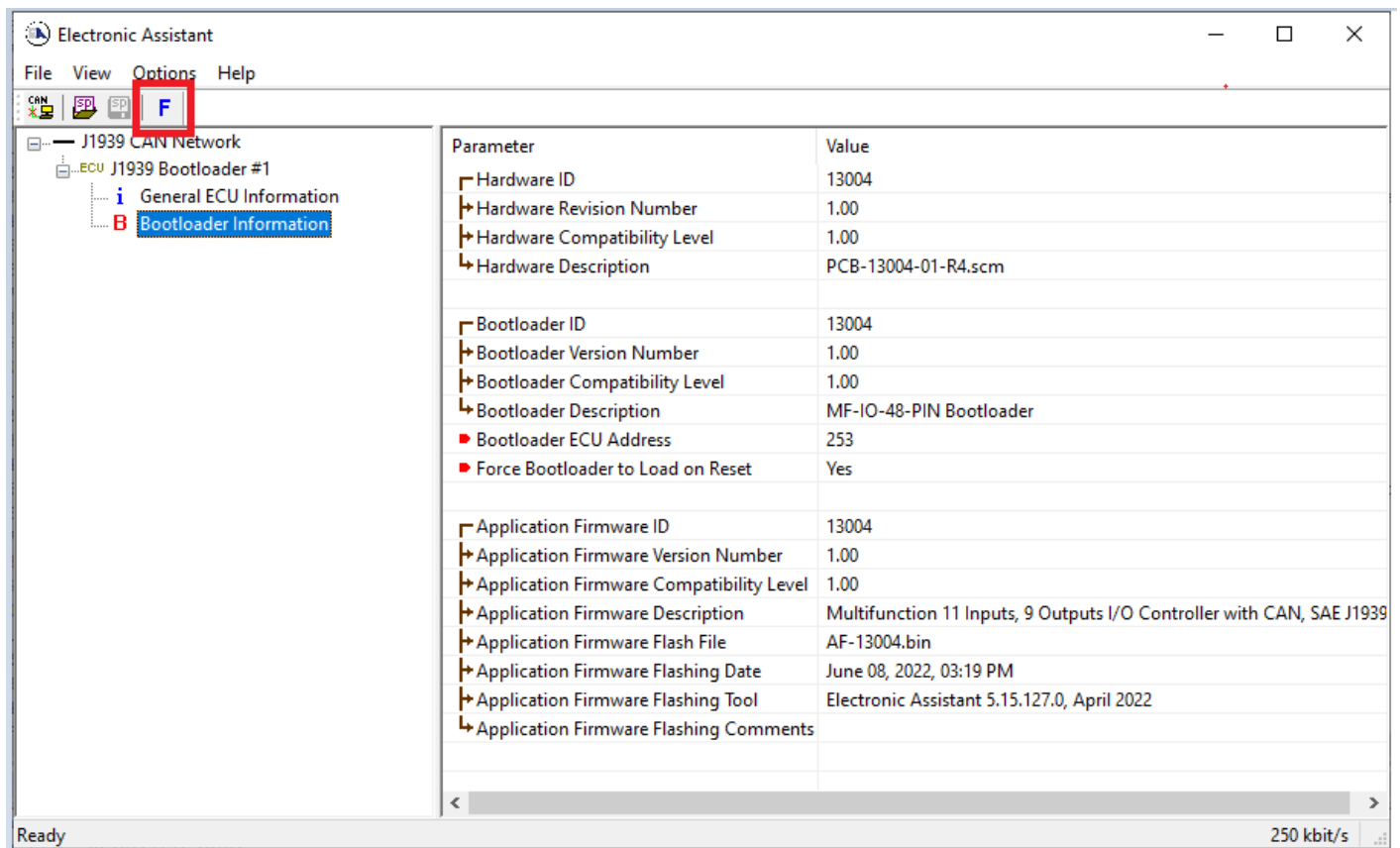
- ECU J1939 Bootloader #1
 - General ECU Information
 - Bootloader Information

Parameter	Value	Description
ECU Part Number	AX031200	
ECU Serial Number	0000121022	
ECU J1939 NAME		PGN 60928, 64-bit ECU Identifier sent in Address Claimed Messages
Arbitrary Address Capable	0X00	No
Industry Group	0X00	Global
Vehicle System Instance	0X00	
Vehicle System	0X7F	Not Available
Reserved	0X00	
Function	0XFF	Not Available
Function Instance	0X00	
ECU Instance	0X00	#1 - First Instance
Manufacturer Code	0X0A2	Axiomatic Technologies
Identity Number	0X19889D	Unique ECU network ID number
ECU Address	0XFD	Reserved for OEM
ECU ID	N/A	PGN 64965 -ECUID
Software ID	N/A	PGN 65242 -SOFT

Ready 250 kbit/s

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.

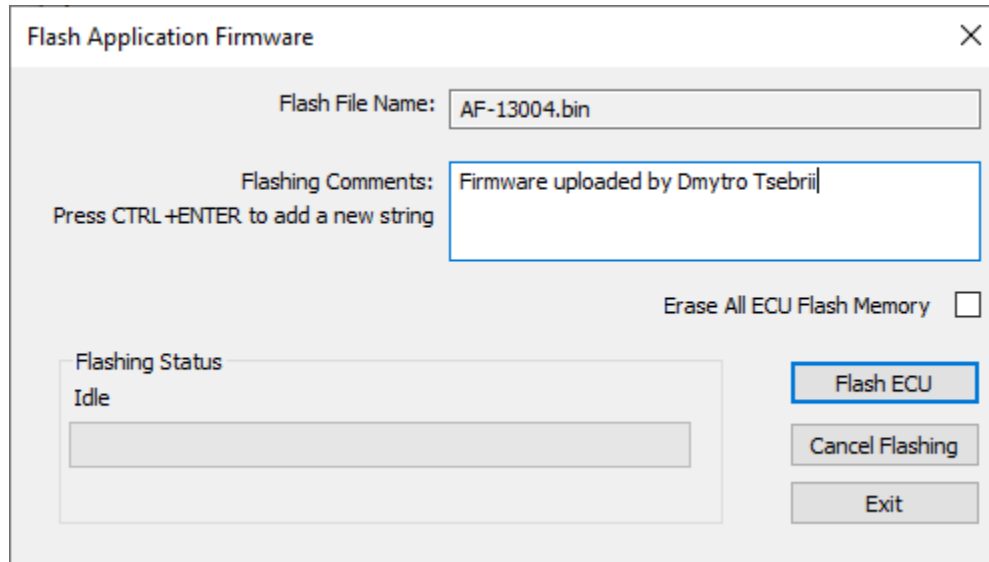
5. When the **Bootloader Information** section is selected, the same information is shown as when it was running the AX030460 firmware, but in this case the **F**lashing feature has been enabled.



6. Select the **F**lashing button and navigate to where you had saved the **AF-13004-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.

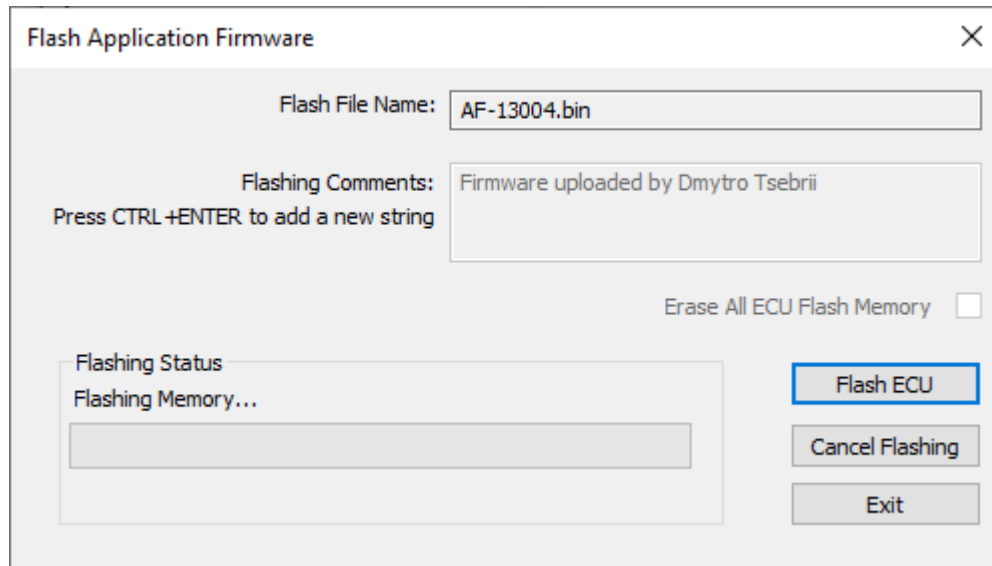


The image shows a software dialog box titled "Flash Application Firmware". It contains a "Flash File Name" field with the text "AF-13004.bin". Below it is a "Flashing Comments" text area containing "Firmware uploaded by Dmytro Tsebrii", with a prompt "Press CTRL+ENTER to add a new string" to its left. To the right of the comments field is a checkbox labeled "Erase All ECU Flash Memory" which is currently unchecked. On the bottom left, there is a "Flashing Status" section showing "Idle" above a progress bar. On the bottom right, there are three buttons: "Flash ECU" (highlighted with a blue border), "Cancel Flashing", and "Exit".

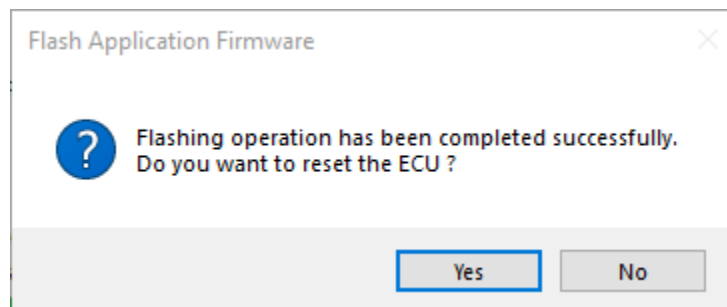


WARNING: Do not check the “Erase All ECU Flash Memory” box unless instructed to do so by your Axiomatic contact. Selecting this will erase ALL data stored in non-volatile flash, including the calibration done by Axiomatic during factory testing. It will also erase any configuration of the setpoints that 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 AX030460 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 AX030460 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 Limitations & Return Materials Process as described on <https://www.axiomatic.com/service/>.

Power Supply

Power Supply Input	12 or 24 V _{DC} nominal (8 to 36 V _{DC} power supply range)
Quiescent Current	89 mA @ 12 V _{DC} ; 51 mA @ 24 V _{DC} (typical)
Protection	Surge and transient protection Reverse polarity protection Undervoltage protection down to 7.5 V _{DC} . Overvoltage protection is up to 38 V _{DC} .

Inputs

Universal Inputs	24x universal signal inputs user selectable as voltage, current, frequency, PWM, or digital types. 12-bit analog to digital resolution (voltage and current inputs) Protected against shorts to Ground or +V_{PS} Universal inputs 3, 6, 8, 11, 12, 15, and 18 have individual counter bases. Universal inputs 1, 2, and 4 share a counter base. Their frequency range must be set together. Similarly, universal inputs [5, 7, and 17], [10, 19, and 21], [9 and 22], [13, 14, 20, and 24], and [16 and 23] share counters within their respective groups. <table><tr><td>Voltage</td><td>Range: 0-5 V Impedance: 170 kΩ Range: 0-10 V Impedance: 120 kΩ Accuracy: ±1 % error</td></tr><tr><td>Current</td><td>Ranges: 0-20 mA or 4-20 mA Current Sensing Resistor: 124 Ω Accuracy: ±1 % error</td></tr><tr><td>Frequency</td><td>Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±1 % error Impedance: 1 MΩ</td></tr><tr><td>PWM</td><td>Duty Cycle: 1 to 100 % Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±2 % error Impedance: 1 MΩ</td></tr><tr><td>Digital</td><td>Active low or Active low Low from 0 to 1.5 V High from 3.5 to 36 V Pull-Up / Pull-Down Resistor: 10 kΩ (configurable)</td></tr></table>		Voltage	Range: 0-5 V Impedance: 170 kΩ Range: 0-10 V Impedance: 120 kΩ Accuracy: ±1 % error	Current	Ranges: 0-20 mA or 4-20 mA Current Sensing Resistor: 124 Ω Accuracy: ±1 % error	Frequency	Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±1 % error Impedance: 1 MΩ	PWM	Duty Cycle: 1 to 100 % Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±2 % error Impedance: 1 MΩ	Digital	Active low or Active low Low from 0 to 1.5 V High from 3.5 to 36 V Pull-Up / Pull-Down Resistor: 10 kΩ (configurable)
Voltage	Range: 0-5 V Impedance: 170 kΩ Range: 0-10 V Impedance: 120 kΩ Accuracy: ±1 % error											
Current	Ranges: 0-20 mA or 4-20 mA Current Sensing Resistor: 124 Ω Accuracy: ±1 % error											
Frequency	Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±1 % error Impedance: 1 MΩ											
PWM	Duty Cycle: 1 to 100 % Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±2 % error Impedance: 1 MΩ											
Digital	Active low or Active low Low from 0 to 1.5 V High from 3.5 to 36 V Pull-Up / Pull-Down Resistor: 10 kΩ (configurable)											
Digital Inputs	4x digital inputs All digital inputs share a counter base. Their frequency range must be set together. <table><tr><td>Frequency</td><td>Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±1 % error Impedance: 1 MΩ</td></tr><tr><td>PWM</td><td>Duty Cycle: 1 to 100 % Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±2 % error Impedance: 1 MΩ</td></tr><tr><td>Digital</td><td>Active low or Active low Low from 0 to 1.5 V High from 3.5 to 36 V Pull-Up / Pull-Down Resistor: 10 kΩ (configurable)</td></tr></table>		Frequency	Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±1 % error Impedance: 1 MΩ	PWM	Duty Cycle: 1 to 100 % Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±2 % error Impedance: 1 MΩ	Digital	Active low or Active low Low from 0 to 1.5 V High from 3.5 to 36 V Pull-Up / Pull-Down Resistor: 10 kΩ (configurable)				
Frequency	Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±1 % error Impedance: 1 MΩ											
PWM	Duty Cycle: 1 to 100 % Range: 1 to 100 Hz, 10 Hz to 1 kHz, 1 to 10 kHz Accuracy: ±2 % error Impedance: 1 MΩ											
Digital	Active low or Active low Low from 0 to 1.5 V High from 3.5 to 36 V Pull-Up / Pull-Down Resistor: 10 kΩ (configurable)											
Encoder Inputs	2x encoder channels 3 pins per encoder: A, B, and Z Frequency Range: 0.5 Hz to 10 kHz Accuracy: ±1 % error Low: 1.5 V max. High: 3.5 V min Pull-Down Resistor: 10 kΩ											
RTD Inputs	2x RTD channels for 3-wire Pt100 sensors RTD Resistance Range: 20 to 400 Ω RTD Lead Resistance Range: 0 to 10 Ω Accuracy: ±0.5 Ω Scan Rate: 10 samples per second per channel											
Signal Ground	6x provided											

Voltage References

Voltage References	6x +5 V reference outputs Accuracy: $\pm 0.5\%$ Load current of all 6 outputs combined must not exceed 200 mA.
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CAN

Ports	3x CAN ports (SAE J1939)
Wake-on-CAN	Provided on CAN port 1 (Pending)
Baud Rate	125 kbit/s, 250 kbit/s, 500 kbit/s, 667 kbit/s, and 1 Mbit/s with auto-baud-rate detection
Network Termination	It is necessary to terminate the network with external termination resistors. The resistors are 120 Ω , 0.25 W minimum, metal film or similar type. They should be placed between CAN High and CAN Low terminals at both ends of the network.
Protection	ESD protected

Ethernet

Port	1 Ethernet port 10/100 Mbit/s
Protection	ESD/EFT protected

General Specifications

Microcontroller	STM32H725IGK3 32-bit, 1 MB flash memory
User Interface	The Ethernet port has a web server for configuration purposes. Refer to the User Manual.
LED Indicators	Individual LED indicators for each of the 10 ports, LINK, and SPEED. The functionality of the LEDs is configurable.
Compliance	RoHS
Operating Conditions	-40 to 85 °C (-40 to 185 °F)
Storage Temperature	-50 to 120 °C (-58 to 248 °F)
Enclosure	Infino SC-1220UR, Polycarbonate Flammability rating: UL 94-V2 Gasket Refer to dimensional drawing.
Protection	IP67
Weight	1.04 lb. (0.472 kg)
Installation	Mounting slots are sized for M6 bolts (or 7/32 in. bolts with washers). The bolt length will be determined by the end-user's mounting plate thickness. Refer to the dimensional drawing.

Electrical Connections

Mating Connectors	10x sets of AX070119 Mating Plug Kit (includes 1x DT06-6S, 1x W6S, 6x 0462-201-16141) are required. Mating plug for 4-pin M12 D-coded connector is not supplied.
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OUR PRODUCTS

AC/DC Power Supplies
Actuator Controls/Interfaces
Automotive Ethernet Switches
Battery Chargers
CAN Controls, Routers, Repeaters
CAN/WiFi
CAN/Bluetooth (Classic, BLE)
CAN bus Routers
CANopen I/O Modules
Current/Voltage/PWM Converters
DC/DC Power Converters
Engine Temperature Scanners
Ethernet/CAN Converters, Gateways
Ethernet Switches
Fan Drive Controllers
Gateways, CAN/Modbus, RS-232
Gyroscopes, Inclinometers
Hydraulic Valve Controllers
Inclinometers, Triaxial
I/O Controls
LVDT Signal Converters
Machine Controls
Media Converters
Modbus, RS-422, RS-485 Controls
Motor Controls, Inverters
Power Supplies, DC/DC, AC/DC
PWM Signal Converters/Isolators
Resolver Signal Conditioners
SAE J1939 I/O Modules
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 registered R&D, electronics design and manufacturing facility in Canada.

Sales offices are in Canada, USA, Australia and Finland.

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.

TECHNICAL SUPPORT

Contact technical support by emailing support@axiomatic.com.

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/>.

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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