USER MANUAL UMAX0301x0

10 UNIVERSAL SIGNAL INPUTS WITH CAN, SAE J1939

USER MANUAL

P/N: AX030120 - J1939 250kbps Baud Rate

P/N: AX030120-01 – J1939 500kbits/s Baud Rate

P/N: AX030120-02 – Custom J1939 Baud Rate, 1Mbits/s

P/N: AX030130 – J1939 250kbps Baud Rate with 5V Reference

P/N: AX030130-01 – J1939 500kbps Baud Rate with 5V Reference

P/N: AX030130-02 – J1939 1Mbps Baud Rate with 5V Reference

VERSION HISTORY

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1.0.1.	Oct. 4, 2013	Ilona Korpelainen	Initial Draft
--	Oct. 21, 2013	Amanda Wilkins	Marketing Review
--	Oct. 25, 2013	Amanda Wilkins	AX030120
1.0.2	Oct. 31, 2013	Ilona Korpelainen	Updated screen captures
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1.0.3	Nov. 25, 2014	Ilona Korpelainen	ECU ID and Component ID PNGs added
1.0.4	Feb. 11, 2015	Antti Keränen	Table naming (tables 17,18&19) on page 29 updated, Over voltage setpoint defaults updated. Note of maximum pulse count frequency added on page 8.
--	Feb. 17, 2015	Antti Keränen	P/Ns AX030120-01 and AX030120-02 added. P/N table added to page 6. EA configuration note added to page 22.
1.0.5	Jul. 3, 2015	Antti Keränen	Added note concerning Inputs 4, 5, 9 and 10 accuracy in Frequency and PWM measurements to page 9.
-	August 21, 2015	Amanda Wilkins	Updated EA version
-	January 25, 2016	Amanda Wilkins	Added vibration compliance and CE mark
1.0.6	March 7, 2016	Ilona Korpelainen	Updated to reflect firmware version 3.00
1.0.7	September 1, 2016	Amanda Wilkins	Added input impedance and scan rate to Technical Specs.
1.0.8	February 15, 2018	Antti Keränen	New Input Types added, CAN Input and Output signals' configuration setpoints updated. Firmware upgrade instruction updated.
2	February 10, 2020	Gustavo Del Valle	Added part number AX030130 (-01, -02) details to user manual

ACCRONYMS

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	Electronic Assistant®, p/n AX070502 (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)

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REFERENCES

J1939	Recommended Practice for a Serial Control and Communications Vehicle Network, SAE, April 2011
J1939/21	Data Link Layer, SAE, December 2010
J1939/71	Vehicle Application Layer, SAE, March 2011
J1939/73	Application Layer-Diagnostics, SAE, February 2010
J1939/81	Network Management, SAE, May 2003
TDAX030120	Technical Datasheet, 10 Universal Signal Input with CAN, Axiomatic Technologies 2016
TDAX030130	Technical Datasheet, 10 Universal Signal Input with CAN and 5V reference, Axiomatic Technologies 2019
UMAX07050x	User Manual V4.10.77, Electronic Assistant and USB-CAN, Axiomatic Technologies, July 2014

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 Electronic Assistant® V4.10.77.0 and higher

1. OVERVIEW OF CONTROLLER

The 10 Analog Input electronic control unit (ECU) is a device that measures inputs and sends the data to an SAE J1939 CAN network. Its 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.

The Axiomatic Electronic Assistant® is used to configure the 10 Analog Inputs ECU. Programming configurable properties, 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 10 Analog Input controller. Throughout this document EA setpoint names are referred with bolded text in double-quotes and the setpoint option is referred with italicized text in single-quotes. For example, "**Input Sensor 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, 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. The math function block gives user an opportunity to process inputs with basic mathematical of logical functions. And the CAN transmit message function block configures properties of the messages sent to the CAN bus. These function blocks are presented in detail in next subchapters.

The 10 Analog Input ECU can be ordered using the following part numbers depending on the application.

AX030120	ECU with the default J1939 baud rate (250kbits/s).
AX030120-01	ECU with the 500kbits/s J1939 baud rate.
AX030120-02	ECU with a custom 1Mbits/s J1939 baud rate.
AX030130	ECU with the default J1939 baud rate (250kbits/s) and 5V Reference.
AX030130-01	ECU with the 500kbits/s J1939 baud rate and 5V Reference.
AX030130-02	ECU with a custom 1Mbits/s J1939 baud rate and 5V Reference.

1.1. Input Function Blocks

The controller has ten fully programmable universal inputs that can be setup to read: voltage, current, PWM, frequency, or digital input signals. The "**Input Sensor Type**" setpoint is used to configure input type. Selecting input type effects on other setpoints and how they are interpreted and should thus be selected first on this block. The input sensor types are listed in Table 1.

0	*Disabled*
12	*Voltage 0 to 5 V*
13	*Voltage 0 to 10 V*
20	*Current 0 to 20 mA*
21	*Current 4 to 20 mA*
40	*Frequency 0.5 to 50 Hz*
41	*Frequency 10 Hz to 1 kHz*
42	*Frequency 100 Hz to 10 kHz*
50	*PWM Low Frequency (<1kHz)*
51	*PWM High Frequency (>100Hz)*
60	*Digital (normal)*
61	*Digital (inverse)*
62	*Digital (latched)*
70	*Counter*
71	*Pulse Counter*
72	*Pulse Counter (both edges)*

Table 1 – Universal Input Type Options

Voltage (i.e. 0-5V, 0-10V) or Current (0-20mA, 4-20mA) inputs go directly to a 12-bit analog-to-digital converter (ADC) on the processor. A voltage input is a high impedance input protected against shorts to GND or Vcc. In current mode, a 250Ω resistor is used to measure the input signal. Analog Inputs should be connected to the Analog GND reference pins provided on the connector, per Table 18.

Input Sensor Type	Error Threshold units	Transmit data resolution	Transmit data offset units
Disabled	N/A	N/A	N/A
Voltage 0 to 5 V	V	0.001 V/Bit	V
Voltage 0 to 10 V	V	0.001 V/Bit	V
Current 0 to 20 mA	mA	0.1 mA/Bit	mA
Current 4 to 20 mA	mA	0.1 mA/Bit	mA
Frequency 0.5 to 50 Hz	Hz(RPM)	1 Hz/Bit (RPM/Bit)	HZ(RPM)
Frequency 10 Hz to 1 kHz	Hz(RPM)	1 Hz/Bit (RPM/Bit)	HZ(RPM)
Frequency 100 Hz to 10 kHz	Hz(RPM)	1 Hz/Bit (RPM/Bit)	HZ(RPM)
PWM Low Frequency (<1kHz)	%dc	0.1 %dc/Bit	%dc
PWM High Frequency (>100Hz)	%dc	0.1 %dc/Bit	%dc
Digital (normal)	N/A	1 State/Bit	Sate
Digital (inverse)	N/A	1 State/Bit	
Digital (latched)	N/A	1 State/Bit	
Counter	N/A	1 Pulse(s)/Bit	Pulse(s)
Pulse Counter	N/A	1 Pulse(s)/Bit	Pulse(s)
Pulse Counter (both edges)	N/A	1 Pulse(s)/Bit	Pulse(s)

Table 2 - Input Sensor types effect on other setpoints

Frequency/RPM or Pulse Width Modulated (PWM) inputs are connected to 16-bit timer pins on the processor. "**Debounce Time**" setpoint is used to select an input capture filter for the timer pin in question.

0	*None*
1	*111ns*
2	*1.78us*
3	*14.22us*

Table 3 – Debounce Time Options

An additional software debounce filter can be used with Digital Input types for filtering the inputs using longer time constants than with the default debounce filter. The available software implemented debounce times are listed in Table 4.

0	*0ms*
1	*10ms*
2	*20ms*
3	*40ms*
4	*100ms*
5	*200ms*
6	*400ms*
7	*1000ms*

Table 4 - Software Debounce Filter Times

The "**Pulse Per Revolution**" setpoint is only associated with the frequency input type. If a non-zero Pulse/Rev is selected, then the input data will be reported as in rotations-per-minute (RPM). Otherwise, frequency inputs are measured in Hertz.

NOTE: The input channels 4, 5, 9 and 10 have limited accuracy when used for detecting edges (Frequency / PWM measurements). The measurement accuracy can be enhanced using software filtering, but in case the Frequency or PWM duty cycle measurements need to have high accuracy, please avoid using these four channels.

The Counter input sensor type implements input pulse timing feature. "**Measuring Window"** setpoint defines number of pulses to be timed. Pulses in the input signal are calculated and the time passed until the number of pulses has been received is timed. Once the count has been reached, the time is transferred as input signal measurement result and the calculation is started again.

NOTE: The Counter inputs work up to 5kHz with 1% accuracy. Higher input frequencies may result in accuracy degrading of the detected edge count.

There are three digital "**Input Sensor Type**" options: Normal, Inverse and Latched. With digital input sensor types, the input measurement is given, either 1 (ON) or 0 (OFF). Input voltage is measured with 3V threshold.

On Frequency, PWM and digital input modes 10kΩ pull-up or pull-down resistors can be enabled or disabled by setting the value of the "**Pullup/Pulldown Resistor**" setpoint. Setpoint options are given in Table 5. By default pull-down resistors are enabled for all inputs.

0	*Pullup/down Off*
1	*10 kΩ Pullup*
2	*10 kΩ Pulldown*

Table 5 – Pullup/Pulldown Resistor Options

"**Active High/Active Low**" setpoint is used to configure how signal high and low are interpreted. Setpoint options are given in Table 6. By default all inputs are selected to be Active High, which means that signal high is interpreted as 1(ON) and signal low as 0(OFF).

0	*Active High*
1	*Active Low*

Table 6 – Active High/Low Options

Table 7 shows the effect of different digital input types on input signal measurement interpretation with recommended "**Pullup/Pulldown Resistor**" and "**Active High/Low**" combinations.

Input Sensor Type		**Pulldown Active High**	**Pullup Active Low**	**Input measured (state)**
6	*Digital (normal)*	High	Low or Open	1 (ON)
		Low or Open	High	0 (OFF)
61	*Digital (inverse)*	High or Open	Low	1 (ON)
		Low	High or Open	0 (OFF)
62	*Digital (latched)*	High to Low	Low to High	0 (no change)
		Low to High	High to Low	1 (state change)

Table 7 – Digital Input Sensor Type versus Input State

Input Sensor Type		**Function**
70	*Counter*	Count pulses in the specified time window (defined using **Measuring Window** setpoint)
71	*Pulse Counter*	Count pulses (only rising edges). Maximum number before wrapping back to zero can be defined using **Max Pulse Count** setpoint.
72	*Pulse Counter (both edges)*	Count pulses (both rising and falling edges). Maximum number before wrapping back to zero can be defined using **Max Pulse Count** setpoint.

Table 8 – Pulse Counter Sensor Type versus Input State

Table 8 describes the Pulse Counter Input types available. The main difference between the '*Counter*' and '*Pulse Counter*' types is that '*Counter*' measures the time (defined using "**Measuring Window**") which is needed to count the specified number of pulses. The '*Pulse Counter*' modes count pulses (using edge detection), independent of time (max count is defined using "**Max Pulse Count**").

The “**Minimum Range**” and “**Maximum Range**” setpoints are used to define range of the signal input outputs as a control source. For example, if “**Maximum Range**” is set to 4V for an input, the control signal is saturated at 4V if input signal rises above 4V. The “**Minimum Range**” and “**Maximum Range**” setpoints are interpreted in input types units, thus they should be re-adjusted after editing “**Input Sensor Type**”.

Software filters can be applied to the measured input signal. Setpoints “**Software Filter Type**” and “**Software Filter Constant**” are used to configure the software filter. By default, no filter is applied to the signal. Software filtering is described in detail in next section.

1.2. Input filtering

Measured input data from universal inputs can be filtered to form desired CAN message data. Input filters are configured with “**Filter Type**” and “**Filter Constant**” setpoints. Filters are configured for each input individually.

“**Filter Type**” setpoint defines the type of software filter used. Setpoint options are ‘*No Filtering’*, ‘*Moving Average’* and ‘*Repeating Average’*. The ‘*No Filtering’* option applies no filtering to the measured input data. The ‘*Moving Average* option applies the transfer function below to the measured input data, where $Value_N$ is the current value of the CAN message data, $Value_{N-1}$ is the previous CAN message data and Filter Constant is the value of the “**Filter Constant setpoint**”.

Equation 1 - Moving Average Transfer Function:

$$Value_N = Value_{N-1} + \frac{(Input - Value_{N-1})}{Filter\ Constant}$$

Equation 2 - Repeating Average Transfer Function:

$$Value = \frac{\sum_0^N Input_N}{N}$$

The ‘*Repeating Average’* option applies the transfer function above to the measured input data, where N is value of the **“Filter Constant”** setpoint. At every reading of the input value, the value is added to the sum. At every N^{th} read, the sum is divided by N, and the result is new CAN message data. The sum is set to zero for the next read and summing is started again.

1.3. Diagnostic Function Blocks

The 10 Analog Input Controller supports diagnostic messaging. DM1 message is a message, containing Active Diagnostic Trouble Codes (DTC) that is sent to the J1939 network in case a fault has been detected. A Diagnostic Trouble Code is defined by the J1939 standard as a four-byte value.

In addition to supporting the DM1 message, the following are supported:

SPN	Suspect Parameter Number	(user defined)
FMI	Failure Mode Identifier	(see Table 10 and Table 11)
CM	Conversion Method	(always set to 0)
OC	Occurrence Count	(number of times the fault has happened)

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 10 Analog Input 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 1 below.

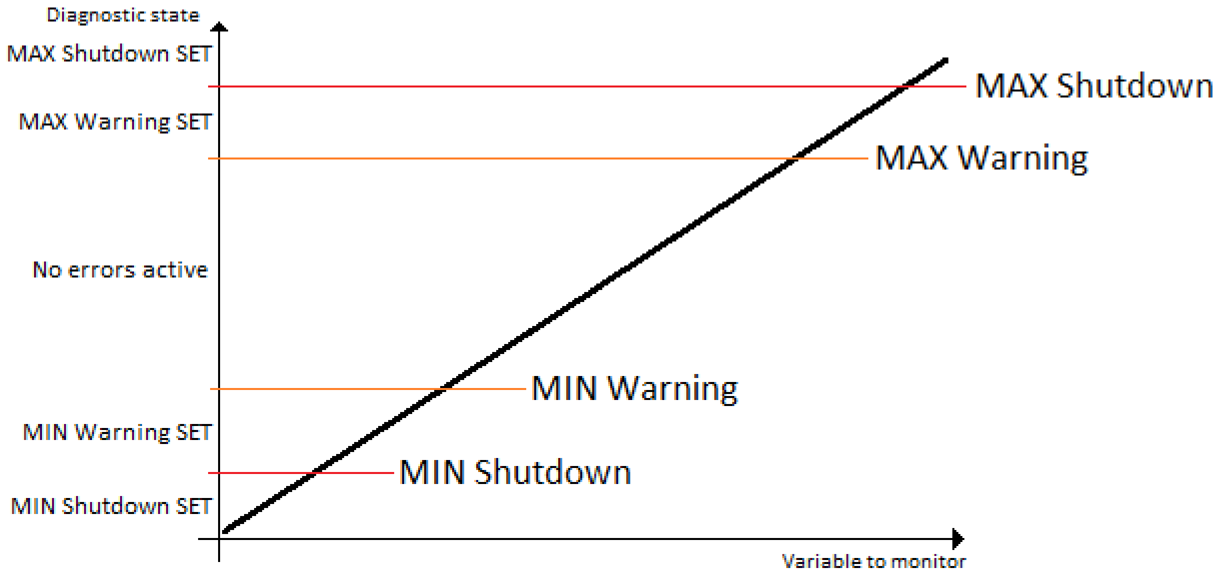


Figure 1 – Double Minimum and Maximum Error Thresholds

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 10 Analog Input 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 9. By default, the '*Amber, Warning'* lamp is typically the one set be any active fault.

0	*Protect*
1	*Amber Warning*
2	*Red Stop*
3	*Malfunction*

Table 9 – Lamp Set by Event in DM1 Options

"**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.

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

Table 10 – FMI for Event Options

Every fault has associated a default FMI with them. The used FMI can be configured with "**FMI for Event**" setpoint, presented in Table 10. When an FMI is selected from Low Fault FMIs in Table 11 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 11. There is no automatic setting of High and Low FMIs in the firmware, the user can configure these freely.

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

Table 11 – Low Fault FMIs and corresponding High Fault FMIs

1.4. 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 1.5.

Lookup tables have two differing modes defined by "**X-Axis Type**" setpoint, given in Table 12. 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.

0	*Data Response*
1	*Time Response*

Table 12 – X-Axis Type Options

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 13. 'Ramp To' gives a linearized slope between points, whereas 'Jump to' gives a point to point response, where any input value between X_{N-1} and X_N will result Lookup Table output being Y_N. "Point0 – Response" is always 'Jump To' and cannot be edited. Choosing 'Ignored' response causes associated point and all the following points to be ignored.

0	*Ignore*
1	*Ramp To*
2	*Jump To*

Table 13 – PointN – Response Options

In case Time Response is used, the "**Autocycle**" setpoint can be used for generating a repeating, cyclic output while the selected control source enables the time response output of the particular lookup table.

The X values are limited by minimum and maximum range of the selected input source if the source is one of the Input Blocks or 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 0 and 10,000. 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 X_{10} is changed first, then lower indexes in descending order.

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

The Y-Axis has no constraints on the data it presents, thus inverse, decreasing, increasing or other response can be easily established. The Smallest of the Y-Axis values is used as Lookup Table output min and the largest of the Y-Axis values is used as Lookup Table output max (i.e. used as Xmin and Xmax values in linear calculation, Section 1.3). Ignored points are not considered for min and max values.

1.5. Programmable Logic Function Block

The Programmable Logic Function Block is very powerful tool. A Programmable Logic can be linked to up to three Lookup Tables, any of which would be selected only under given conditions. Thus output of a Programmable Logic at any given time will be the output of the Lookup Table selected by 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 "**Programmable Logic Enabled**" setpoint must be set to '*True*'. By default all Logic blocks are disabled.

The three associated tables are selected by setting "**Table X – Lookup Table Block Number**" 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 14. 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.

0	*=, Equal*
1	*!=, Not Equal*
2	*>, Greater Than*
3	*>=, Greater Than or Equal*

4	*<, Less Than*
5	*<=, Less Than or Equal*

Table 14 – Table X – Condition Y, Operator Options

The three conditions are evaluated and if the result satisfies logical operation defined with "**Table X – Conditions Logical Operator**" setpoint, given in Table 15, the associated Lookup Table is selected as output of the Logical block. Option '*0 – Default Table*' selects associated Lookup Table in all conditions.

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*

Table 15 – Table X – Conditions Logical Operator Options

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.

1.6. 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 five input signals. Each input is then scaled according to the associated limit and scaling setpoints.

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

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

A mathematical function block includes four selectable functions, which each implements equation $\mathrm{A\ operator\ B}$, where A and B are function inputs and operator is function selected with setpoint "**Math function X Operator**". Setpoint options are presented in Table 16. The functions are connected together, so that result of the preceding function goes into Input A of the next function. Thus Function 1 has both Input A and Input B selectable with setpoints, where Functions 2 to 4 have only Input B selectable. Input is selected by setting "**Function X Input Y Source**" and "**Function X Input Y Number**". If "**Function X Input B Source**" is set to 0 '*Control not used'* signal goes through function unchanged.

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

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*
15	*MAX-MIN, Result = Absolute value of (InA – InB)*

Table 16 – Math function X Operator Options

For logic operations (6, 7, 8) scaled input greater or equal to 1 is treated as TRUE. For logic operations (0 to 8), the result of the function will always be 0 (FALSE) of 1 (TRUE). For the arithmetic functions (9 to 14), it is recommended to scale the data such that the resulting operation will not exceed full scale (0 to 100%) and saturate the output result.

When dividing, a zero divider will always result in a 100% output value for the associated function.

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

1.7. 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 AX0301x0 ECU has ten CAN Transmit Messages and each message has four completely user defined signals.

1.7.1. 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.

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.

1.7.2. 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 17. Setting “**Control Source**” to ‘*Control Not Used’* disables the signal.

“**Transmit Data Type**” setpoint selects the data type from options “not used”, “discrete” and “continuous”. Continuous data is scaled using the min, max, resolution and offset parameters whereas the discrete type is written to the CAN message as unsigned value without scaling. “**Transmit Data Width**” 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.

1.8. 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).

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

Once a message has been enabled, a Lost Communication fault will be flagged if that message is not received off the bud within the "**Receive Message Timeout**" period. This could trigger a Lost Communication event as described in section 1.3. 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 10 Input Controller on Proprietary B PGNs. However, should a PDU1 message be selected, the 10 Input 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 Type**" defines if the data received is handled as "discrete" or "continuous" data. Continuous data is scaled using the min, max, resolution and offset parameters whereas the discrete type is read in as unsigned value without scaling. The "**Receive Data Width**", "**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 10 Input Controller I/O supports up to ten unique CAN Receive Messages. Defaults setpoint values are listed in section 0.

1.9. 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 17. All sources, except "CAN message reception timeout", are available for all blocks, including 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.

Sources	Number Range	Notes
0: Control Not Used	N/A	When this is selected, it disables all other setpoints associated with the signal in question.
1: Received CAN Message	1 to 10	User must enable the function block, as it is disabled by default.
2: Input Measured	1 to 10	
3: Lookup Table	1 to 10	
4: Programmable Logic Block	1 to 5	User must enable the function block, as it is disabled by default.
5: Math Function Block	1 to 5	User must enable the function block, as it is disabled by default.
6: Control Constant Data	1 to 15	1 = FALSE, 2 = TRUE, 3 to 15 = User Selectable
7: Power Supply Measured	0 to 255	Measured power supply value in Volts. The Parameter sets the threshold in Volts to compare with.
8: Processor Temperature Measured	0 to 255	Measured processor temperature in °C. The Parameter sets the threshold in Celcius to compare with.
9: CAN Reception Timeout	N/A	Only available in Diagnostic blocks.

Table 17 – Available Control Sources and Numbers

If a non-digital signal is selected to drive a digital input, the signal is interpreted to be OFF at or below the minimum of selected source and ON at or above the maximum of the selected source, and it will not change in between those points. Thus analog to digital interpretation has a built in hysteresis defined by minimum and maximum of the selected source, as shown in Figure 2. For example Universal Input signal is interpreted to be ON at or above “Maximum Range” and OFF at or below “Minimum Range”.

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

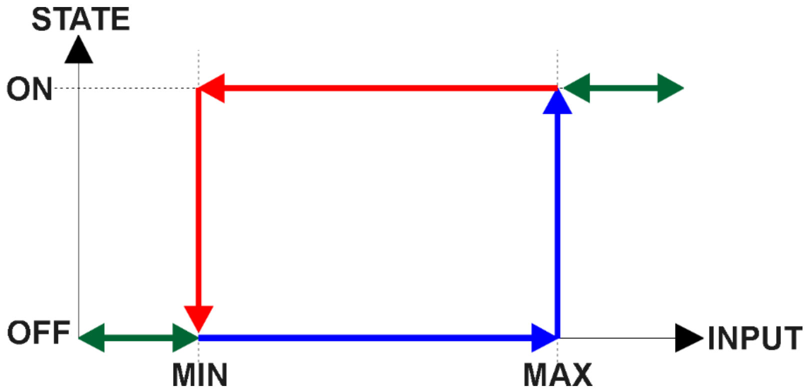
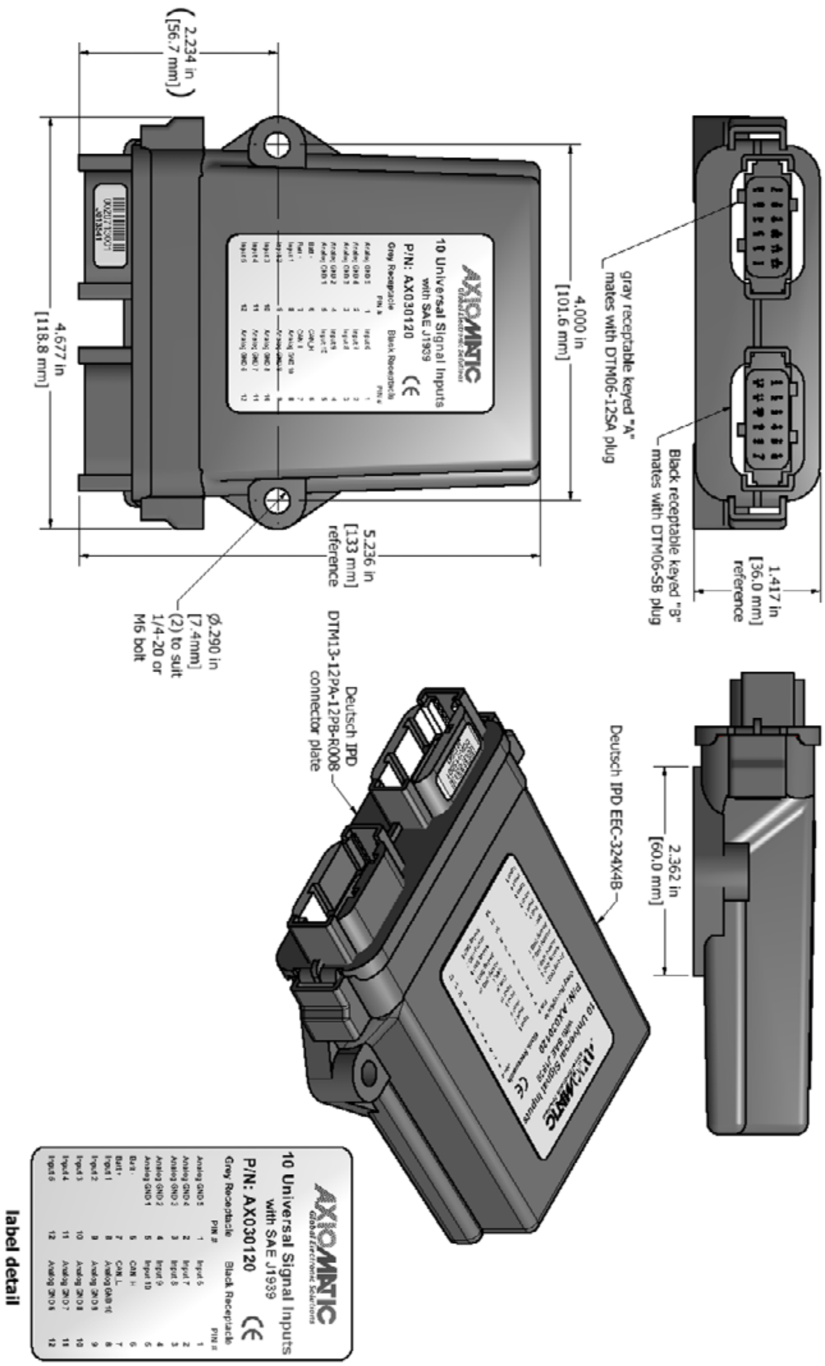


Figure 2 - Analog source to Digital input

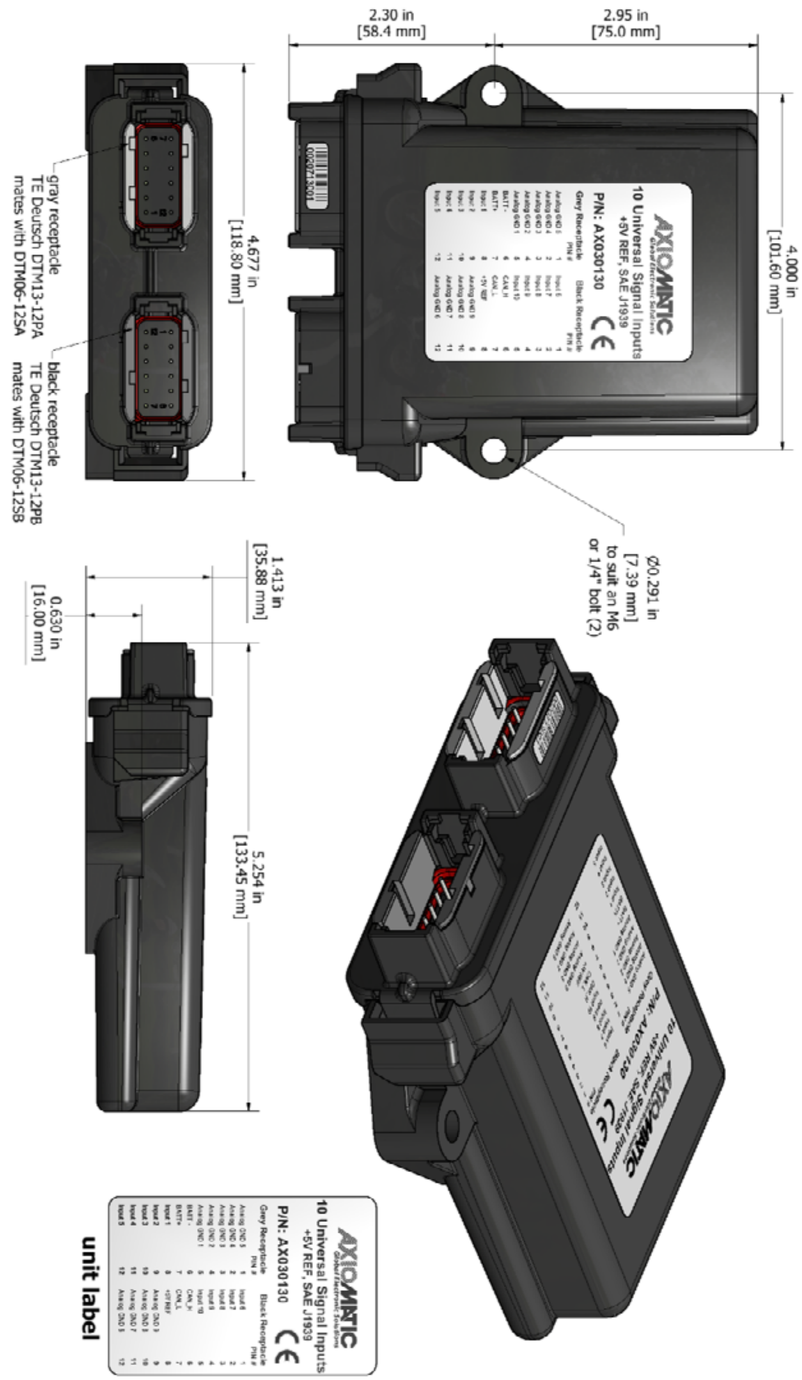
2. INSTALLATION INSTRUCTIONS

2.1. Dimensions and Pinout

2.1.1. AX030120 Dimensions



2.1.2. AX030130 Dimensions



2.1.3. Connector Pinout for AX030120 and AX030130

Grey Connector		Black Connector	
Pin #	**Function**	**Pin #**	**Function**
1	Analog GND 5	1	Input 6
2	Analog GND 4	2	Input 7
3	Analog GND 3	3	Input 8
4	Analog GND 2	4	Input 9
5	Analog GND 1	5	Input 10
6	Batt -	6	CAN_H
7	Batt +	7	CAN_L
8	Input 1	8	Analog GND 10 (AX030120) +5V Reference (AX030130)
9	Input 2	9	Analog GND 9
10	Input 3	10	Analog GND 8
11	Input 4	11	Analog GND 7
12	Input 5	12	Analog GND 6

Table 18 - AX030120 & AX030130 Connector Pinout

Warning Note: Miswiring of the **Battery +** and **Battery –** pins can damage the controller due to the internal connection of **Battery –** and the Signal Input Grounds.

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

• ECU Identification Information	64965	0x00FDC5
• 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 Electronic Assistant® (EA) allows for quick and easy configuration of the unit over CAN network.

3.2. NAME, Address and Identification Information

The 10 Analog Input 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	66, I/O Controller; 126, Axiomatic I/O Controller
Function Instance	0, Axiomatic AX030120; 16, Axiomatic AX030130
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 EA will allow 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 10 Analog input will continue select the next highest address until it finds one that it can claim. . See J1939/81 for more details about address claiming.

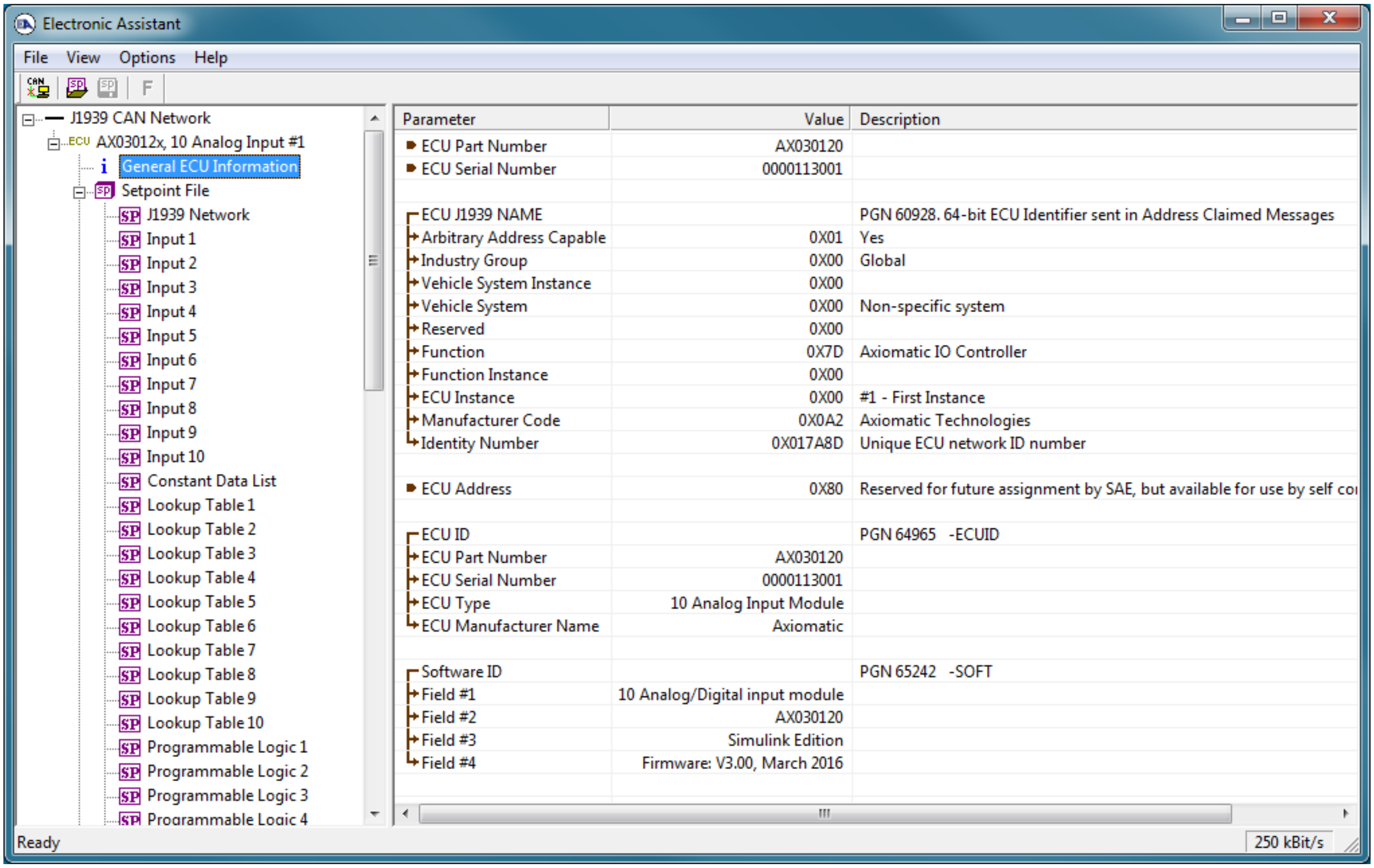


Figure 3 - General ECU Information

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)*

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 (0x00FEDA)	
Start Position	Length	Parameter Name	SPN
1	1 Byte	Number of software identification fields	965
2-n	Variable	Software identification(s), Delimiter (ASCII “*”)	234

Byte 1 is set to 5, and the identification fields are as follows.

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

The EA shows all this information in “General ECU Information”, as shown in Figure 3. *Note: The information provided in the Software ID is available for any J1939 service tool which supports the PGN -SOFT*

Component Identification

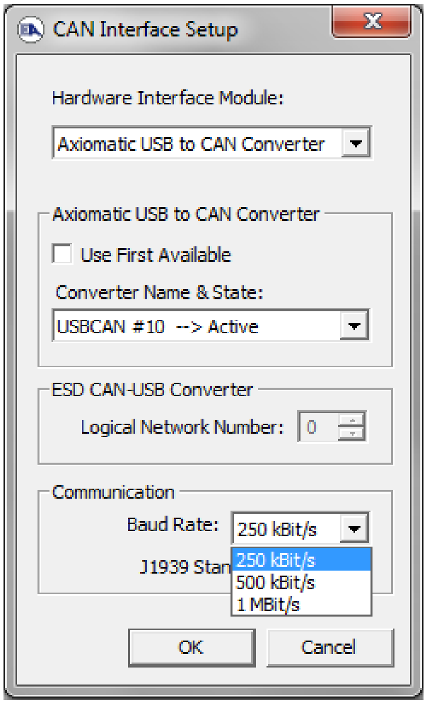
PGN 65259		Component Identification	-CI
Transmission Repetition Rate:		On request	
Data Length:		Variable	
Extended Data Page:		0	
Data Page:		0	
PDU Format:		254	
PDU Specific:		235 PGN Supporting Information:	
Default Priority:		6	
Parameter Group Number:		65259 (0x00FEEB)	
Start Position	Length	Parameter 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 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 EA. For more information on how each setpoint is used by 10 Analog Input, refer to the relevant section in this user manual.

4.1. Accessing the ECU Using EA

ECU with P/N AX0301x0 does not need any specific setup for EA. In order to access the high speed versions, AX0301x0-01 and/or AX0301x0-02, the CAN bus Baud Rata needs to be set accordingly. The CAN Interface Setup can be found from “Options” menu in EA.



4.2. J1939 Setpoints

"**ECU Instance Number**" and "**ECU Address**" setpoints and their effect are defined in section 3.2.

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

Table 19 – J1939 Setpoints

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 EA after the file is loaded so that only the new NAME and address are showing in the J1939 CAN Network ECU list.

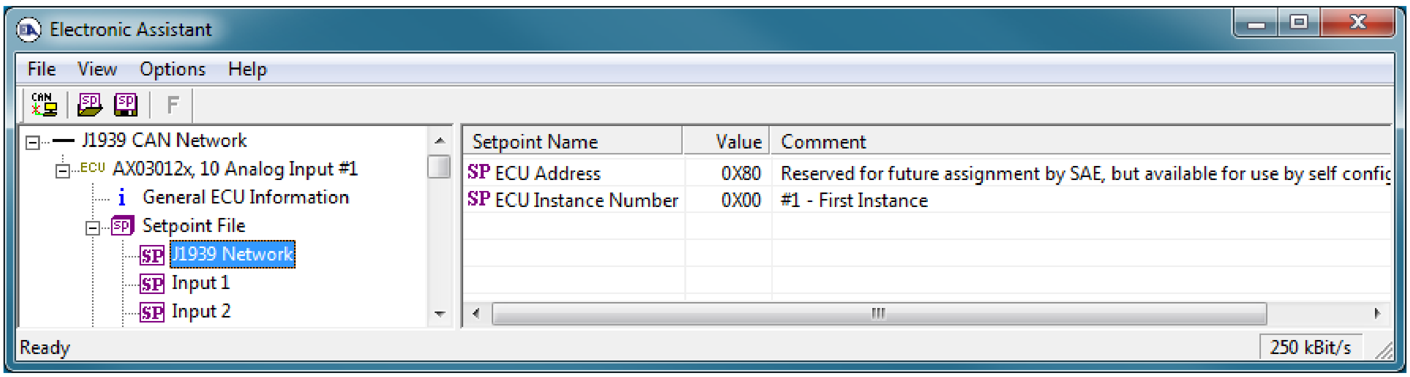


Figure 4 - Screen Capture of J1939 Setpoints

4.3. Input Setpoints

The Inputs are defined in section 1.1. Please refer there for detailed information about how all these setpoints are used.

Name	Range	Default	Notes
Input Sensor Type	Drop List	VOLTAGE_0_TO_5V	See Table 1
Minimum Range	Limit to Maximum Range	0V	See section 1.3
Maximum Range	Minimum Range to Limit	5V	See section 1.3
Debounce Time	Drop List	None	See Table 3
Additional Software Debounce Filter Time	Drop List	0ms	See Table 4
Pulses per Revolution	Drop List	FALSE	See Section 1.1
Measuring Window	0..60000	100 pulses	See Section 1.1
Max Pulse Count	0..65535	10 pulses	See Section 1.1
Pullup/Pulldown Resistor	Drop List	10kΩ Pulldown (active high)	See Table 5
Active High/Active Low	Drop List	Active High	See Table 6
Software Filter Type	Drop List	No Filtering	See section 1.2
Software Filter Constant	1..1000	1	See section 1.2

Table 20 - Input Setpoints

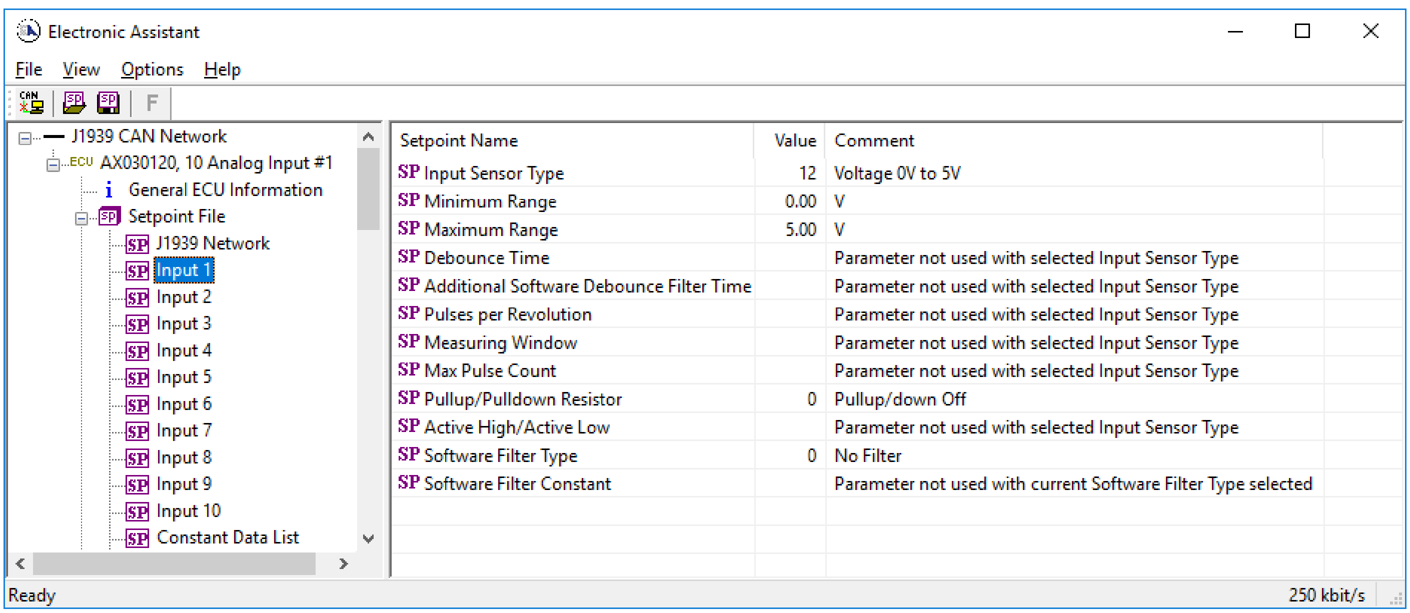


Figure 5 - Screen Capture of Input Setpoints

4.4. Constant Data List

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

The first two constants are fixed values of 0 (False) and 1 (True) for use in binary logic. The remaining 13 constants are fully user programmable to any value between +/. 1 000 000. The default values (shown in Figure 6) are arbitrary and should be configured by the user as appropriate for their application.

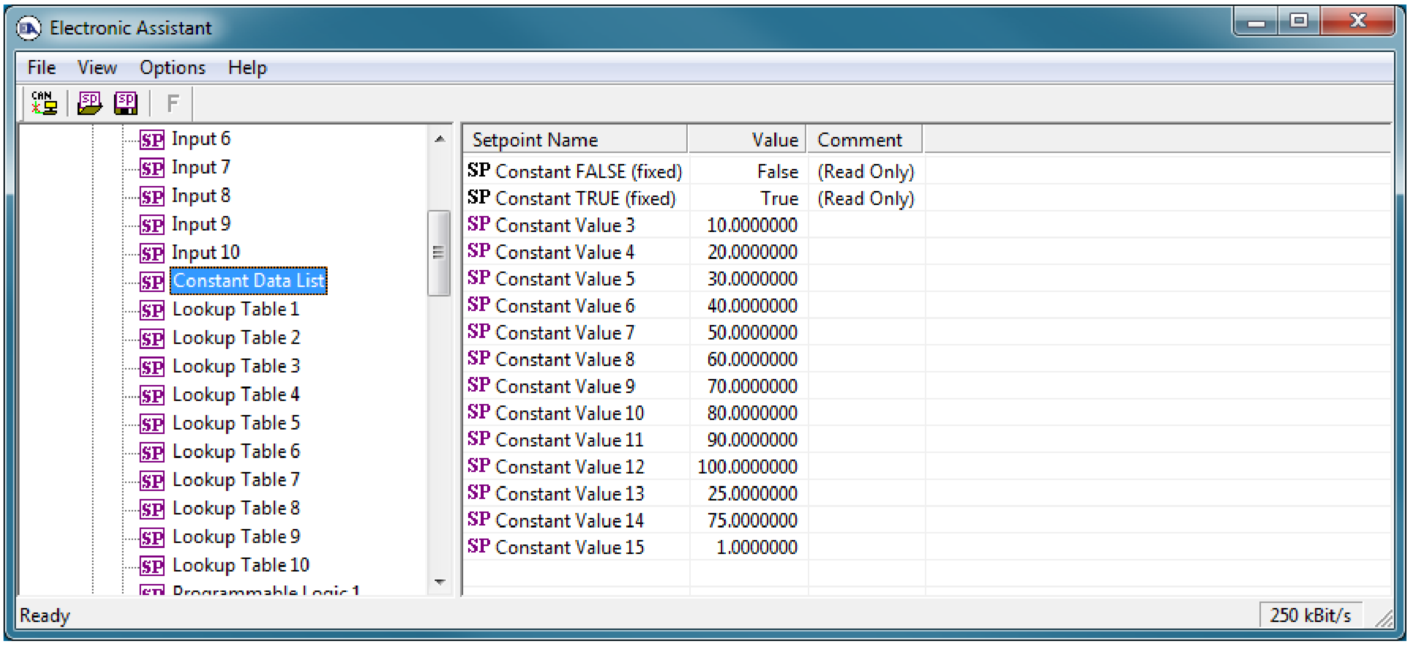


Figure 6 - Screen Capture of Constant Data List Setpoints

4.5. Lookup Table

The Lookup Table Function Block is defined in Section 1.4. 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**".

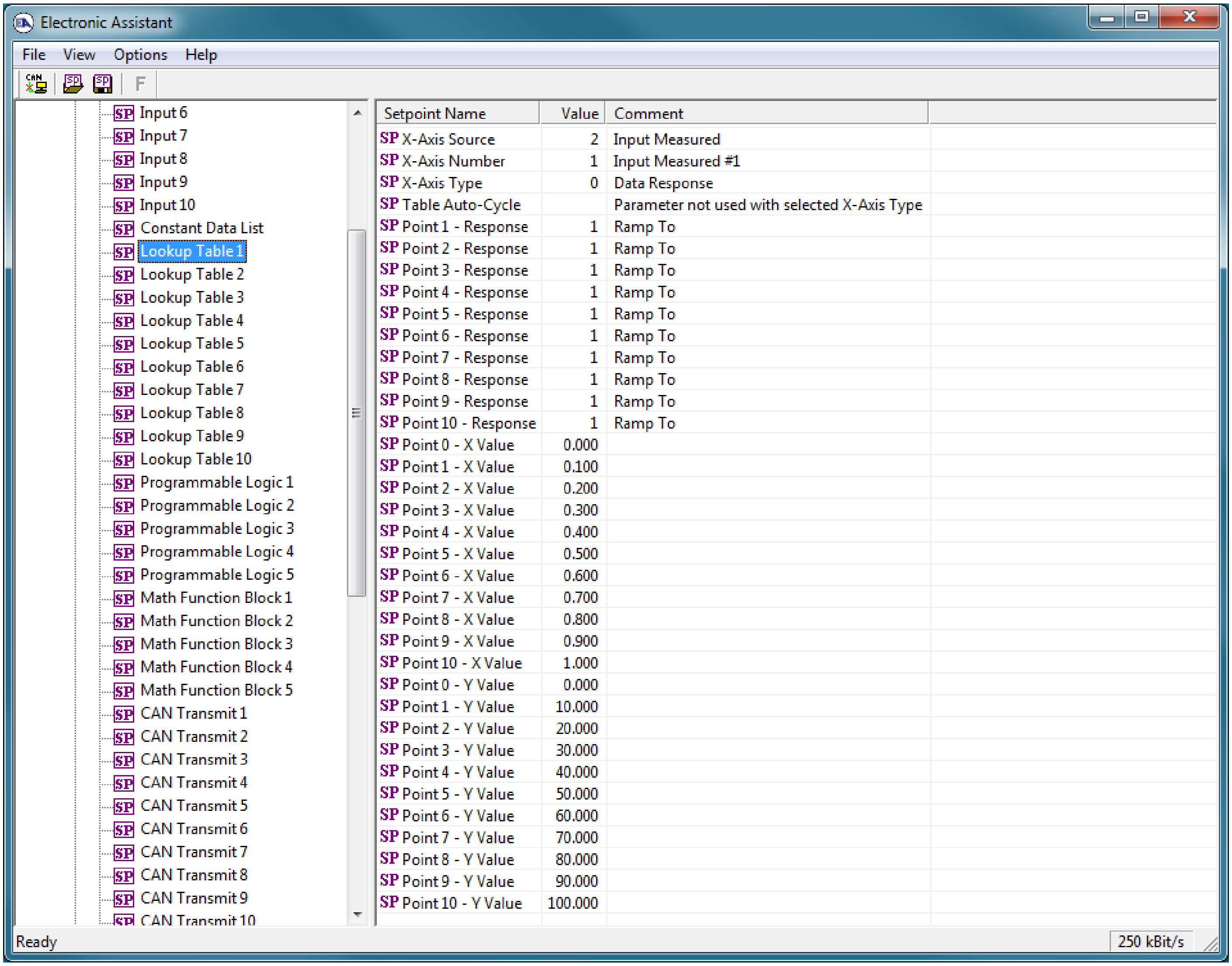


Figure 7 - Screen Capture of Lookup table Setpoints

Name	**Range**	**Default**	**Notes**
X-Axis Source	Drop List	Control Not Used	See Table 17
X-Axis Number	Depends on control source	1	See Table 17
X-Axis Type	Drop List	Data Response	See Table 12
Table Auto-Cycle	Drop List	0	
Point 1 - Response	Drop List	Ramp To	See Table 13
Point 2 - Response	Drop List	Ramp To	See Table 13
Point 3 - Response	Drop List	Ramp To	See Table 13
Point 4 - Response	Drop List	Ramp To	See Table 13
Point 5 - Response	Drop List	Ramp To	See Table 13
Point 6 - Response	Drop List	Ramp To	See Table 13
Point 7 - Response	Drop List	Ramp To	See Table 13

Point 8 - Response	Drop List	Ramp To	See Table 13
Point 9 - Response	Drop List	Ramp To	See Table 13
Point 10 - Response	Drop List	Ramp To	See Table 13
Point 0 - X Value	From X-Axis source minimum to Point 1 - X Value	X-Axis source minimum 0.000	See Section 1.4
Point 1 - X Value	From Point 0 - X Value to Point 2 - X Value	0.500	See Section 1.4
Point 2 - X Value	From Point 1 - X Value to Point 3 - X Value	1.000	See Section 1.4
Point 3 - X Value	From Point 2 - X Value to Point 4 - X Value	1.500	See Section 1.4
Point 4 - X Value	From Point 3 - X Value to Point 5 - X Value source	2.000	See Section 1.4
Point 5 - X Value	From Point 4 - X Value to Point 6 - X Value	2.500	See Section 1.4
Point 6 - X Value	From Point 5 - X Value to Point 7 - X Value	3.000	See Section 1.4
Point 7 - X Value	From Point 6 - X Value to Point 8 - X Value	3.500	See Section 1.4
Point 8 - X Value	From Point 7 - X Value to Point 9 - X Value	4.000	See Section 1.4
Point 9 - X Value	From Point 8 - X Value to Point 10 - X Value	4.500	See Section 1.4
Point 10 - X Value	From Point 9 - X Value to X-Axis source maximum	X-Axis source maximum 5.000	See Section 1.4
Point 0 - Y Value	-10^6 to 10^6	0.000	
Point 1 - Y Value	-10^6 to 10^6	10.000	
Point 2 - Y Value	-10^6 to 10^6	20.000	
Point 3 - Y Value	-10^6 to 10^6	30.000	
Point 4 - Y Value	-10^6 to 10^6	40.000	
Point 5 - Y Value	-10^6 to 10^6	50.000	
Point 6 - Y Value	-10^6 to 10^6	60.000	
Point 7 - Y Value	-10^6 to 10^6	70.000	
Point 8 - Y Value	-10^6 to 10^6	80.000	
Point 9 - Y Value	-10^6 to 10^6	90.000	
Point 10 - Value	-10^6 to 10^6	100.000	

Table 21 – Lookup Table Setpoints

4.6. Programmable Logic

The Programmable Logic function block is defined in Section 1.5. Please refer there for detailed information about how all these setpoints are used. “**Programmable Logic Enabled**” is ‘*False*’ by default. To enable Logic set “**Programmable Logic Enabled**” to ‘*True*’ and select appropriate “**Argument Source**”.

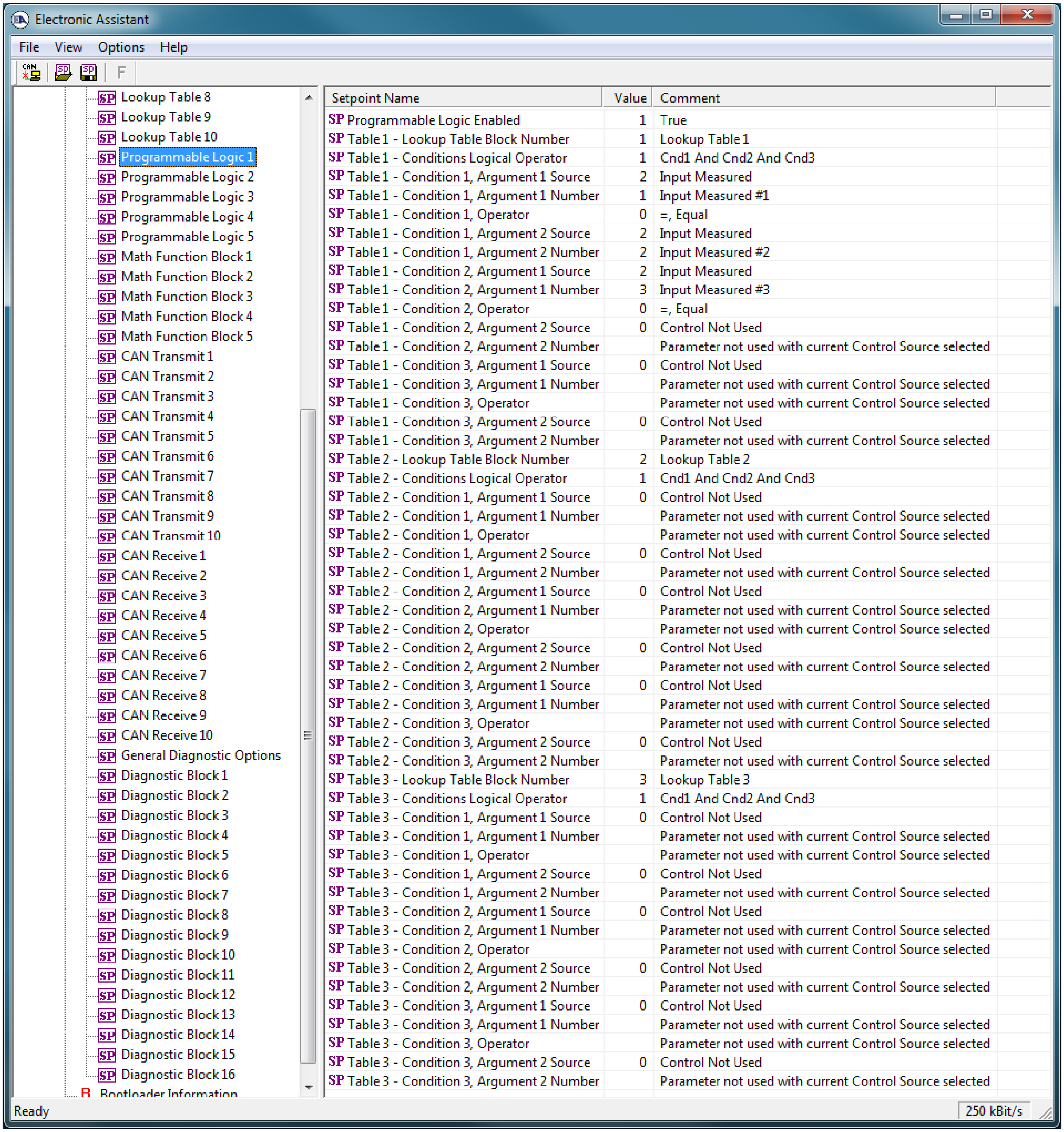


Figure 8 - Screen Capture of Programmable Logic Setpoints

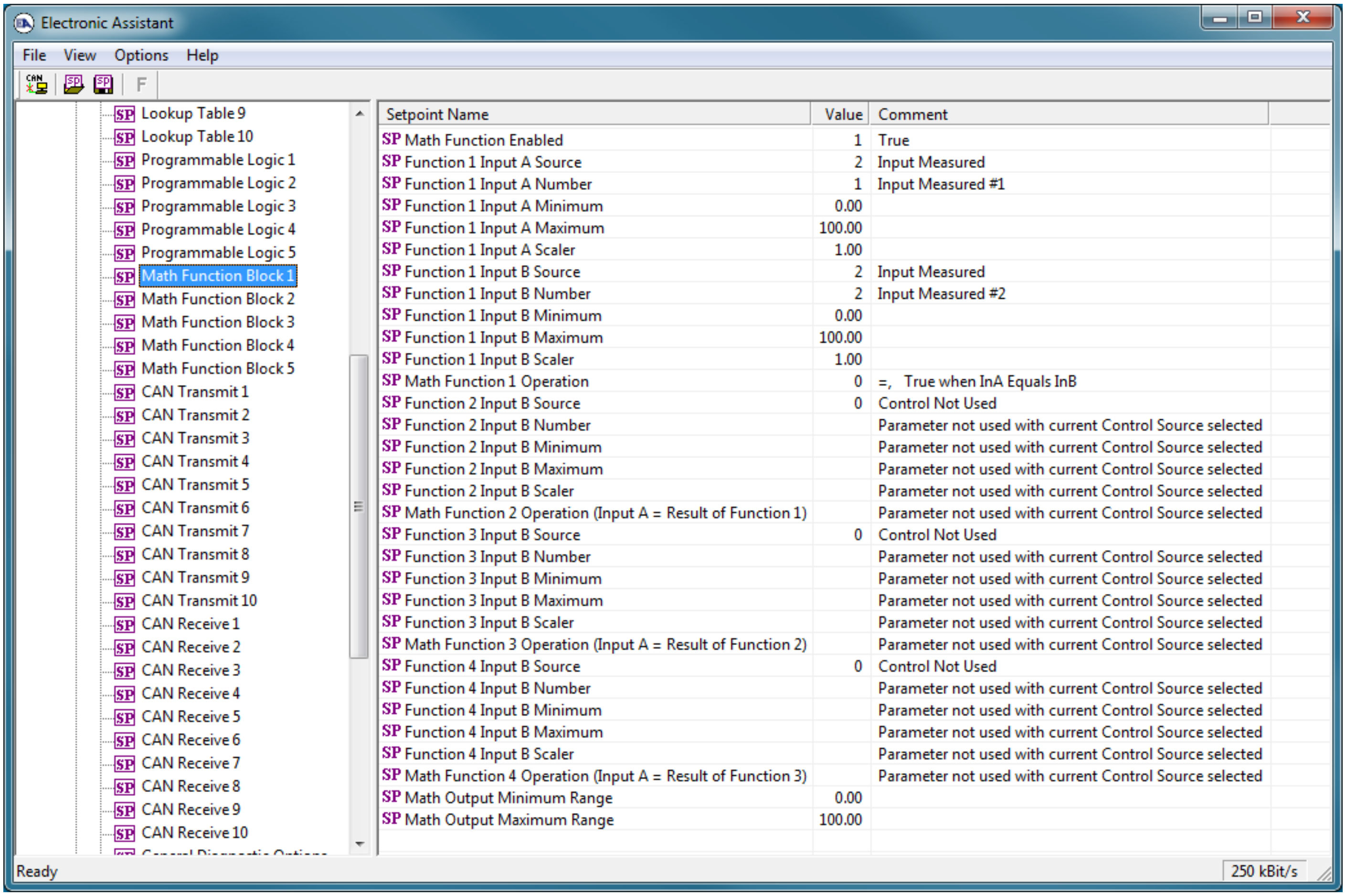
Setpoint ranges and default values for Programmable Logic Blocs are listed in Table 22. Only “**Table1**” setpoint are listed, because other “**TableX**” setpoints are similar, except for the default value of the “**Lookup Table Block Number**” setpoint, which is X for “**TableX**”.

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 15
Table1 - Condition1, Argument 1 Source	Drop List	Control Not Used	See Table 17
Table1 - Condition1, Argument 1 Number	Depends on control source	1	See Table 17
Table1 - Condition1, Operator	Drop List	=, Equal	See Table 14
Table1 - Condition1, Argument 2 Source	Drop List	Control Not Used	See Table 17
Table1 - Condition1, Argument 2 Number	Depends on control source	1	See Table 17
Table1 - Condition2, Argument 1 Source	Drop List	Control Not Used	See Table 17
Table1 - Condition2, Argument 1 Number	Depends on control source	1	See Table 17
Table1 - Condition2, Operator	Drop List	=, Equal	See Table 14
Table1 - Condition2, Argument 2 Source	Drop List	Control Not Used	See Table 17
Table1 - Condition2, Argument 2 Number	Depends on control source	1	See Table 17
Table1 - Condition3, Argument 1 Source	Drop List	Control Not Used	See Table 17
Table1 - Condition3, Argument 1 Number	Depends on control source	1	See Table 17
Table1 - Condition3, Operator	Drop List	=, Equal	See Table 14
Table1 - Condition3, Argument 2 Source	Drop List	Control Not Used	See Table 17
Table1 - Condition3, Argument 2 Number	Depends on control source	1	See Table 17

Table 22 – Programmable Logic Setpoints

4.7. Math Function Block

The Math Function Block is defined in Section 1.6. 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 Function Enabled	1	True
SP Function 1 Input A Source	2	Input Measured
SP Function 1 Input A Number	1	Input Measured #1
SP Function 1 Input A Minimum	0.00	
SP Function 1 Input A Maximum	100.00	
SP Function 1 Input A Scaler	1.00	
SP Function 1 Input B Source	2	Input Measured
SP Function 1 Input B Number	2	Input Measured #2
SP Function 1 Input B Minimum	0.00	
SP Function 1 Input B Maximum	100.00	
SP Function 1 Input B Scaler	1.00	
SP Math Function 1 Operation	0	=, True when InA Equals InB
SP Function 2 Input B Source	0	Control Not Used
SP Function 2 Input B Number		Parameter not used with current Control Source selected
SP Function 2 Input B Minimum		Parameter not used with current Control Source selected
SP Function 2 Input B Maximum		Parameter not used with current Control Source selected
SP Function 2 Input B Scaler		Parameter not used with current Control Source selected
SP Math Function 2 Operation (Input A = Result of Function 1)		Parameter not used with current Control Source selected
SP Function 3 Input B Source	0	Control Not Used
SP Function 3 Input B Number		Parameter not used with current Control Source selected
SP Function 3 Input B Minimum		Parameter not used with current Control Source selected
SP Function 3 Input B Maximum		Parameter not used with current Control Source selected
SP Function 3 Input B Scaler		Parameter not used with current Control Source selected
SP Math Function 3 Operation (Input A = Result of Function 2)		Parameter not used with current Control Source selected
SP Function 4 Input B Source	0	Control Not Used
SP Function 4 Input B Number		Parameter not used with current Control Source selected
SP Function 4 Input B Minimum		Parameter not used with current Control Source selected
SP Function 4 Input B Maximum		Parameter not used with current Control Source selected
SP Function 4 Input B Scaler		Parameter not used with current Control Source selected
SP Math Function 4 Operation (Input A = Result of Function 3)		Parameter not used with current Control Source selected
SP Math Output Minimum Range	0.00	
SP Math Output Maximum Range	100.00	

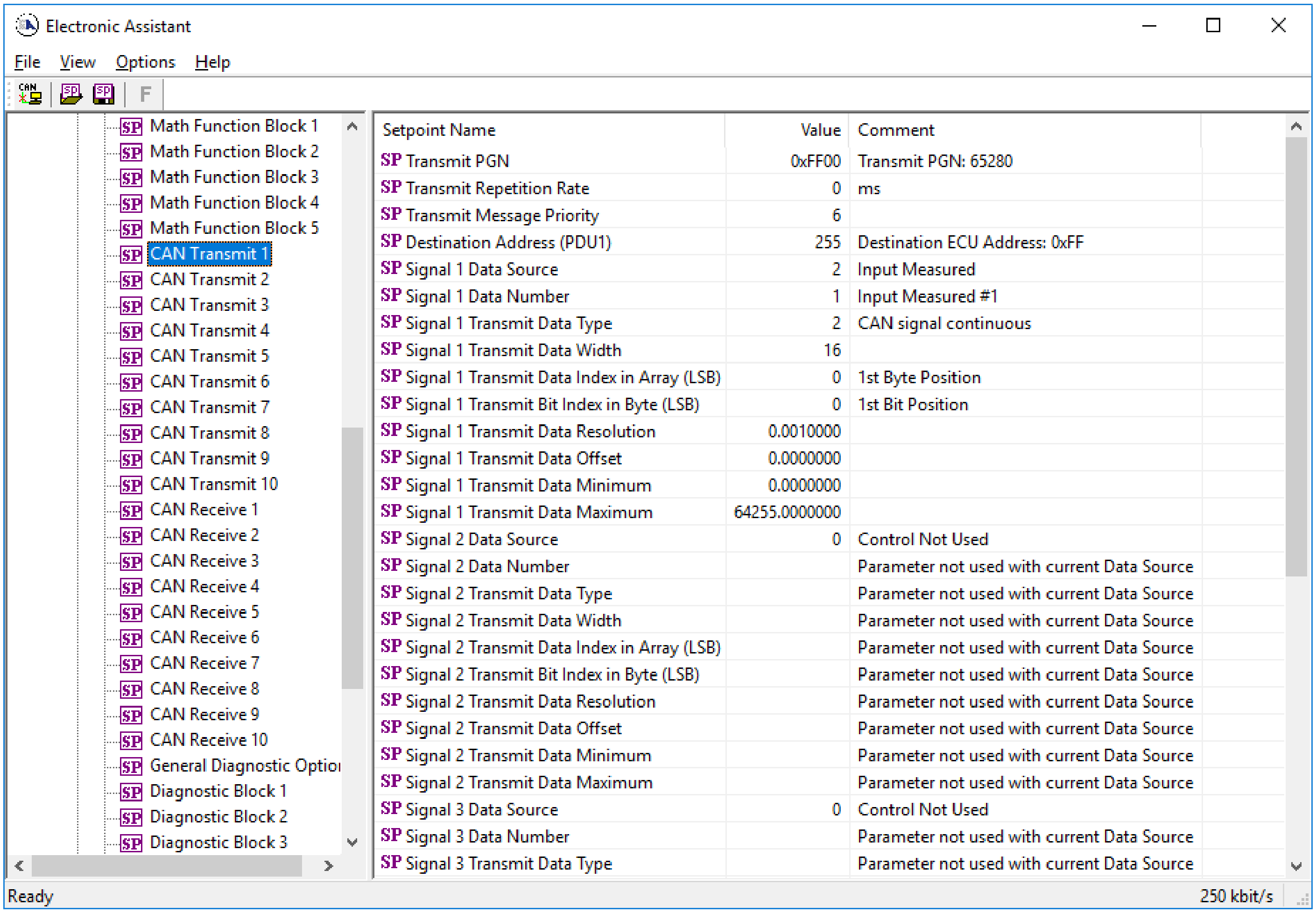
Figure 9 - Screen Capture of Math Function Block Setpoints

Name	Range	Default	Notes
Math Function Enabled	Drop List	False	
Function 1 Input A Source	Drop List	Control not used	See Table 17
Function 1 Input A Number	Depends on control source	1	See Table 17
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 17
Function 1 Input B Number	Depends on control source	1	See Table 17
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 16
Function 2 Input B Source	Drop List	Control not used	See Table 17
Function 2 Input B Number	Depends on control source	1	See Table 17
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 16
Function 3 Input B Source	Drop List	Control not used	See Table 17
Function 3 Input B Number	Depends on control source	1	See Table 17
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 16
Function 4 Input B Source	Drop List	Control not used	See Table 17
Function 4 Input B Number	Depends on control source	1	See Table 17
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 16
Math Output Minimum Range	-10^6 to 10^6	0.0	
Math Outptu Maximum Range	-10^6 to 10^6	100.0	

Table 23 – Math Function Setpoints

4.8. CAN Transmit Setpoints

CAN Transmit Message Function Block is presented in Section 1.7.1. Please refer there for detailed information how these setpoints are used. "**Transmit Repetition Rate**" is 0ms by default, thus no message will be sent.



Setpoint Name	Value	Comment
SP Transmit PGN	0xFF00	Transmit PGN: 65280
SP Transmit Repetition Rate	0	ms
SP Transmit Message Priority	6	
SP Destination Address (PDU1)	255	Destination ECU Address: 0xFF
SP Signal 1 Data Source	2	Input Measured
SP Signal 1 Data Number	1	Input Measured #1
SP Signal 1 Transmit Data Type	2	CAN signal continuous
SP Signal 1 Transmit Data Width	16	
SP Signal 1 Transmit Data Index in Array (LSB)	0	1st Byte Position
SP Signal 1 Transmit Bit Index in Byte (LSB)	0	1st Bit Position
SP Signal 1 Transmit Data Resolution	0.0010000	
SP Signal 1 Transmit Data Offset	0.0000000	
SP Signal 1 Transmit Data Minimum	0.0000000	
SP Signal 1 Transmit Data Maximum	64255.0000000	
SP Signal 2 Data Source	0	Control Not Used
SP Signal 2 Data Number		Parameter not used with current Data Source
SP Signal 2 Transmit Data Type		Parameter not used with current Data Source
SP Signal 2 Transmit Data Width		Parameter not used with current Data Source
SP Signal 2 Transmit Data Index in Array (LSB)		Parameter not used with current Data Source
SP Signal 2 Transmit Bit Index in Byte (LSB)		Parameter not used with current Data Source
SP Signal 2 Transmit Data Resolution		Parameter not used with current Data Source
SP Signal 2 Transmit Data Offset		Parameter not used with current Data Source
SP Signal 2 Transmit Data Minimum		Parameter not used with current Data Source
SP Signal 2 Transmit Data Maximum		Parameter not used with current Data Source
SP Signal 3 Data Source	0	Control Not Used
SP Signal 3 Data Number		Parameter not used with current Data Source
SP Signal 3 Transmit Data Type		Parameter not used with current Data Source

Figure 10 - Screen Capture of CAN Transmit Message Setpoints

Name	Range	Default	Notes
Transmit PGN	0xff00 … 0xffff	Different for each	See Section 1.7.1
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 1 Control Source	Drop List	Different for each	See Table 17
Signal 1 Control Number	Drop List	Different for each	See 1.7.2
Signal 1 Transmit Data Type	Drop List	Continuous	
Signal 1 Transmit Data Width	1-32	16	
Signal 1 Transmit Data Index in Array	0-7	0	
Signal 1 Transmit Bit Index In Byte	0-7	0	
Signal 1 Transmit Data Resolution	-100000.0 to 100000	0.001	
Signal 1 Transmit Data Offset	-10000 to 10000	0.0	
Signal 2 Control Source	Drop List	Signal undefined	See Table 17
Signal 2 Control Number	Drop List	Signal undefined	See 1.7.2
Signal 2 Transmit Data Type	Drop List	Continuous	
Signal 2 Transmit Data Width	1-32	16	
Signal 2 Transmit Data Index in Array	0-7	2	
Signal 2 Transmit Bit Index In Byte	0-7	0	
Signal 2 Transmit Data Resolution	-100000.0 to 100000	0.001	
Signal 2 Transmit Data Offset	-10000 to 10000	0.0	
Signal 3 Control Source	Drop List	Signal undefined	See Table 17
Signal 3 Control Number	Drop List	Signal undefined	See 1.7.2
Signal 3 Transmit Data Type	Drop List	Continuous	
Signal 3 Transmit Data Width	1-32	16	
Signal 3 Transmit Data Index in Array	0-7	4	
Signal 3 Transmit Bit Index In Byte	0-7	0	
Signal 3 Transmit Data Resolution	-100000.0 to 100000	0.001	
Signal 3 Transmit Data Offset	-10000 to 10000	0.0	
Signal 4 Control Source	Drop List	Signal undefined	See Table 17
Signal 4 Control Number	Drop List	Signal undefined	See 1.7.2
Signal 4 Transmit Data Type	Drop List	Continuous	
Signal 4 Transmit Data Width	1-32	16	
Signal 4 Transmit Data Index in Array	0-7	6	
Signal 4 Transmit Bit Index In Byte	0-7	0	
Signal 4 Transmit Data Resolution	-100000.0 to 100000	0.001	
Signal 4 Transmit Data Offset	-10000 to 10000	0.0	

Table 24 – CAN Transmit Message Setpoints

4.9. CAN Receive Setpoints

The Math Function Block is defined in Section 1.7.2. 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.

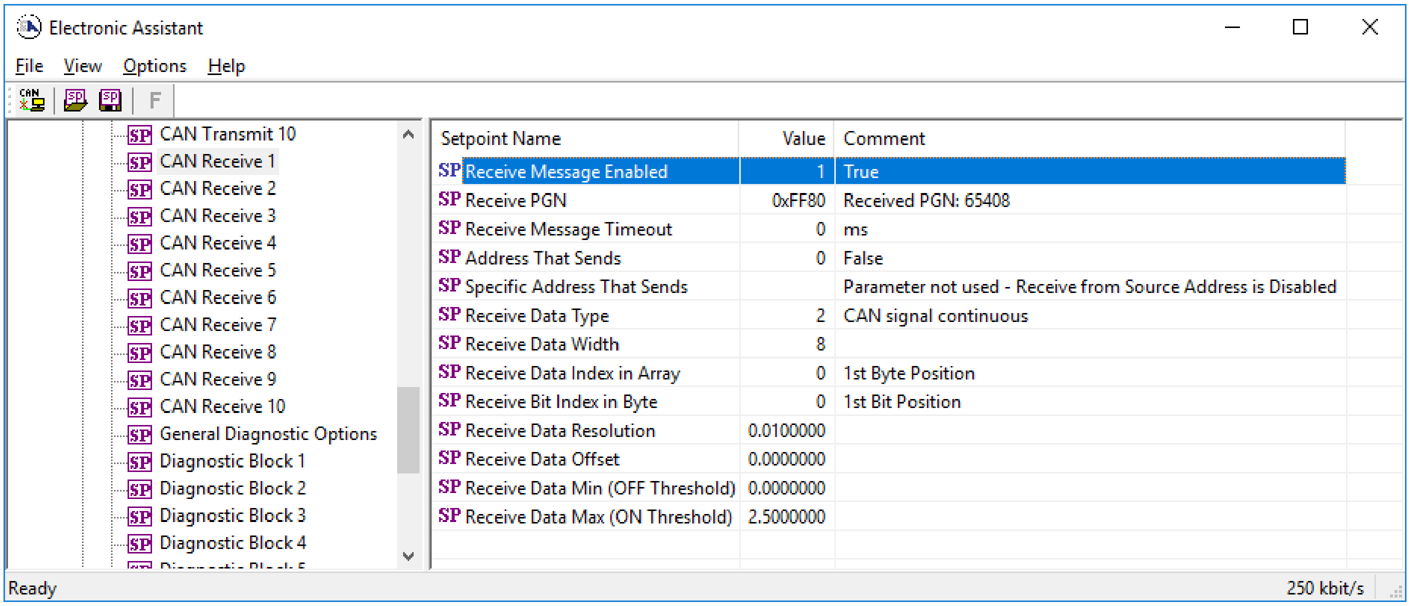


Figure 11 - Screen Capture of CAN Receive Message Setpoints

Name	Range	Default	Notes
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	Drop List	False	
Address That Sends	0 to 255	254 (0xFE, Null Addr)	
Receive Transmit Data Type	Drop List	Continuous	
Receive Transmit Data Width	1-32	8	
Receive Transmit Data Index in Array	0-7	0	
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)	Min to 100000	2.0	

Table 25 – CAN Receive Setpoints

4.10. 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 1.3 for more info.

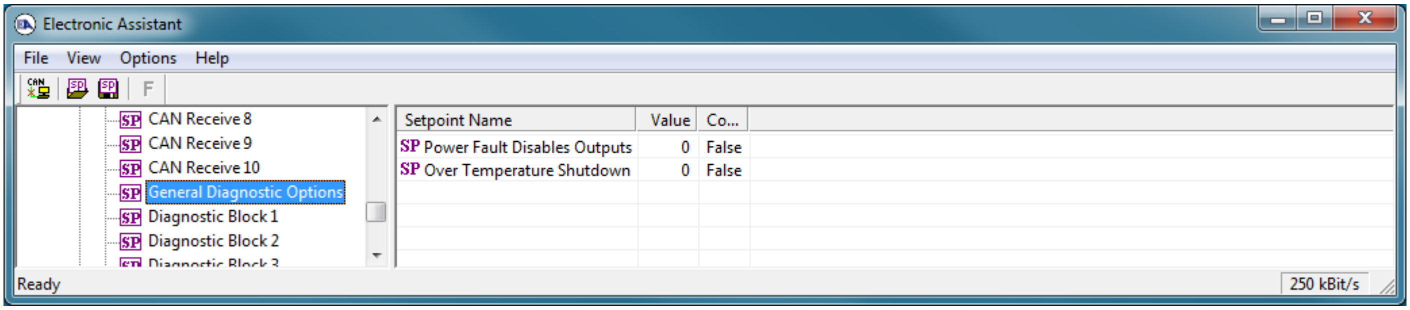


Figure 12 - Screen Capture of General Diagnostics Options Setpoints

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

Table 26 – General Diagnostics Options Setpoints

4.11. 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 1.3. Please refer there for detailed information how these setpoints are used.

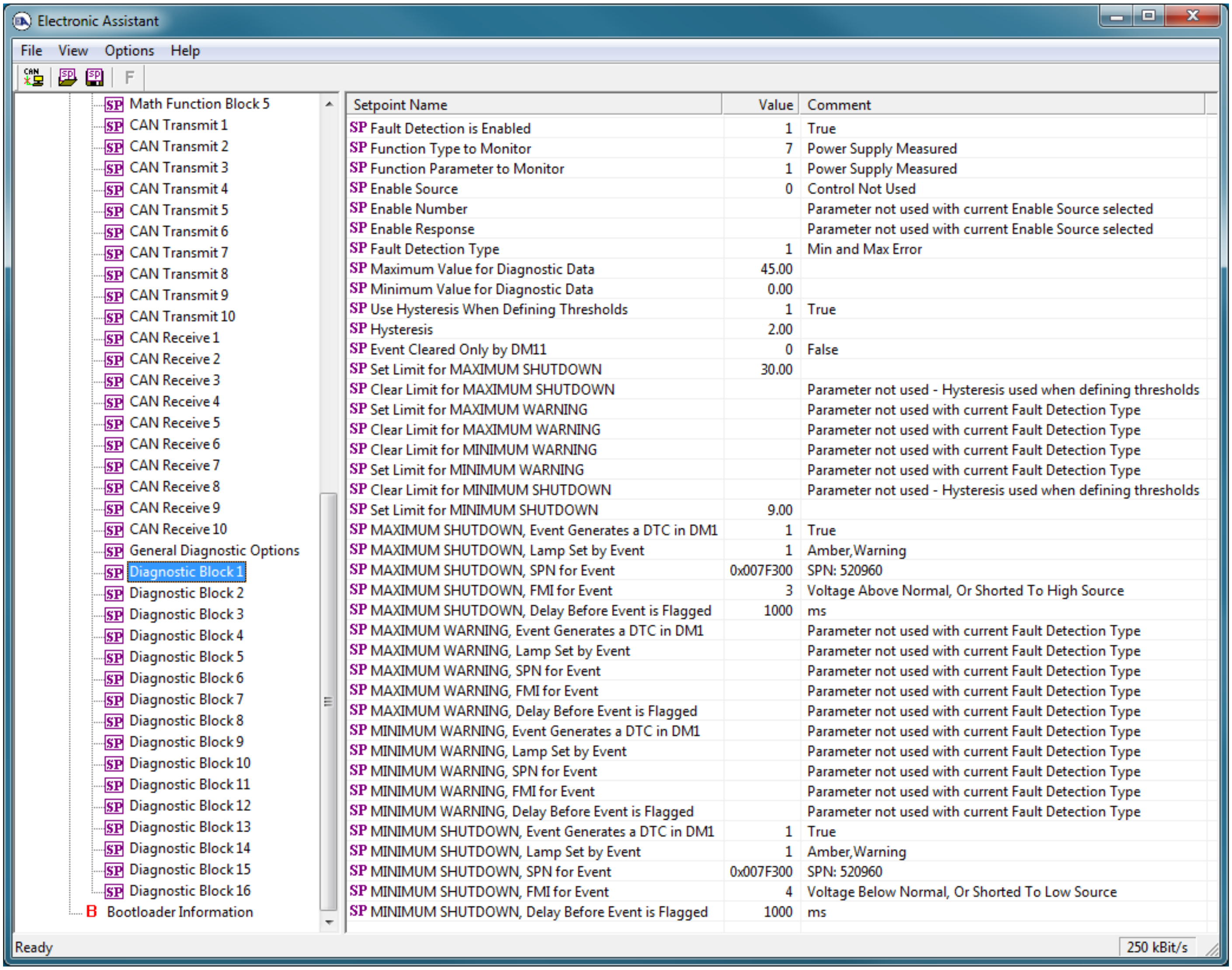


Figure 13 - Screen Capture of Diagnostic Block Setpoints

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	1 – Min and Max Error	See section **Error! Reference source not found.**
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 9
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 10
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 9
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 10
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 9
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 10
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 9
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 10
MINIMUM SHUTDOWN, Delay Before Event is Flagged	0...60000 ms	1000	

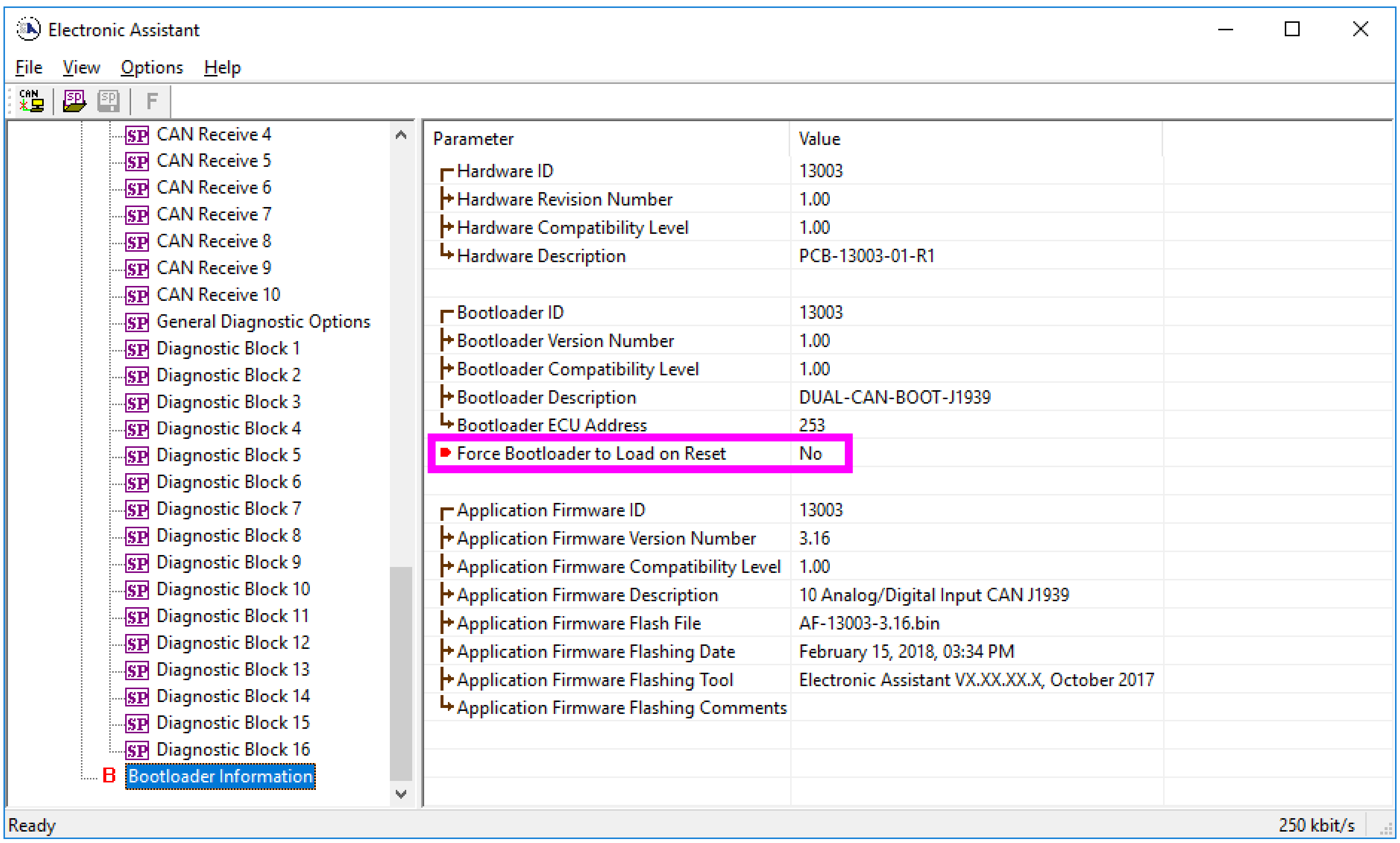
Table 27 – Diagnostic Block Setpoints

5. REFLASHING OVER CAN WITH EA BOOTLOADER

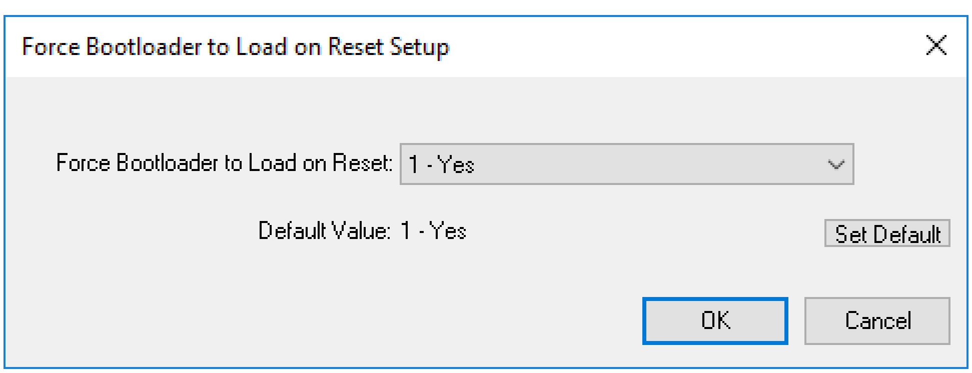
The AX0301x0 can be upgraded with new application firmware using the **Bootloader Information** section. This section details the simple step-by-step instructions to upload new firmware provided by Axiomatic onto the unit via CAN, without requiring it to be disconnected from the J1939 network.

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

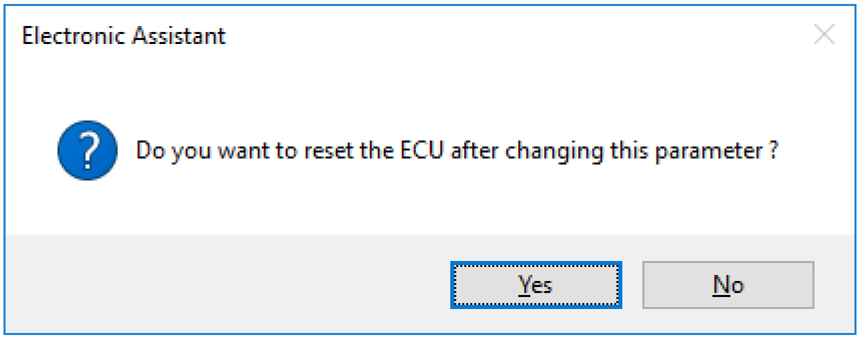
1. When EA first connects to the ECU, the **Bootloader Information** section will display the following information.



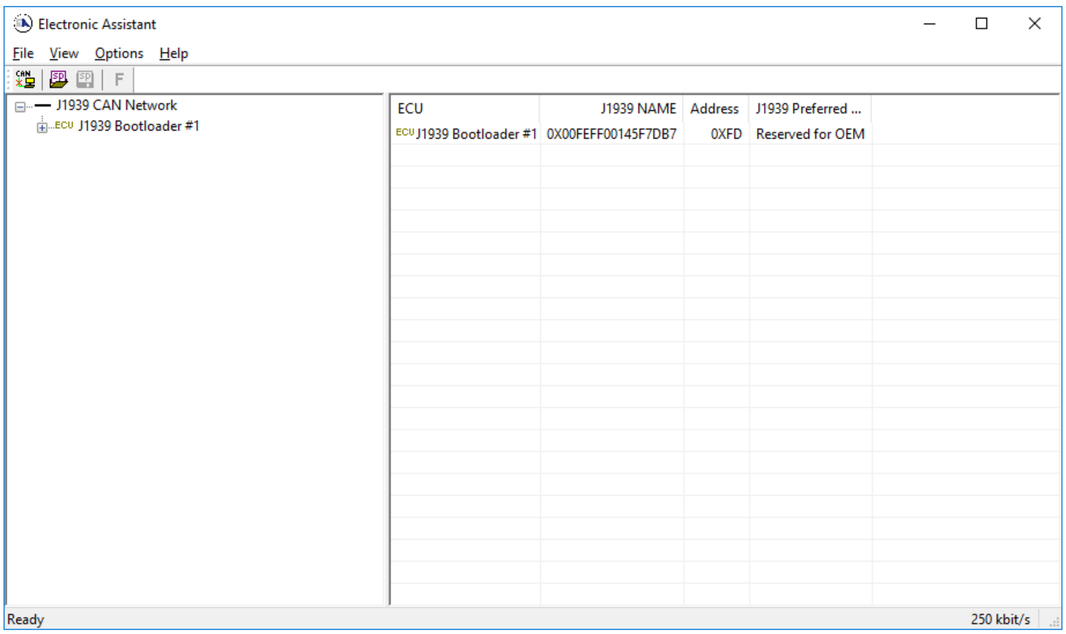
2. To use the bootloader to upgrade the firmware running on the ECU, change the variable **"Force Bootloader To Load on Reset**" to *Yes.*

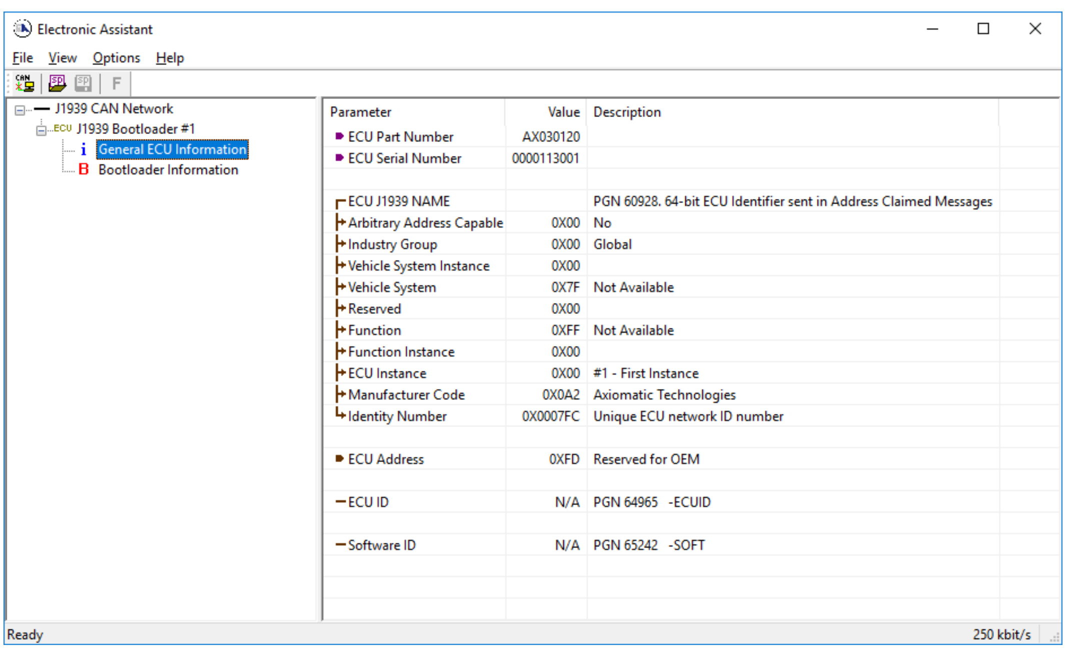


3. When the prompt box asks if you want to reset the ECU, select *Yes*.



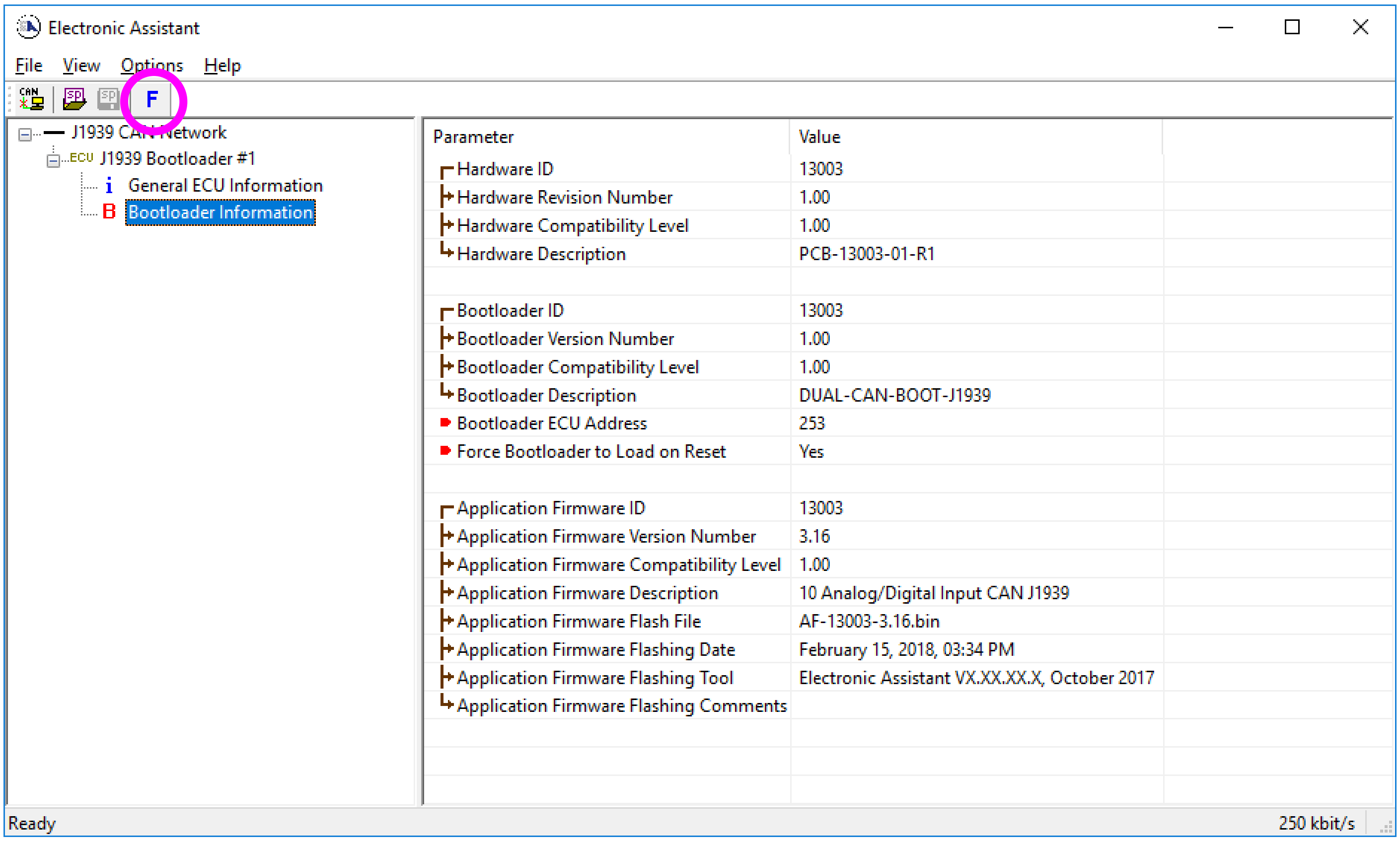
4. Upon reset, the ECU will no longer show up on the J1939 network as an AX0301x0 but rather as **J1939 Bootloader #1**.





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

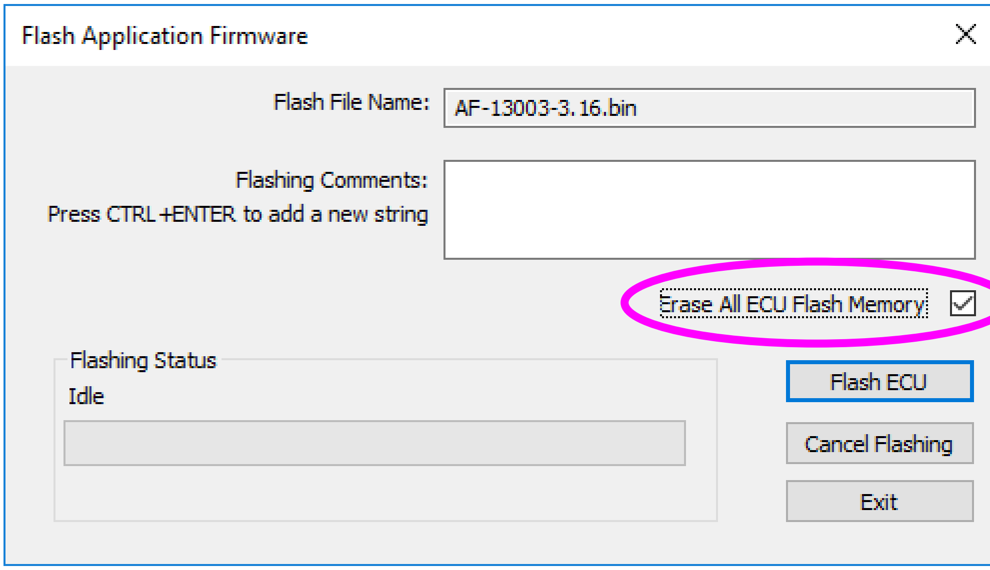
5. When the **Bootloader Information** section is selected, the same information is shown as when it was running the AX0301x0 firmware, but in this case the **F**lashing feature has been enabled.



6. Select the **F**lashing button and navigate to where you had saved the **AF-13003-x.xx.bin** file sent from Axiomatic. (Note: only binary (.bin) files can be flashed using the EA tool.)

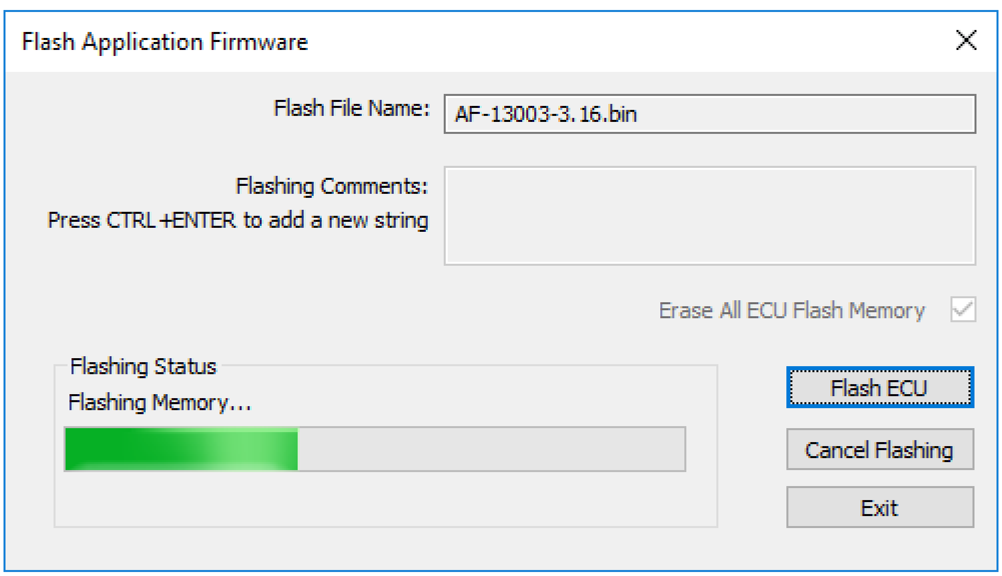
7. Once the Flash Application Firmware window opens, you can enter comments such as "Firmware upgraded by [Name]" if you so desire. This is not required, and you can leave the field blank if you do not want to use it.

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

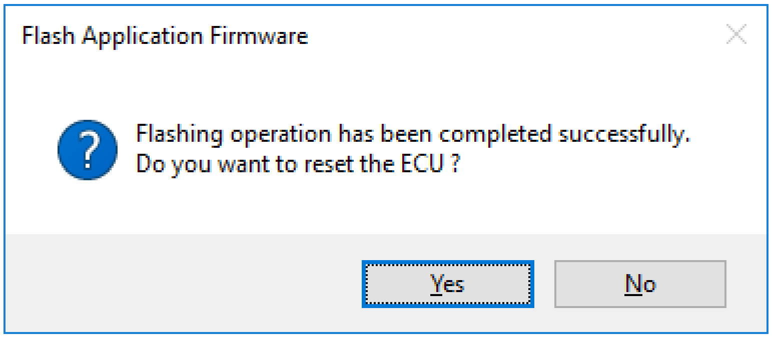


NOTE: It is good practice to tick the "Erase All ECU Flash Memory" box. Please note, that selecting this option will **erase ALL data stored in non-volatile flash**. It will also erase any configuration of the setpoints that might have been done to the ECU and reset all setpoints to their factory defaults. In case the controller contains custom settings, those settings need to be saved to PC before reflashing.

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 AX030120 application will start running, and the ECU will be identified as such by EA. Otherwise, the next time the ECU is power-cycled, the AX030120 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

Power Input Specifications

Power Supply Input - Nominal	12 or 24Vdc nominal operating voltage 8…60 Vdc power supply range for voltage transients
Surge Protection	Provided
Reverse Polarity Protection	Provided
Quiescent Current	< 25mA @ Vin = 24V
Voltage Reference	+5V, 100mA (only supported by AX030130)

Signal Input Specifications

<table>
<tr><td>Inputs</td><td>10 user selectable inputs (See below.)

Analog 12-bit (0-5V, 0-10V, 0-20mA)
PWM 12-bit
Frequency
Counter input 16-bit
Digital (active high) [ON when input ≥ 1.5V]

<table>
<tr><th colspan="2">Inputs – User Selections</th></tr>
<tr><td>0</td><td>Disabled</td></tr>
<tr><td>12</td><td>Voltage (0-5 V)</td></tr>
<tr><td>13</td><td>Voltage (0-10 V)</td></tr>
<tr><td>20</td><td>Current (0-20 mA)</td></tr>
<tr><td>21</td><td>Current (4-20 mA)</td></tr>
<tr><td>40</td><td>Frequency (0.5 to 50 Hz)</td></tr>
<tr><td>41</td><td>Frequency (10 Hz to 1 kHz)</td></tr>
<tr><td>42</td><td>Frequency (100 Hz to 10 kHz)</td></tr>
<tr><td>50</td><td>PWM Low Frequency (<1 kHz)</td></tr>
<tr><td>51</td><td>PWM High Frequency (>100 Hz)</td></tr>
<tr><td>70</td><td>16-bit Counter</td></tr>
<tr><td>60</td><td>Digital (normal)</td></tr>
<tr><td>61</td><td>Digital (inverse)</td></tr>
<tr><td>62</td><td>Digital (latched)</td></tr>
</table>
All inputs with the exception of 16-Bit Counter are sampled every 1ms. Analog Input types have a 12-bit resolution.
With current inputs, short circuit protection is provided.</td></tr>
<tr><td>Minimum and Maximum Ratings</td><td>
<table>
<tr><th>Characteristic</th><th>Min</th><th>Max</th><th>Units</th></tr>
<tr><td>Power Supply</td><td>8</td><td>60</td><td>V dc</td></tr>
<tr><td>Voltage Input</td><td>0</td><td>43</td><td>V dc</td></tr>
<tr><td>Current Input</td><td>0</td><td>21</td><td>mA</td></tr>
<tr><td>Current Input – Voltage Level</td><td>0</td><td>12</td><td>Vdc</td></tr>
<tr><td>Digital Type Input – Voltage Level</td><td>0</td><td>43</td><td>Vdc</td></tr>
<tr><td>PWM Duty Cycle</td><td>0</td><td>100</td><td>%</td></tr>
<tr><td>PWM Frequency</td><td>50</td><td>10 000</td><td>Hz</td></tr>
<tr><td>PWM Voltage pk - pk</td><td>0</td><td>43</td><td>V dc</td></tr>
<tr><td>RPM Frequency</td><td>50</td><td>10 000</td><td>Hz</td></tr>
</table></td></tr>
<tr><td>Input Accuracy</td><td>
<table>
<tr><th>Input Type</th><th>Accuracy</th><th>Resolution</th></tr>
<tr><td>Voltage</td><td>+/- 1%</td><td>1 mV</td></tr>
<tr><td>Current</td><td>+/- 1%</td><td>1uA</td></tr>
<tr><td>Digital Type
(Digital, PWM, Frequency, Counter)</td><td>+/- 1%</td><td>0.01%</td></tr>
</table></td></tr>
<tr><td>Input Impedance</td><td>0-5V: 1 MOhm
0-10V: 170 kOhm
0(4)-20mA: 249 Ohm
Frequency/Digital Input: Pull Up/Pull Down 22 KOhm</td></tr>
<tr><td>Scan Rate</td><td>Each input is scanned in 100uS.
A complete scan of 10 inputs occurs with new measured values every 1mS.</td></tr>
<tr><td>Analog GND</td><td>10 Analog GND connections are provided.
Grounds are internally connected.</td></tr>
<tr><td>Short Circuit Protection
To Ground and Battery +</td><td>Provided</td></tr>
</table>

General Specifications

Microprocessor	STM32F205VGT6
Communications	1 CAN port (2.0B, SAE J1939) An on-board RS-232 port is used for factory programming only.
User Interface	User configuration and diagnostics are provided with the Axiomatic Electronic Assistant®. The Axiomatic Service Tool is a *Windows*-based graphical user interface that allows easy configuration of the controller setpoints.
Network Termination	It is necessary to terminate the network with external termination resistors. The resistors are 120 Ohm, 0.25W minimum, metal film or similar type. They should be placed between CAN_H and CAN_L terminals at both ends of the network.
Simulink® Block Library	Model **AX030120** includes a Simulink® block library. **Simulink®** is a model-based design tool from Mathworks®. Using Simulink®, the OEM machine designer may simulate their control system with the Axiomatic module included. This permits fine tuning of the design parameters and testing of functionality prior to machine prototype installation. The Hardware Interface Library for Simulink® Files are available from Axiomatic.
Update Time	All inputs, except for frequency and counter inputs, are sampled every 1 ms. Frequency and counter inputs are measured based on the value in the 'Measuring Window' setpoint.
Electrical Connections	Deutsch DTM series 24 pin receptacle (DTM13-12PA-12PB-R008) Mating plug: Deutsch DTM06-12SA and DTM06-12SB with 2 wedgelocks (WM12S) and 24 contacts (0462-201-20141). 20 AWG wire is recommended for use with contacts 0462-201-20141.
Enclosure and Dimensions	High Temperature Nylon housing - Deutsch IPD PCB Enclosure (EEC-325X4B) 4.62 x 5.24 x 1.43 inches 117.42 x 133.09 x 36.36 mm (W x L x H excluding mating plugs)
Operating Conditions	-40 to 85°C (-40 to 185°F)
Weight	0.55 lb. (0.25 kg)
Protection	IP67, Unit is conformal coated in the housing.
EMC Compliance	CE mark
Vibration	MIL-STD-202G, Method 204D, test condition A – 10 g peak (Sine) MIL-STD-202G, Method 214A, test condition B – 7.68 Grms (Random)
Shock	MIL-STD-202G, Method 213B, test condition A 50 g half sine pulse, 6 ms, 6 pulses per axis
Mounting	Mounting holes sized for ¼ inch or M6 bolts. The bolt length will be determined by the end-user's mounting plate thickness. The mounting flange of the controller is 0.63 inches (16 mm) thick. If the module is mounted without an enclosure, it should be mounted vertically with connectors facing left and right to reduce likelihood of moisture entry. The CAN wiring is considered intrinsically safe. The power wires are not considered intrinsically safe and so in hazardous locations, they need to be located in conduit or conduit trays at all times. The module must be mounted in an enclosure in hazardous locations for this purpose. All field wiring should be suitable for the operating temperature range. Install the unit with appropriate space available for servicing and for adequate wire harness access (6 inches or 15 cm) and strain relief (12 inches or 30 cm).

OUR PRODUCTS

Actuator Controls

Automotive Ethernet Converters

Battery Chargers

CAN bus Controls

CAN/Wifi, CAN/Bluetooth

Current/Voltage Converters

DC/DC Power Converters

Engine Temperature Scanners

Ethernet/CAN Converters, Switches

Fan Drive Controllers

Gateways, CAN/Modbus Protocols

Gyroscope Inclinometers

Hydraulic Valve Controllers

Inclinometers, Triaxial

I/O Controls

LVDT Simulators

Machine Controls

Motor Controls

Power Supplies

PWM Signal Converters/Isolators

Resolver Signal Conditioners

Service Tools

Signal Conditioners, Converters

Strain Gauge CAN Controls

Surge Suppressors

OUR COMPANY

Axiomatic provides electronic machine controls, components, and systems to the off-highway, commercial vehicle, electric vehicle, power generator set, material handling, renewable energy and industrial OEM markets.

We provide efficient, innovative solutions that focus on adding value for our customers.

We innovate with engineered and off-the-shelf machine controls.

We emphasize service and partnership with our customers, suppliers, and employees to build long term relationships and mutual trust.

QUALITY DESIGN AND MANUFACTURING

Axiomatic in Canada operates an ISO 9001:2015 registered design and manufacturing facility.

SERVICE

All products to be returned to Axiomatic require a Return Materials Authorization Number (RMA#). Please request an RMA# from rma@axiomatic.com.

Please provide the following information when requesting an RMA number:

- Serial number, part number
- Axiomatic invoice number and date
- Hours of operation, description of problem
- Wiring set up diagram, application
- Other comments as needed

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 as described on www.axiomatic.com/service.html.

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