CAN to SINE/Square Wave Output and PWM Output Controller

With CAN, SAE J1939

USER MANUAL

P/N: AX030550

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VERSION HISTORY

Version	Date	Author	Modification
1.0.0	June 16, 2020	Peter Sotirakos	Initial Draft; for software version 1.00
1.0.1	August 1, 2023	Kiril Mojsov	Legacy Updates

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: AX070502 or AX070506K

TABLE OF CONTENTS

REFERENCES

J1939	Recommended Practice for a Serial Control and Communications Vehicle Network, SAE, April 2011
J1939/21	Data Link Layer, SAE, December 2010
J1939/71	Vehicle Application Layer, SAE, March 2011
J1939/73	Application Layer-Diagnostics, SAE, February 2010
J1939/81	Network Management, SAE, May 2003
TDAX030550	Technical Datasheet, CAN to SINE/Square Wave Output and PWM Output Controller with 2 SAE J1939, Axiomatic Technologies 2020
UMAX07050x	User Manual V5.13.88.0, Axiomatic Electronic Assistant and USB-CAN, Axiomatic Technologies, 2020

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: These products are supported by Axiomatic Electronic Assistant V5.15.112.1 and higher.

1. OVERVIEW OF CONTROLLER

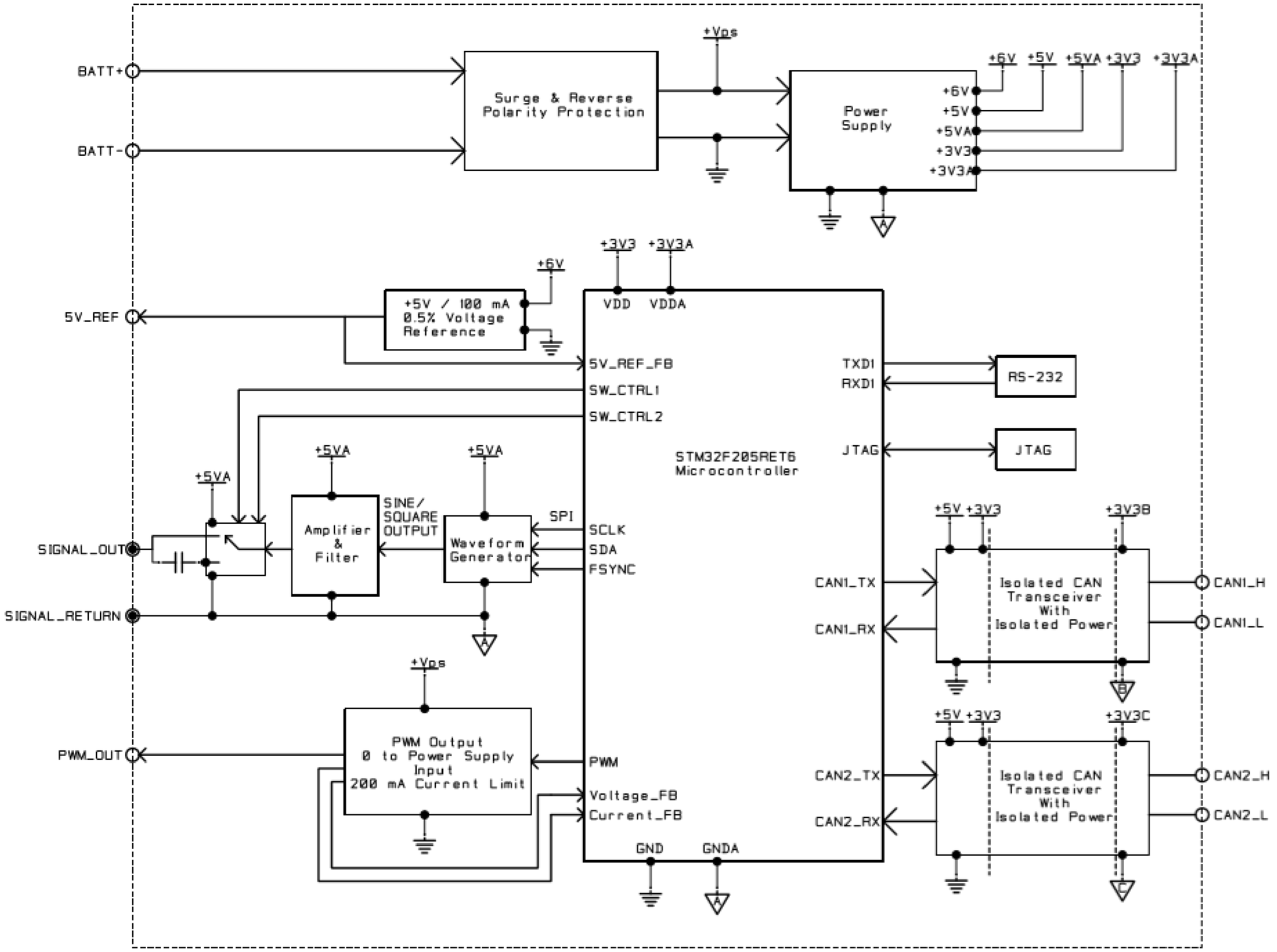


Figure 1 - AX030550 Block Diagram

The CAN to SINE/Square Wave Output and PWM Output Controller (CAN-SINE-SQR-OUT) is designed to provide waveform and pulse-width modulation outputs. The configurable control algorithms allow for this unit to be used for a wide range of applications.

Both outputs can be operated as contained control systems, driving the outputs directly from on-board logical function blocks, or they can be integrated into a SAE J1939 CAN Network. All outputs and logical function blocks on the unit are inherently independent from one another, but can be programmed to interact in a large number of ways.

The *Windows*-based Axiomatic Electronic Assistant (EA) is used to configure the controller via a USB-CAN (AX070501) device. Configurable properties, Axiomatic EA setpoints, are outlined in chapter 4. Setpoint configuration can be saved in a file which can be used to easily program the same configuration into another CAN-SINE-SQR-OUT unit. 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, "**Output Waveform Setting**" setpoint set to option '*Sine Wave'*.

This unit is configured to use a dual CAN network for various features; however, Axiomatic EA functionality is only operable on the CAN2 interface. Both CAN interfaces are capable of automatically detecting the baud rate.

In this document the configurable properties of the ECU are divided into function blocks, namely Common CAN Function Block, Output Function Block, Diagnostic Function Block, Constant Data Function Block, PID 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. These function blocks are presented in detail in next subchapters.

1.1. Common CAN Function Block

The Common CAN function block is used to adjust the CAN settings of both CAN interfaces. The same set of parameters exist for each CAN interface, but they can be set independently of each other.

The "**Auto Baud Rate**" setpoints are used to either enable or disable automatic baud rate detection, if disabled any changes to the CAN baud rate will have to be manually accounted for. When enabled, the unit will match the baud rate set by the other end of the CAN connection. The "**Slew Rate**" parameters determine the slew rate setting of the CAN communication, and can either be set to *'Fast'* or *'Slow'*. The "**Baud Rate**" setting can be used to manually set the baud rate of a CAN interface, if that interface is not being automatically detected.

1.2. Output Function Block

The controller has two configurable outputs; a Waveform Output, and a PWM Output. Both outputs can be set to use either a control source, or fixed values to drive their control. The Waveform output is a can have its shape, range, phase, and frequency adjusted. By adjusting the "**Waveform Setting**" the form of the output changes. The options for this setting are listed in Table 1.

0	*Waveform Off*
1	*Sine Wave*
2	*Square Wave 1*
3	*Square Wave 2*

Table 1 – Output Waveform Settings

When the output has the *'Square Wave 1'* the set frequency for the waveform is halved, but the frequency of the output is normal when *'Square Wave 2'* is chosen. The "**Waveform Range**" parameter adjusts the voltage range of the output waveform, as described in Table 2.

0	*Normal Range, 0 ... 5V range*
1	*Shifted, -0.5 ... 4.5V range*

Table 2 – Output Waveform Range

All of the Waveform Phase, Waveform Frequency, PWM Duty Cycle, and PWM Frequency parameters have the same general format, where the "**Source**" and "**Number**" setpoints determine which signal is used as a control source. Setting the source to *'Control Not Used'* allows the "**Value**" setpoint to serve as a fixed input for the related source.

The “**Waveform Phase**” parameters adjust the amount of phase shift that the output waveform signal will have. It can be shifted by any value between 0 and 2π, calculated as follows:

$$Phase\ Shift = \frac{2\pi}{4095} \times Input\ Value$$

The “**Waveform Frequency**” parameters control the frequency of the output waveform signal. The signal can operate at a range from 10Hz to 20kHz.

The PWM Output can be controlled by adjusting its duty cycle and frequency. The “**PWM Duty Cycle**” parameters can be set to any value in the range of 0% to 100%. When a control source is used to drive this value, the input value will be converted to a percentage of the total range based off of the set minimum and maximum limits of the control source. Additionally, the frequency of the PWM signal can be set within the range of 1Hz to 25kHz, by changing the “**PWM Frequency**” parameters.

1.3. Diagnostic Function Blocks

The Diagnostic Input function blocks are used to setup the diagnostic messages for the controller.

The 5 types of diagnostics supported by the controller are shown in Table 3.

Function Block	Minimum Threshold	Maximum Threshold
Feedback Overcurrent Fault	N/A	N/A
Over Temperature Fault	N/A	Temperature Shutdown
Power Undervoltage Fault	VPS Undervoltage	N/A
Power Overvoltage Fault	N/A	VPS Overvoltage
Lost Communication Fault	N/A	Received Message Timeout (any)

Table 3 – Diagnostic Blocks and Fault Detection Thresholds

If and only if the “**Event Generates a DTC in DM1**” parameter is set to true will the other setpoints in the function block be enabled. They are all related to the data that is sent to the J1939 network as part of the DM1 message, Active Diagnostic Trouble Codes.

A Diagnostic Trouble Code (DTC) is defined by the J1939 standard as a 4-byte value which is a combination of:

SPN	Suspect Parameter Number	(first 19 bits of the DTC, LSB first)
FMI	Failure Mode Identifier	(next 5 bits of the DTC)
CM	Conversion Method	(1 bit, always set to 0)
OC	Occurrence Count	(7 bits, number of times the fault has happened)

In addition to supporting the DM1 message, the Controller 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**

So long as even one Diagnostic function block has “**Event Generates a DTC in DM1**” set to true, the Controller will send the DM1 message every one second, regardless of whether there are any active faults, as recommended by the standard. While there are no active DTCs, the Controller will send the “No Active Faults” message. If a previously active DTC becomes inactive, a DM1 will be sent immediately to reflect this. As soon as the last active DTC goes inactive, it will send a DM1 indicating that there are no more active DTCs.

If there is more than on active DTC at any given time, the regular DM1 message will be sent using a multipacket Broadcast Announce Message (BAM). If the controller receives a request for a DM1 while this is true, it will send the multipacket message to the Requester Address using the Transport Protocol (TP).

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

The Diagnostic function block has a setpoint “**Event Cleared Only by DM11**”. By default, this is set to false, which means that as soon as the condition that caused an error flag to be set goes away, the DTC is automatically made Previously Active, and is no longer included in the DM1 message. However, when this setpoint is set to true, even if the flag is cleared, the DTC will not be made inactive, so it will continue to be sent on the DM1 message. Only when a DM11 has been requested will the DTC go inactive. This feature may be useful in a system where a critical fault needs to be clearly identified as having happened, even if the conditions that caused it went away.

In addition to all the active DTCs, another part of the DM1 message is the first byte, which reflects the Lamp Status. Each Diagnostic function block has the setpoint “**Lamp Set by Event in DM1**” which determines which lamp will be set in this byte while the DTC is active. The J1939 standard defines the lamps as ‘*Malfunction*’, ‘*Red Stop*’, ‘*Amber, Warning*’ or *‘Protect’*. By default, the *‘Amber, Warning’* lamp is typically the one set by any active fault.

By default, every Diagnostic function block has associated with it a proprietary SPN. However, this setpoint “**SPN for Event used in DTC**” is fully configurable by the user should they wish it to reflect a standard SPN define in J1939-71 instead. If the SPN is change, the OC of the associate error log is automatically reset to zero.

Every Diagnostic function block also has associated with it a default FMI. The only setpoint for the user to change the FMI is “**FMI for Event used in DTC**”, even though some Diagnostic function blocks can have both high and low errors. In those cases, the FMI in the setpoint reflects that of the low-end condition, and the FMI used by the high fault will be determined per Table 4. If the FMI is changed, the OC of the associate error log is automatically reset to zero.

FMI for Event used in DTC – Low Fault	**Corresponding FMI used in DTC – High Fault**
FMI=1, Data Valid But Below Normal Operational 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 Range – 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 4 – Low Fault FMI versus High Fault FMI

If the FMI used is anything other than one of those in Table 4, then both the low and the high faults will be assigned the same FMI. This condition should be avoided, as the log will still use different OC for the two types of faults, even though they will be reported the same in the DTC. It is the user's responsibility to make sure this does not happen.

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 Sending DM1**" timer for the Diagnostic function block. If the fault has remained present during the delay time, then the controller will set the DTC to active, and it 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.

1.4. Constant Data Block

The Constant Data block is used to provide fixed values as a control source to other function blocks. The setpoints are separated as "**Discrete Constant Data**" and "**Continuous Constant Data**".

1.5. PID Control Function Block

The PID Control function block is an independent logic block, but it is normally intended to be associated with proportional output control blocks described earlier. When the "**Control Source**" for an output has been setup as a '*PID Function Block*', the command from the selected PID block drives the physical output.

The "**Target Source**" and "**Target Number**" setpoints determine control input and the "**Feedback Source**" and "**Feedback Number**" setpoints determine the established the feedback signal to the PID function block. The "**Control Response**" will use the selected inputs as per the options listed in Table 5. When active, the PID algorithm will be called every "**Cycle Time**" in milliseconds.

0	*Single Output*
1	*Setpoint Control*
2	*On When Over Target*
3	*On When Below Target*

Table 5 – PID Response Options

When a '*Single Output*' response is selected, the Target and Feedback inputs do not have to share the same units. In both cases, the signals are converted to a percentage values based on the minimum and maximum values associated with the source function block.

For example, output of a Math Function Block could be used to set the target value, in which case it would be converted to a percentage value using "**Math Output Minimum Range**" and "**Math Output Maximum Range**" setpoints. The closed-loop feedback signal could be connected a '*CAN Receive Message'* and selected as the feedback source. In this case the value of the message data would be converted to a percentage based on the "**Data Minimum**" and "**Data Maximum**" setpoints in the CAN Receive block. The output of the PID function would depend on the difference between the commanded target and the measured feedback as a percentage of each signals range. In this mode, the output of the block would be a value from -100% to 100%.

When a '*Setpoint Control*' response is selected, the "**Target Source**" automatically gets updated to '*Control Constant Data*' and cannot be changed. The value set in the associated constant in the Constant Data List function block becomes the desired target value. In this case, both the target and the feedback values are assumed to be in same units and range. The minimum and maximum values for the feedback automatically become the constraints on the constant target. In this mode, the output of the block would be a value from 0% to 100%.

The last two response options, '*On When Over Target'* and '*On When Under Target'*, are designed to allow the user to combine the two proportional outputs as a push-pull drive for a system. Both outputs must be setup to use the same control input (linear response) and feedback signal in order to get the expected output response. In this mode, the output will be between 0% and 100%.

In Order to allow the output to stabilize, the user can select a non-zero value for "**Output Tolerance**". If the absolute value of Error_K is less than this value, Error_K in the formula below will be set to zero.

The PID algorithm used is shown below, where G, Ki, Ti, Kd, Td and Cycle_Time are configurable parameters.

$$PIDOutput_k = P_k + I_k + D_k$$

$$P_k = P\_Gain * Error_k$$
$$I_k = I\_Gain * ErrorSum_k$$
$$D_k = D\_Gain * (Error_k - Error_{k-1})$$

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

$$P\_Gain = G$$
$$I\_Gain = G * Ki * \ T/Ti \ \ (\text{Note: If Ti is zero, I\_Gain} = 0)$$
$$D\_Gain = G * Kd * Td/T$$

$$T = Cycle\_Time * 0.001$$

Equation 1 - PID Control Algorithm

Each system will have to be turned for the optimum output response. Response times, overshoots and other variables will have to be decided by the customer using an appropriate PID tuning strategy. Axiomatic is not responsible for tuning the control system.

1.6. Lookup Table Function Block

Lookup Tables are used to give an 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 1.7.

Lookup tables have two differing modes defined by "**X-Axis Type**" setpoint, given in Table 6. 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 6 – 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 7. *'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 7 – PointN – Response Options

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 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). Ignored points are not considered for min and max values.

1.7. Programmable Logic Function Blocks

The Programmable Logic Function Block is very powerful tool. A Programmable Logic block 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 "**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 8. 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 8 – Table X – Condition Y Operator Options

The three conditions are evaluated and if the result satisfies logical operation defined with "**Logical Operator X**" setpoint, given in Table 9, 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 9 – 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 Table 1 gets selected.

1.8. Math Function Blocks

There are four 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 $\mathrm{A\ operator\ B}$, where A and B are function inputs and operator is function selected with a setpoint "**Math Function X**". Setpoint options are presented in Table 10. 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*

Table 10 – Math function X Operator Options

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

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

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

1.9. CAN Receive Function Blocks

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 "**CAN Interface**" setting determines which CAN interface the CAN Receive signal is received over. A CAN Receive signal can only be received over a single interface at a time.

The “**Signal Type**” is the most important setpoint associated with this function block and it should be selected first. Setting it to *‘Undefined’* will result in other setpoints being disabled. By default, ALL receive messages are set to *‘Continuous’*.

By default, all control messages are expected to be sent to the CAN-SINE-SQR-OUT on Proprietary B PGNs. However, should a PDU1 message be selected, the CAN-SINE-SQR-OUT can be setup to receive it from any ECU by setting the “**Is From Selected Address**” to ‘True’ and the “**Selected Address**” to the Global Address (0xFF). If a specific address is selected instead, then any other ECU data on the PGN will be ignored.

The “**Size**”, “**Pos Byte**”, “**Pos Bit**”, “**Resolution**” and “**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 “**Data Minimum**” and “**Data Maximum**” 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.

Once a message has been enabled, a Lost Communication fault will be flagged if that message is not received off the bus within the “**Auto-Reset Time**” 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.

The CAN-SINE-SQR-OUT I/O supports up to ten unique CAN Receive Messages. Defaults setpoint values are listed in section 324.12.

1.10. 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 AX030550 ECU has five CAN Transmit Messages and each message has four completely user defined signals.

1.10.1. 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 “**CAN Interface**” setting determines which CAN interface the CAN Transmit signal is transmitted over. A CAN Transmit signal can only be transmitted over a single interface at a time.

The “**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**.

“**Transfer Rate**” setpoint defines the interval used to send the message to the J1939 network. If the “**Transfer 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 “**Priority**” is always initialized to 6 (low priority) and the “**Destination**” 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.

1.10.2. CAN Transmit Signal Setpoints

Each CAN transmit message has four associated signals, which define data inside the Transmit message. “**Signal X Control Source**” setpoint together with “**Signal X Control Number**” setpoint define the signal source of the message. “**Signal X Control Source**” and “**Signal X Control Number**” options are listed in Table 11. Setting “**Signal X Control Source**” to ‘*Control Not Used’* disables the signal.

“**Signal X Size**” setpoint determines how many bits signal reserves from the message. “**Signal X Pos Byte**” determines in which of 8 bytes of the CAN message LSB of the signal is located. Similarly, “**Signal X Pos Bit**” determines in which of 8 bits of a byte the LSB is located. These setpoints are freely configurable, thus **it is the User’s responsibility to ensure that signals do not overlap and mask each other**.

“**Signal X Resolution**” setpoint determines the scaling done on the signal data before it is sent to the bus. “**Signal X 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.

1.11. 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 16. Though 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: CAN Input Signal	1 to 10	User must enable the function block, as it is disabled by default.
2: Constant Discrete Data	1 to 5	
3: Constant Continuous Data	1 to 5	

4: PID Block	1 to 4	User must enable the function block, as it is disabled by default.
5: Lookup Table	1 to 12	User must enable the function block, as it is disabled by default.
6: Math Function Block	1 to 6	User must enable the function block, as it is disabled by default.
7: Programmable Logic Block	1 to 4	User must enable the function block, as it is disabled by default.
11: Power Supply Measured	N/A	Measured power supply value in Volts and used in Power Supply Diagnostics, can be mapped to a CAN Transmit Message.
12: Processor Temperature Measured	N/A	Measured processor temperature in °C and used in Over Temperature Diagnostics, can be mapped to a CAN Transmit Message.

Table 11 – 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, CAN Receive message 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.

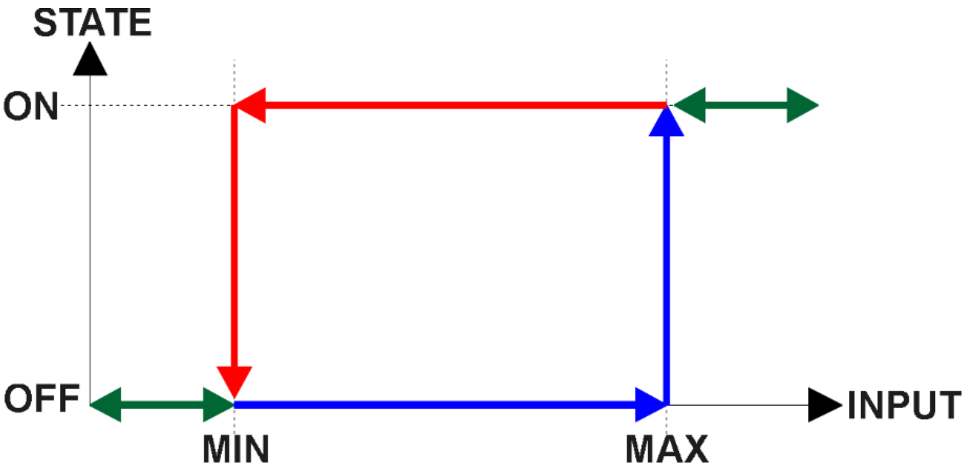


Figure 2 - Analog source to Digital input

2. INSTALLATION INSTRUCTIONS

2.1. Dimensions and Pinout

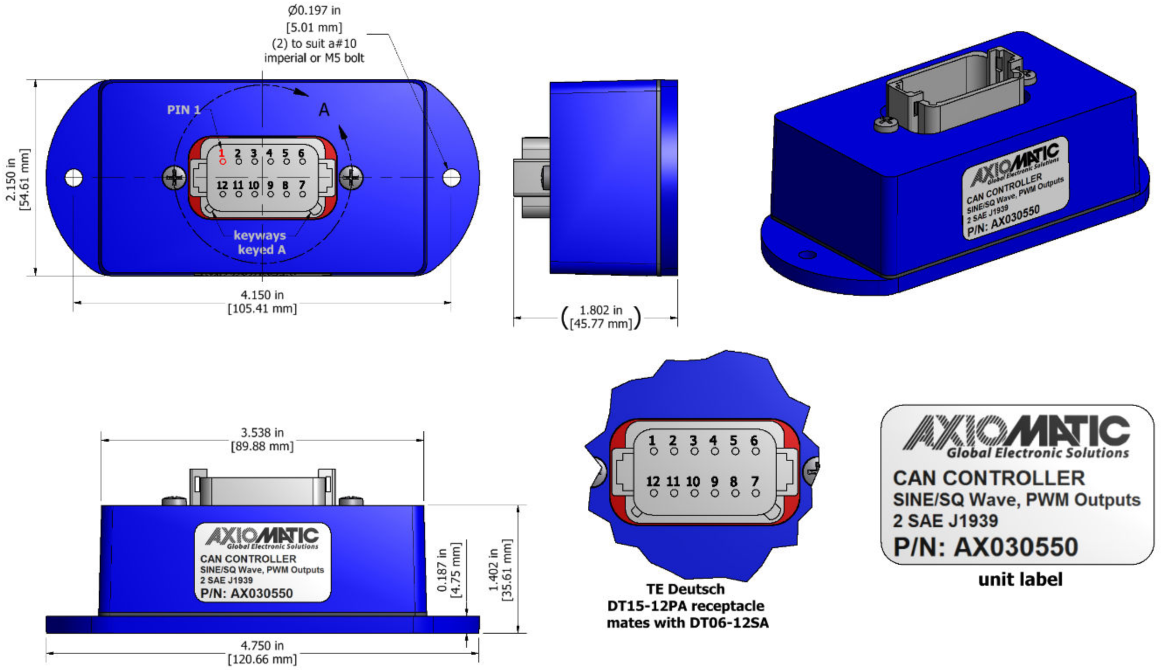


Figure 3 – AX030550 Dimensional Drawing

12-pin connector (equivalent TE Deutsch P/N: DT15-12PA)
A mating plug kit is available as Axiomatic P/N: **AX070105.**

CAN and I/O Connector	
Pin #	**Description**
1	+5V Reference
2	Ground
3	PWM Output
4	Ground
5	CAN_L
6	CAN_H
7	Signal Output
8	Signal Ground
9	CAN 2_H
10	CAN 2_L
11	BATT-
12	BATT+

Table 12 – AX030550 Pinout

3. OVERVIEW OF J1939 FEATURES

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

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

3.1. Introduction to Supported Messages

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

From J1939-21 – Data Link Layer

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

From J1939-73 – Diagnostics

DM1 – Active Diagnostic Trouble Codes	65226	0x00FECA
DM2 – Previously Active Diagnostic Trouble Codes	65227	0x00FECB
DM3 – Diagnostic Data Clear/Reset for Previously Active DTCs	65228	0x00FECC
DM11 – Diagnostic Data Clear/Reset for Active DTCs	65235	0x00FED3
DM14 – Memory Access Request	55552	0x00D900
DM15 – Memory Access Response	55296	0x00D800
DM16 – Binary Data Transfer	55040	0x00D700

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

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 CAN-SINE-SQR-OUT I/O 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	126, Axiomatic I/O Controller
Function Instance	21, Axiomatic AX030550
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 allows for 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 CAN-SINE-SQR-OUT I/O will continue select the next highest address until it finds one that it can claim. See J1939/81 for more details about address claiming.

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

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.

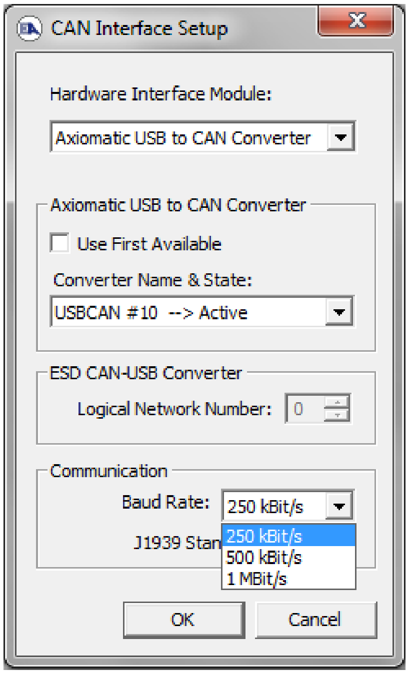
Note: The information provided in the Software ID is available for any J1939 service tool which supports the PGN -SOFT.

4. ECU SETPOINTS ACCESSED WITH THE AXIOMATIC ELECTRONIC ASSISTANT

This section describes in detail each setpoint, and their default and ranges. Default values presented in tables are values used when setpoint in question is active. Many of the setpoints are dependent on other setpoints and they may not be active by default. Associated Figures show screen capture of initial operation, however some of the setpoints are not in default condition as they are set differently to activate more setpoints for the image. The setpoints are divided into setpoint groups as they are shown in the Axiomatic EA. For more information on how each setpoint is used by the controller, refer to the relevant section in this user manual.

4.1. Accessing the ECU Using the Axiomatic EA

ECU with P/N AX030550 does not need any specific setup for the Axiomatic EA. The CAN-SINE-SQR-OUT controller is operable at 250k, 500k or 1M Bit/s baud rates and will detect which one is set through the Axiomatic EA. The CAN Interface Setup can be found from “Options” menu in the Axiomatic EA.



CAN Interface Setup

Hardware Interface Module: Axiomatic USB to CAN Converter

Axiomatic USB to CAN Converter

☐ Use First Available

Converter Name & State: USBCAN #10 --> Active

ESD CAN-USB Converter

Logical Network Number: 0

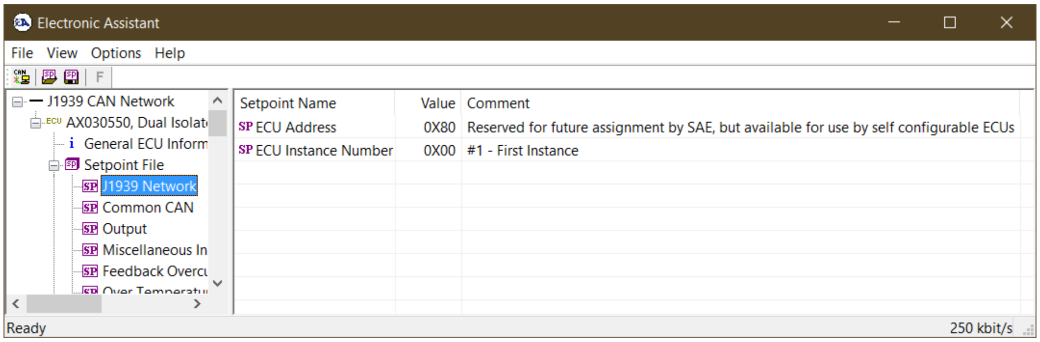
Communication

Baud Rate: 250 kBit/s

J1939 Stan

4.2. J1939 Network Setpoints

“**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

Figure 4 - Screen Capture of J1939 Setpoints

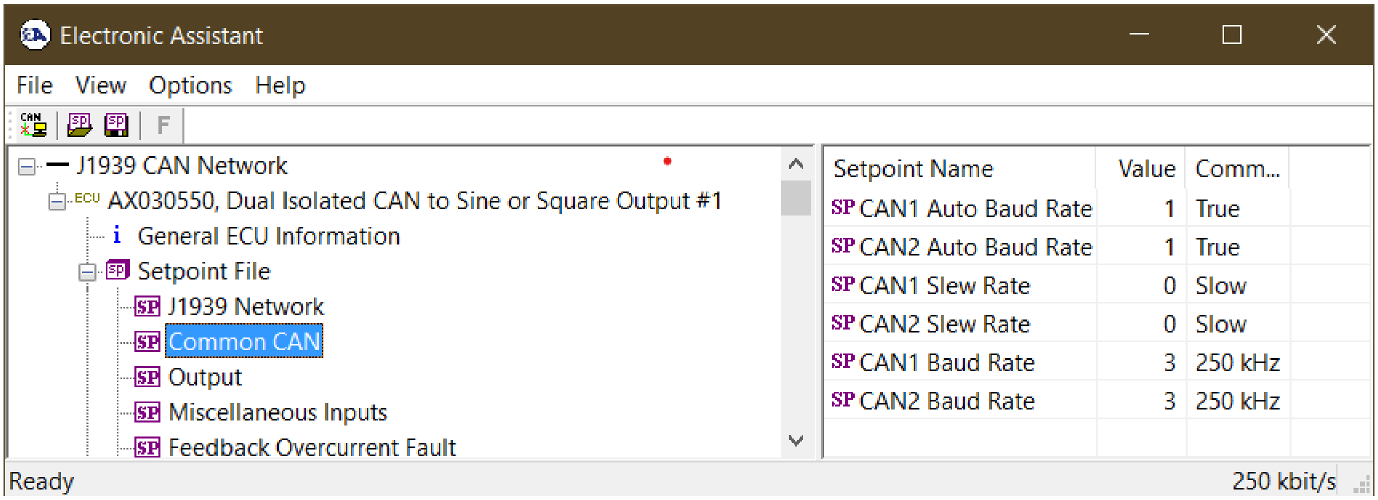
Name	Range	Default	Notes
ECU Address	0x80	0..253	Preferred address for a self-configurable ECU
ECU Instance	0..7	0x00	Per J1939-81

Table 13 – J1939 Network 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 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. Common CAN Setpoints

The Common CAN Function Block is defined in Section 1.1. Please refer there for detailed information about how these setpoints are used.



Setpoint Name	Value	Comm...
CAN1 Auto Baud Rate	1	True
CAN2 Auto Baud Rate	1	True
CAN1 Slew Rate	0	Slow
CAN2 Slew Rate	0	Slow
CAN1 Baud Rate	3	250 kHz
CAN2 Baud Rate	3	250 kHz

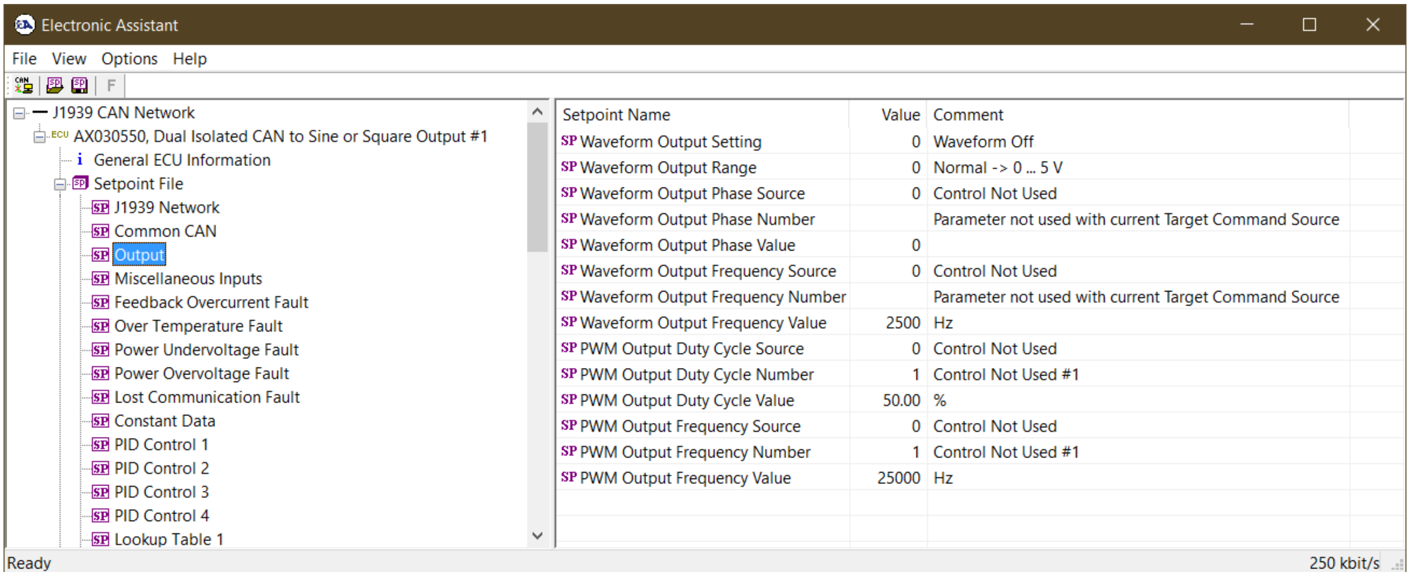
Figure 5 - Screen Capture of Output Setpoints

Name	Range	Default	Notes
CAN1 Auto Baud Rate	Drop List	True	
CAN2 Auto Baud Rate	Drop List	True	
CAN1 Slew Rate	Drop List	0	
CAN2 Slew Rate	Drop List	0	
CAN1 Baud Rate	Drop List	250 kHz	
CAN2 Baud Rate	Drop List	250 kHz	

Table 14 – Common CAN Setpoints

4.4. Output Setpoints

The Output Function Block is defined in Section 1.2. Please refer there for detailed information about how these setpoints are used. Outputs are disabled by default. In order to enable an output "**Output Type**" and "**Control Source**" must be chosen.



Setpoint Name	Value	Comment
SP Waveform Output Setting	0	Waveform Off
SP Waveform Output Range	0	Normal -> 0 ... 5 V
SP Waveform Output Phase Source	0	Control Not Used
SP Waveform Output Phase Number		Parameter not used with current Target Command Source
SP Waveform Output Phase Value	0	
SP Waveform Output Frequency Source	0	Control Not Used
SP Waveform Output Frequency Number		Parameter not used with current Target Command Source
SP Waveform Output Frequency Value	2500	Hz
SP PWM Output Duty Cycle Source	0	Control Not Used
SP PWM Output Duty Cycle Number	1	Control Not Used #1
SP PWM Output Duty Cycle Value	50.00	%
SP PWM Output Frequency Source	0	Control Not Used
SP PWM Output Frequency Number	1	Control Not Used #1
SP PWM Output Frequency Value	25000	Hz

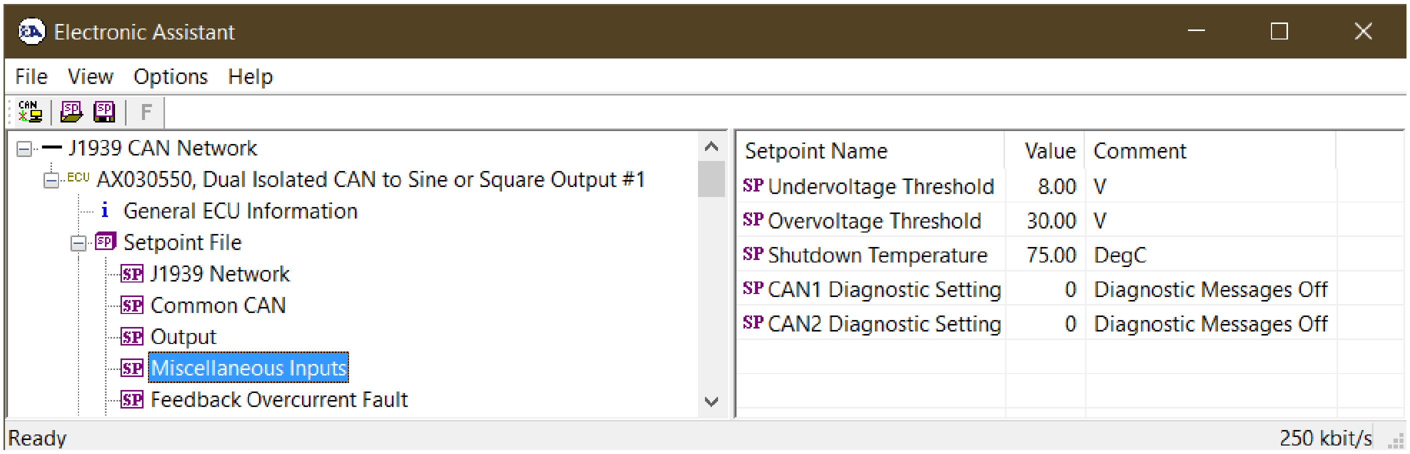
Figure 6 - Screen Capture of Output Setpoints

Name	Range	Default	Notes
Output Waveform Setting	Drop List	Waveform Off	Refer to Section 1.2
Output Waveform Range	Drop List	Normal Range	Refer to Section 1.2
Output Waveform Phase Source	Drop List	Control Not Used	
Output Waveform Phase Number	Depends on Control Source	1	
Output Waveform Phase Value	0…4095	0	Resolution of 2pi/4095
Output Waveform Frequency Source	Drop List	Control Not Used	See Table 11
Output Waveform Frequency Number	Depends on Control Source	1	See Table 11
Output Waveform Frequency Value	10…20000Hz	2500Hz	
Output PWM Duty Cycle Source	Drop List	Control Not Used	See Table 11
Output PWM Duty Cycle Number	Depends on Control Source	1	See Table 11
Output PWM Duty Cycle Value	0…100%	50%	
Output PWM Frequency Source	Drop List	Control Not Used	See Table 11
Output PWM Frequency Number	Depends on Control Source	1	See Table 11
Output PWM Frequency Value	1…25000Hz	25000Hz	

Table 15 – Output Setpoints

4.5. Miscellaneous Inputs Setpoints

The Miscellaneous Inputs Function Block contains setpoints affecting the controller's diagnostic behaviour. The voltage thresholds and shutdown temperature serve as the limits for when their corresponding fault will be triggered.



Setpoint Name	Value	Comment
Undervoltage Threshold	8.00	V
Overvoltage Threshold	30.00	V
Shutdown Temperature	75.00	DegC
CAN1 Diagnostic Setting	0	Diagnostic Messages Off
CAN2 Diagnostic Setting	0	Diagnostic Messages Off

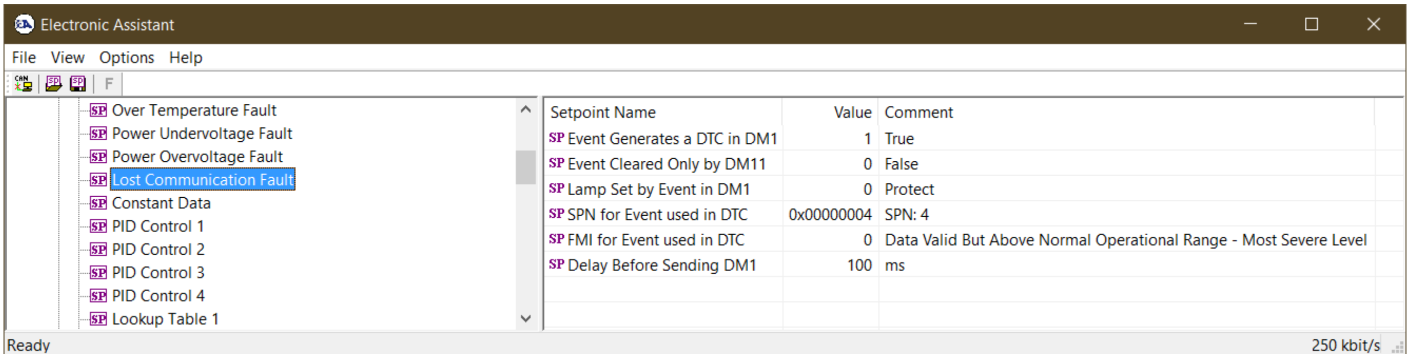
Figure 7 - Screen Capture of Miscellaneous Inputs Setpoints

Name	Range	Default	Notes
Undervoltage Threshold	8…Overvoltage Threshold	8V	
Overvoltage Threshold	Undervoltage Threshold…36	30V	
Shutdown Temperature	-40…85°C	75°C	
CAN1 Diagnostic Setting	Drop List	Empty Diagnostic Messages Blocked	
CAN2 Diagnostic Setting	Drop List	Empty Diagnostic Messages Blocked	

Table 16 – Miscellaneous Inputs Setpoints

4.6. Diagnostic Input Setpoints

The Diagnostic Input function block is defined in Section 1.3. Please refer to that section for detailed information about how all these setpoints are used.



Setpoint Name	Value	Comment
Event Generates a DTC in DM1	1	True
Event Cleared Only by DM11	0	False
Lamp Set by Event in DM1	0	Protect
SPN for Event used in DTC	0x00000004	SPN: 4
FMI for Event used in DTC	0	Data Valid But Above Normal Operational Range - Most Severe Level
Delay Before Sending DM1	100	ms

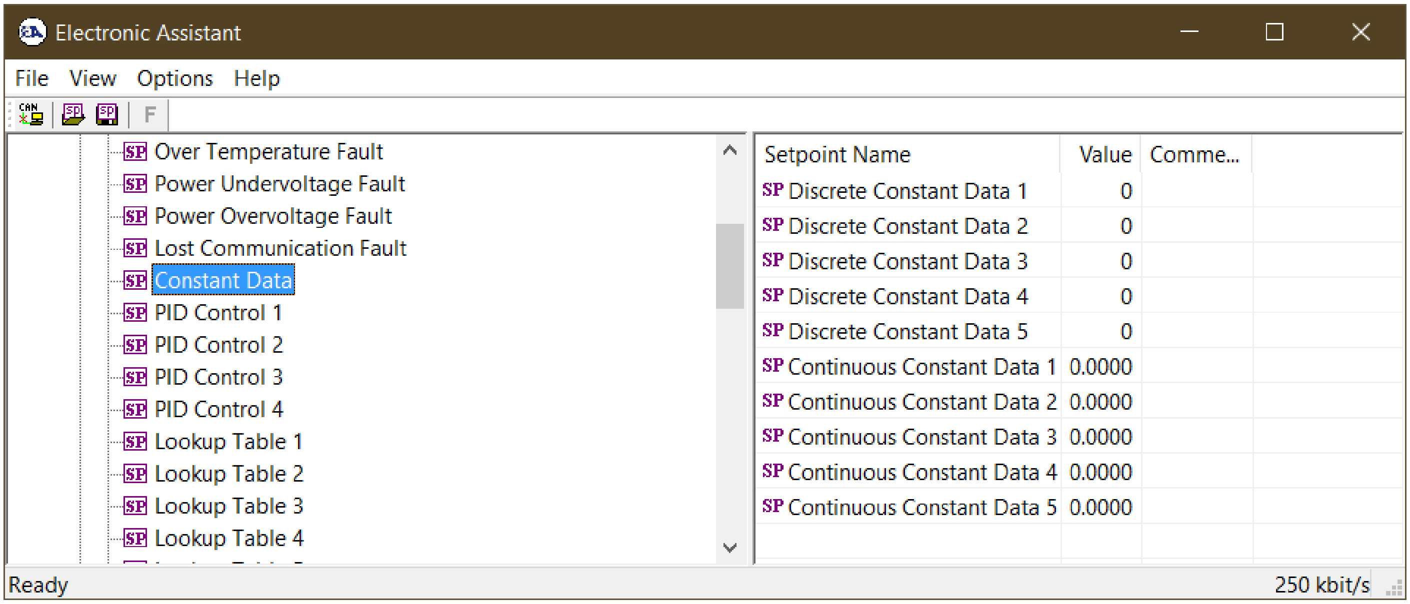
Figure 8 - Screen Capture of Diagnostic Input Setpoints

Name	Range	Default	Notes
Event Generates a DTC in DM1	Drop List	True	Refer to Section 1.3
Event Only Cleared by DM11	Drop List	False	Refer to Section 1.3
Lamp Set by Event in DM1	Drop List	0	Refer to Section 1.3
SPN for Event used in DTC	0…524287	n	Refer to Section 1.3
FMI for Event used in DTC	Drop List	0	Refer to Section 1.3
Delay Before Sending DM1	0…60000 ms	100 ms	Refer to Section 1.3

Table 17 – Diagnostic Input Setpoints

4.7. Constant Data Setpoints

The Constant Data Function Block is defined in Section 1.4. Please refer to that section for detailed information about how all these setpoints are used.



- Over Temperature Fault
- Power Undervoltage Fault
- Power Overvoltage Fault
- Lost Communication Fault
- Constant Data
- PID Control 1
- PID Control 2
- PID Control 3
- PID Control 4
- Lookup Table 1
- Lookup Table 2
- Lookup Table 3
- Lookup Table 4

Setpoint Name	Value	Comme...
Discrete Constant Data 1	0	
Discrete Constant Data 2	0	
Discrete Constant Data 3	0	
Discrete Constant Data 4	0	
Discrete Constant Data 5	0	
Continuous Constant Data 1	0.0000	
Continuous Constant Data 2	0.0000	
Continuous Constant Data 3	0.0000	
Continuous Constant Data 4	0.0000	
Continuous Constant Data 5	0.0000	

Figure 9 - Screen Capture of Constant Data Setpoints

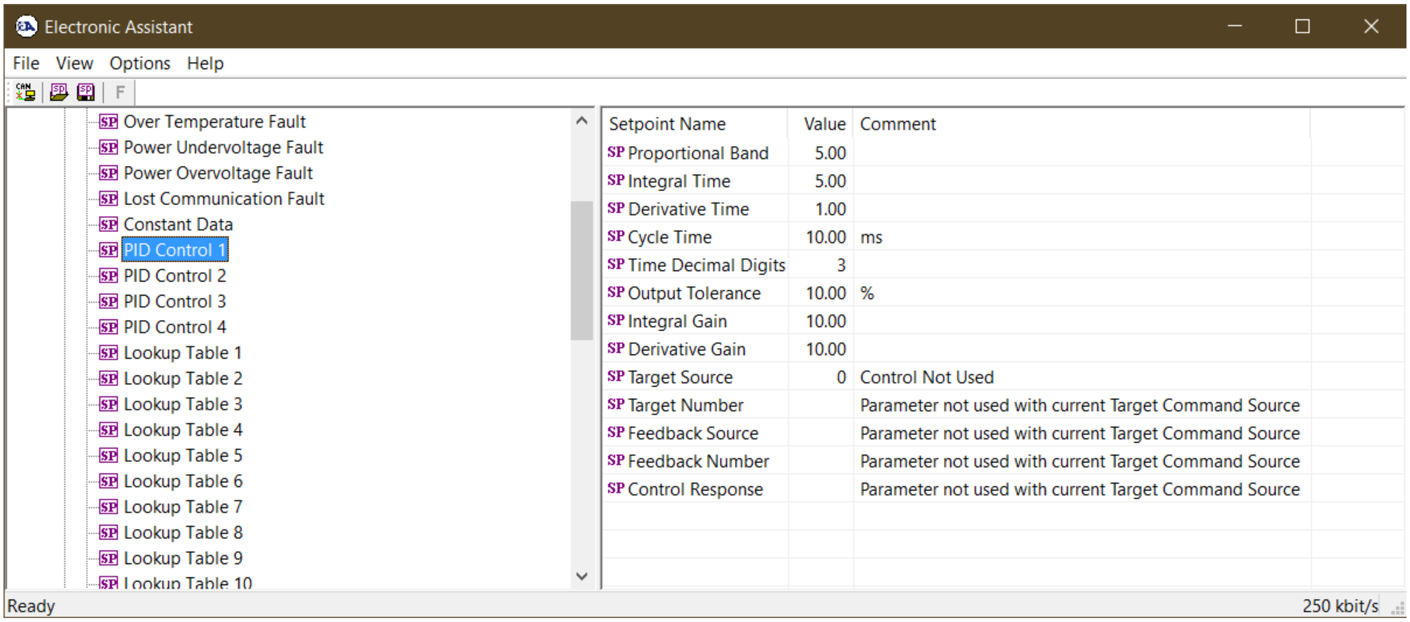
Name	Range	Default	Notes
Discrete Constant Data 1	0…4294967295	0	
Discrete Constant Data 2	0…4294967295	0	
Discrete Constant Data 3	0…4294967295	0	
Discrete Constant Data 4	0…4294967295	0	
Discrete Constant Data 5	0…4294967295	0	
Continuous Constant Data 1	-3.4e38…3.4e38	0	
Continuous Constant Data 2	-3.4e38…3.4e38	0	
Continuous Constant Data 3	-3.4e38…3.4e38	0	
Continuous Constant Data 4	-3.4e38…3.4e38	0	
Continuous Constant Data 5	-3.4e38…3.4e38	0	

Table 18 – Constant Data Setpoints

4.8. PID Control Setpoints

The PID Control Function Block is defined in Section 1.5. Please refer there for detailed information about how all these setpoints are used.

Command Source is set to '*Control Not Used'* by default. To enable a PID Control, select appropriate "**Target Source**" and "**Feedback Source**".



Setpoint Name	Value	Comment
SP Proportional Band	5.00	
SP Integral Time	5.00	
SP Derivative Time	1.00	
SP Cycle Time	10.00	ms
SP Time Decimal Digits	3	
SP Output Tolerance	10.00	%
SP Integral Gain	10.00	
SP Derivative Gain	10.00	
SP Target Source	0	Control Not Used
SP Target Number		Parameter not used with current Target Command Source
SP Feedback Source		Parameter not used with current Target Command Source
SP Feedback Number		Parameter not used with current Target Command Source
SP Control Response		Parameter not used with current Target Command Source

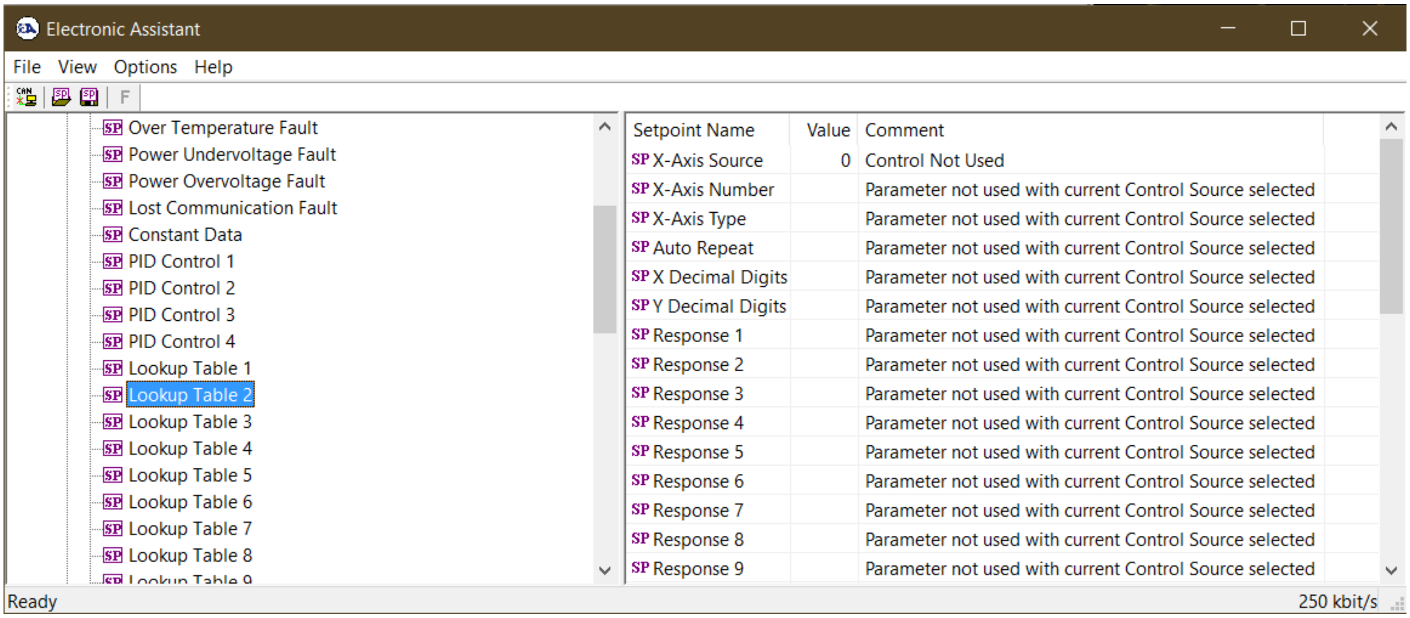
Figure 10 - Screen Capture of PID Control Setpoints

Name	Range	Default	Notes
Proportional Band, G	0…10	5.00	See Equation 1
Integral Time, Ti	0.001…1000.0	5.00	
Derivative Time, Td	0.001…1000.0	1.00	
Cycle Time	1…1000 ms	10ms	
Time Decimal Digits	0…3	3	Resolution is 10^x, affects Ti and Td
Output Tolerance	0…100 %	1.00 %	
Integral Gain, Ki	0.0…10.0	10.00	0 disables integral, PD ctrl
Derivative Gain, Kd	0.0…10.0	10.00	0 disables derivative, PI ctrl
Target Source	Drop List	Control Not Used	See Table 11
Target Number	Depends on control source	1	See Table 11
Feedback Source	Drop List	Control Not Used	See Table 11
Feedback Number	Depends on control source	1	See Table 11
Control Response	Drop List	Single Output	See Table 5

Table 19 – Programmable Logic Setpoints

4.9. Lookup Table Setpoints

The Lookup Table Function Block is defined in Section 1.6 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
X-Axis Source	0	Control Not Used
X-Axis Number		Parameter not used with current Control Source selected
X-Axis Type		Parameter not used with current Control Source selected
Auto Repeat		Parameter not used with current Control Source selected
X Decimal Digits		Parameter not used with current Control Source selected
Y Decimal Digits		Parameter not used with current Control Source selected
Response 1		Parameter not used with current Control Source selected
Response 2		Parameter not used with current Control Source selected
Response 3		Parameter not used with current Control Source selected
Response 4		Parameter not used with current Control Source selected
Response 5		Parameter not used with current Control Source selected
Response 6		Parameter not used with current Control Source selected
Response 7		Parameter not used with current Control Source selected
Response 8		Parameter not used with current Control Source selected
Response 9		Parameter not used with current Control Source selected

Figure 11 - Screen Capture of Lookup Table Setpoints

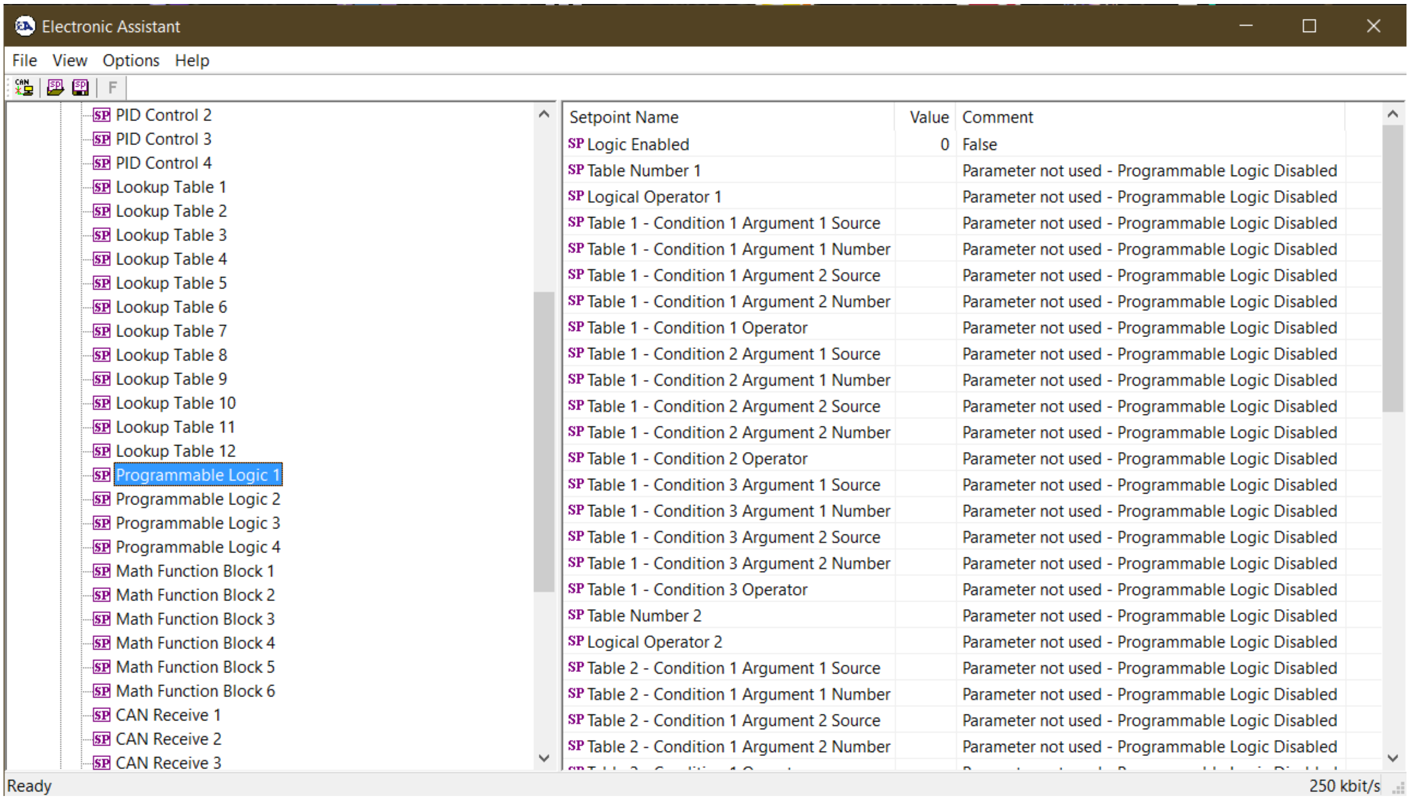
Name	Range	Default	Notes
X-Axis Source	Drop List	Control Not Used	See Table 11
X-Axis Number	Depends on control source	1	See Table 11
X-Axis Type	Drop List	Data Response	See Table 6
Auto Repeat	Drop List	False	
X Decimal Digits	0…3	0	Resolution is 10^x, affects X points
Y Decimal Digits	0…3	0	Resolution is 10^x, affects Y points
Response 1	Drop List	Ramp To	See Table 7
Response 2	Drop List	Ramp To	See Table 7
Response 3	Drop List	Ramp To	See Table 7
Response 4	Drop List	Ramp To	See Table 7
Response 5	Drop List	Ramp To	See Table 7
Response 6	Drop List	Ramp To	See Table 7
Response 7	Drop List	Ramp To	See Table 7
Response 8	Drop List	Ramp To	See Table 7
Response 9	Drop List	Ramp To	See Table 7
Response 10	Drop List	Ramp To	See Table 7
Point X1	From X-Axis source minimum to Point 1 - X Value	X-Axis source minimum Depends on the Table number	See Section 1.6
Point X2	From Point 0 - X Value to Point 2 - X Value	Depends on the Table number	See Section 1.6
Point X3	From Point 1 - X Value to Point 3 - X Value	Depends on the Table number	See Section 1.6
Point X4	From Point 2 - X Value to Point 4 - X Value	Depends on the Table number	See Section 1.6
Point X5	From Point 3 - X Value to Point 5 - X Value source	Depends on the Table number	See Section 1.6
Point X6	From Point 4 - X Value to Point 6 - X Value	Depends on the Table number	See Section 1.6
Point X7	From Point 5 - X Value to Point 7 - X Value	Depends on the Table number	See Section 1.6
Point X8	From Point 6 - X Value to Point 8 - X Value	Depends on the Table number	See Section 1.6
Point X9	From Point 7 - X Value	Depends on the Table number	See Section 1.6

	to Point 9 - X Value		
Point X10	From Point 8 - X Value to Point 10 - X Value	Depends on the Table number	See Section 1.6
Point Y1	-10^6 to 10^6	Depends on the Table number	
Point Y2	-10^6 to 10^6	Depends on the Table number	
Point Y3	-10^6 to 10^6	Depends on the Table number	
Point Y4	-10^6 to 10^6	Depends on the Table number	
Point Y5	-10^6 to 10^6	Depends on the Table number	
Point Y6	-10^6 to 10^6	Depends on the Table number	
Point Y7	-10^6 to 10^6	Depends on the Table number	
Point Y8	-10^6 to 10^6	Depends on the Table number	
Point Y9	-10^6 to 10^6	Depends on the Table number	
Point Y10	-10^6 to 10^6	Depends on the Table number	

Table 20 – Lookup Table Setpoints

4.10. Programmable Logic Setpoints

The Programmable Logic function block is defined in Section 1.7. Please refer there for detailed information about how all these setpoints are used. "**Logic Enabled**" is '*False*' by default. To enable Logic set "**Logic Enabled**" to '*True*' and select appropriate "**Argument Source**".



Setpoint Name	Value	Comment
Logic Enabled	0	False
Table Number 1		Parameter not used - Programmable Logic Disabled
Logical Operator 1		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 1 Argument 1 Source		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 1 Argument 1 Number		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 1 Argument 2 Source		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 1 Argument 2 Number		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 1 Operator		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 2 Argument 1 Source		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 2 Argument 1 Number		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 2 Argument 2 Source		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 2 Argument 2 Number		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 2 Operator		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 3 Argument 1 Source		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 3 Argument 1 Number		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 3 Argument 2 Source		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 3 Argument 2 Number		Parameter not used - Programmable Logic Disabled
Table 1 - Condition 3 Operator		Parameter not used - Programmable Logic Disabled
Table Number 2		Parameter not used - Programmable Logic Disabled
Logical Operator 2		Parameter not used - Programmable Logic Disabled
Table 2 - Condition 1 Argument 1 Source		Parameter not used - Programmable Logic Disabled
Table 2 - Condition 1 Argument 1 Number		Parameter not used - Programmable Logic Disabled
Table 2 - Condition 1 Argument 2 Source		Parameter not used - Programmable Logic Disabled
Table 2 - Condition 1 Argument 2 Number		Parameter not used - Programmable Logic Disabled

Figure 12 - Screen Capture of Programmable Logic Setpoints

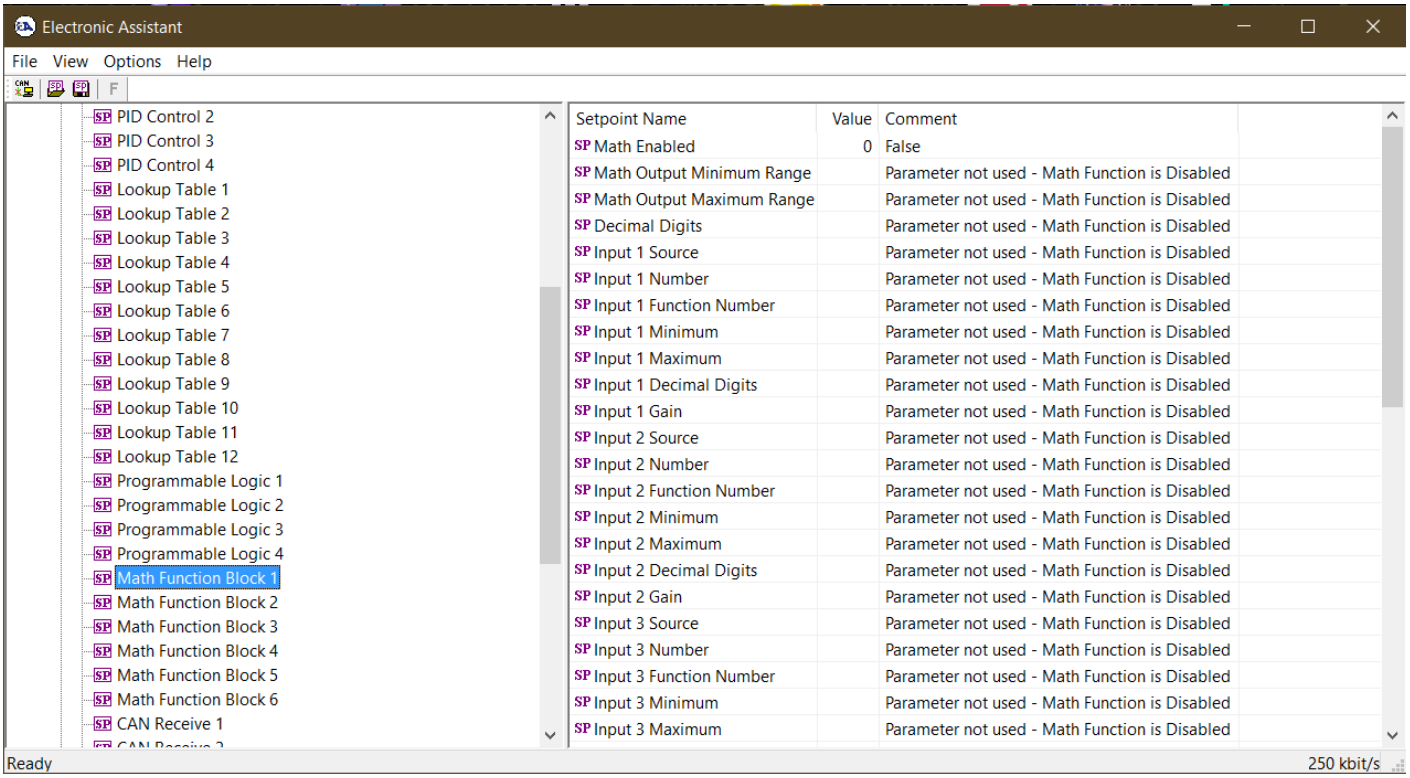
Setpoint ranges and default values for Programmable Logic Blocks are listed in Table 21. Only "**Table 1**" setpoint are listed, because other "**Table X**" setpoints are similar, except for the default value of the "**Table Number**" setpoint, which is X for "**Table X**".

Name	Range	Default	Notes
Logic Enabled	Drop List	False	
Table Number 1	1 to 12	Lookup Table 1	
Logical Operator 1	Drop List	Default Table	See Table 9
Table 1 - Condition 1 Argument 1 Source	Drop List	Control Not Used	See Table 11
Table 1 - Condition 1 Argument 1 Number	Depends on control source	1	See Table 11
Table 1 - Condition 1 Argument 2 Source	Drop List	Control Not Used	See Table 11
Table 1 - Condition 1 Argument 2 Number	Depends on control source	1	See Table 11
Table 1 - Condition 1 Operator	Drop List	=, Equal	See Table 8
Table 1 - Condition 2 Argument 1 Source	Drop List	Control Not Used	See Table 11
Table 1 - Condition 2 Argument 1 Number	Depends on control source	1	See Table 11
Table 1 - Condition 2 Argument 2 Source	Drop List	Control Not Used	See Table 11
Table 1 - Condition 2 Argument 2 Number	Depends on control source	1	See Table 11
Table 1 - Condition 2 Operator	Drop List	=, Equal	See Table 8
Table 1 - Condition 3 Argument 1 Source	Drop List	Control Not Used	See Table 11
Table 1 - Condition 3 Argument 1 Number	Depends on control source	1	See Table 11
Table 1 - Condition 3 Argument 2 Source	Drop List	Control Not Used	See Table 11
Table 1 - Condition 3 Argument 2 Number	Depends on control source	1	See Table 11
Table 1 - Condition 3 Operator	Drop List	=, Equal	See Table 8

Table 21 – Programmable Logic Setpoints

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	0	False
SP Math Output Minimum Range		Parameter not used - Math Function is Disabled
SP Math Output Maximum Range		Parameter not used - Math Function is Disabled
SP Decimal Digits		Parameter not used - Math Function is Disabled
SP Input 1 Source		Parameter not used - Math Function is Disabled
SP Input 1 Number		Parameter not used - Math Function is Disabled
SP Input 1 Function Number		Parameter not used - Math Function is Disabled
SP Input 1 Minimum		Parameter not used - Math Function is Disabled
SP Input 1 Maximum		Parameter not used - Math Function is Disabled
SP Input 1 Decimal Digits		Parameter not used - Math Function is Disabled
SP Input 1 Gain		Parameter not used - Math Function is Disabled
SP Input 2 Source		Parameter not used - Math Function is Disabled
SP Input 2 Number		Parameter not used - Math Function is Disabled
SP Input 2 Function Number		Parameter not used - Math Function is Disabled
SP Input 2 Minimum		Parameter not used - Math Function is Disabled
SP Input 2 Maximum		Parameter not used - Math Function is Disabled
SP Input 2 Decimal Digits		Parameter not used - Math Function is Disabled
SP Input 2 Gain		Parameter not used - Math Function is Disabled
SP Input 3 Source		Parameter not used - Math Function is Disabled
SP Input 3 Number		Parameter not used - Math Function is Disabled
SP Input 3 Function Number		Parameter not used - Math Function is Disabled
SP Input 3 Minimum		Parameter not used - Math Function is Disabled
SP Input 3 Maximum		Parameter not used - Math Function is Disabled

Figure 13 - Screen Capture of Math Function Block Setpoints

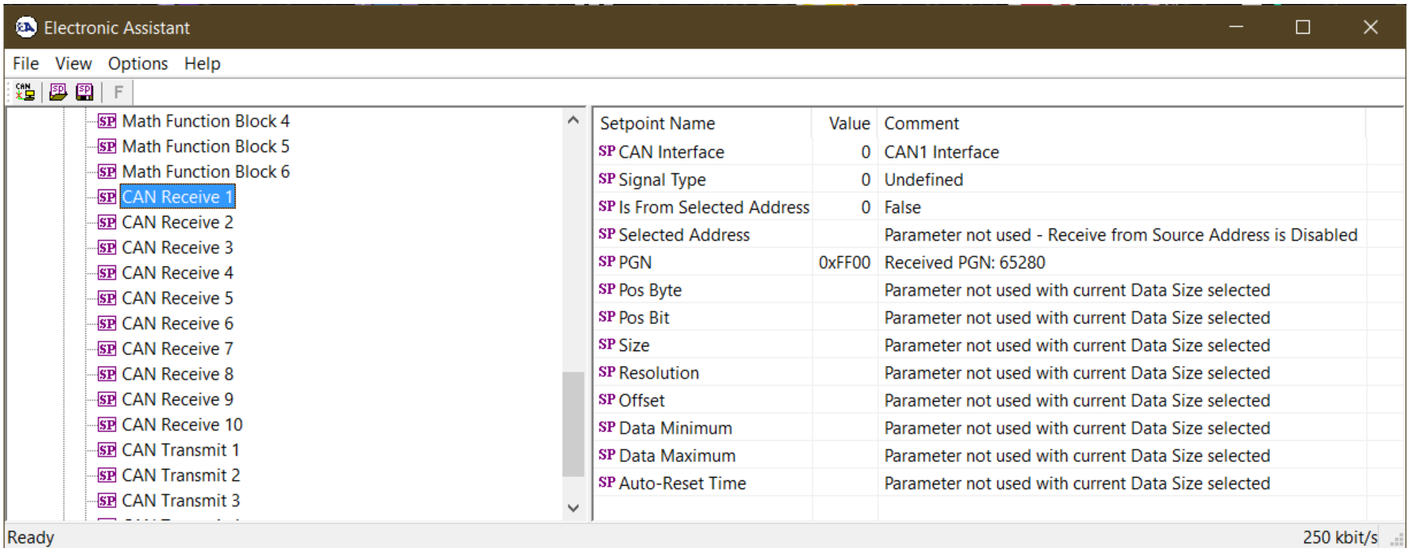
Setpoint ranges and default values for Math Blocks are listed in Table 22. Only “**Input 1**” setpoint are listed, because other “**Input X**” setpoints are similar.

Name	Range	Default	Notes
Math Enabled	Drop List	False	
Math Output Minimum Range	-32768…32767	0	
Math Output Maximum Range	-32768…32767	10000.0	
Decimal Digits	0…3	2	Resolution is 10^x, affects Output Min/Max Ranges
Input 1 Source	Drop List	Control not used	See Table 11
Input 1 Number	Depends on control source	1	See Table 11
Input 1 Function Number	1…3	1	
Input 1 Minimum	$-10^6…10^6$	0.00	
Input 1 Maximum	$-10^6…10^6$	10000.00	
Input 1 Decimal Digits	0..3	2	Resolution is 10^x, affects Input 1 Min/Max Ranges
Input 1 Gain	-100…100	100	
Math Function 1	Drop List	+, Result = InA plus InB	See Table 10
Math Function 2	Drop List	+, Result = InA plus InB	See Table 10
Math Function 3	Drop List	+, Result = InA plus InB	See Table 10

Table 22 – Math Function Setpoints

4.12. CAN Receive Setpoints

The Math Function Block is defined in Section 1.9. Please refer there for detailed information about how these setpoints are used. “**Receive Message Timeout**” is set to 0ms by default.



Setpoint Name	Value	Comment
SP CAN Interface	0	CAN1 Interface
SP Signal Type	0	Undefined
SP Is From Selected Address	0	False
SP Selected Address		Parameter not used - Receive from Source Address is Disabled
SP PGN	0xFF00	Received PGN: 65280
SP Pos Byte		Parameter not used with current Data Size selected
SP Pos Bit		Parameter not used with current Data Size selected
SP Size		Parameter not used with current Data Size selected
SP Resolution		Parameter not used with current Data Size selected
SP Offset		Parameter not used with current Data Size selected
SP Data Minimum		Parameter not used with current Data Size selected
SP Data Maximum		Parameter not used with current Data Size selected
SP Auto-Reset Time		Parameter not used with current Data Size selected

Figure 14 - Screen Capture of CAN Receive Setpoints

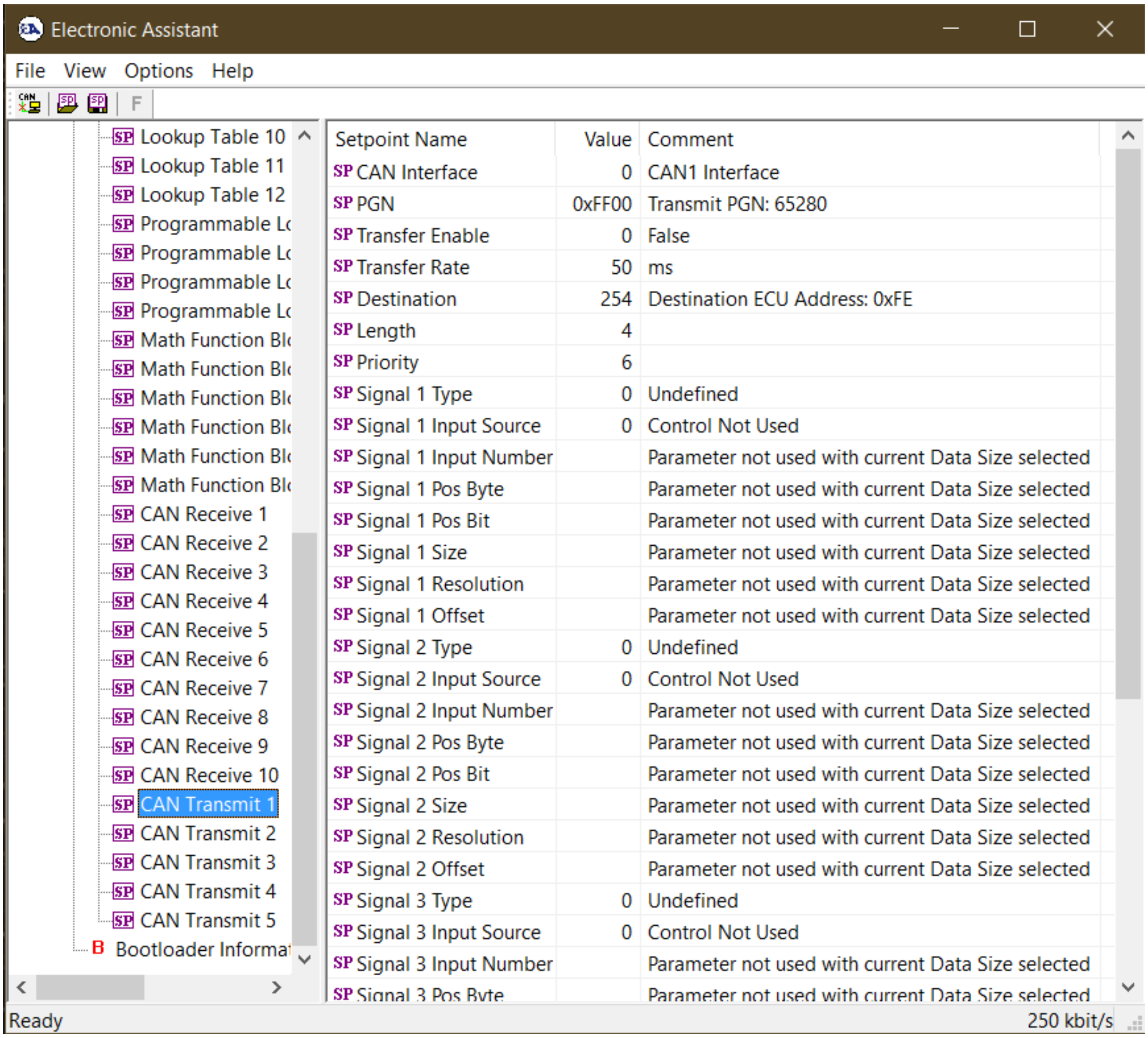
Name	Range	Default	Notes
CAN Interface			
Signal Type	Drop List	2, Continuous	
Is From Selected Address	Drop List	False	
Selected Address	Drop List	False	

PGN	0 to 65536	Different for each	
Pos Byte	0-7	0	
Pos Bit	0-7	0	
Size	Drop List	Continuous 2-Bytes	
Resolution	-100000.0 to 100000	1.0	
Offset	-10000 to 10000	0.0	
Data Minimum	-1000000 to Max	0.0	
Data Maximum	-100000 to 100000	100.0	
Auto-Reset Time	0 to 60 000 ms	0 ms	0ms disables the Lost Comm Fault

Table 23 – CAN Receive Setpoints

4.13. CAN Transmit Setpoints

CAN Transmit Message Function Block is presented in Section 1.10. 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 CAN Interface	0	CAN1 Interface
SP PGN	0xFF00	Transmit PGN: 65280
SP Transfer Enable	0	False
SP Transfer Rate	50	ms
SP Destination	254	Destination ECU Address: 0xFE
SP Length	4	
SP Priority	6	
SP Signal 1 Type	0	Undefined
SP Signal 1 Input Source	0	Control Not Used
SP Signal 1 Input Number		Parameter not used with current Data Size selected
SP Signal 1 Pos Byte		Parameter not used with current Data Size selected
SP Signal 1 Pos Bit		Parameter not used with current Data Size selected
SP Signal 1 Size		Parameter not used with current Data Size selected
SP Signal 1 Resolution		Parameter not used with current Data Size selected
SP Signal 1 Offset		Parameter not used with current Data Size selected
SP Signal 2 Type	0	Undefined
SP Signal 2 Input Source	0	Control Not Used
SP Signal 2 Input Number		Parameter not used with current Data Size selected
SP Signal 2 Pos Byte		Parameter not used with current Data Size selected
SP Signal 2 Pos Bit		Parameter not used with current Data Size selected
SP Signal 2 Size		Parameter not used with current Data Size selected
SP Signal 2 Resolution		Parameter not used with current Data Size selected
SP Signal 2 Offset		Parameter not used with current Data Size selected
SP Signal 3 Type	0	Undefined
SP Signal 3 Input Source	0	Control Not Used
SP Signal 3 Input Number		Parameter not used with current Data Size selected
SP Signal 3 Pos Byte		Parameter not used with current Data Size selected

Figure 15 - Screen Capture of CAN Transmit Setpoints

Name	Range	Default	Notes
CAN Interface	Drop List	CAN1	
PGN	0xff00 … 0xffff	Different for each	See Section 1.10.1
Transfer Enable	Drop List		
Transfer Rate	0 … 65000 ms	0ms	0ms disables transmit
Destination	0...255	255	Not used by default
Length			
Priority	0...7	6	Proprietary B Priority
Signal 1 Type			
Signal 1 Input Source	Drop List	Different for each	See Table 11
Signal 1 Input Number	Drop List	Different for each	See 1.10.2
Signal 1 Pos Byte	0-7	2	
Signal 1 Pos Bit	0-7	0	
Signal 1 Size	Drop List	2 bytes	
Signal 1 Resolution	-100000.0 to 100000	0.001	
Signal 1 Offset	-10000 to 10000	0.0	
Signal 2 Type			
Signal 2 Input Source	Drop List	Different for each	See Table 11
Signal 2 Input Number	Drop List	Different for each	See 1.10.2
Signal 2 Pos Byte	0-7	2	
Signal 2 Pos Bit	0-7	0	
Signal 2 Size	Drop List	2 bytes	
Signal 2 Resolution	-100000.0 to 100000	0.001	
Signal 2 Offset	-10000 to 10000	0.0	
Signal 3 Type			
Signal 3 Input Source	Drop List	Different for each	See Table 11
Signal 3 Input Number	Drop List	Different for each	See 1.10.2
Signal 3 Pos Byte	0-7	2	
Signal 3 Pos Bit	0-7	0	
Signal 3 Size	Drop List	2 bytes	
Signal 3 Resolution	-100000.0 to 100000	0.001	
Signal 3 Offset	-10000 to 10000	0.0	
Signal 4 Type			
Signal 4 Input Source	Drop List	Different for each	See Table 11
Signal 4 Input Number	Drop List	Different for each	See 1.10.2
Signal 4 Pos Byte	0-7	2	
Signal 4 Pos Bit	0-7	0	
Signal 4 Size	Drop List	2 bytes	
Signal 4 Resolution	-100000.0 to 100000	0.001	
Signal 4 Offset	-10000 to 10000	0.0	

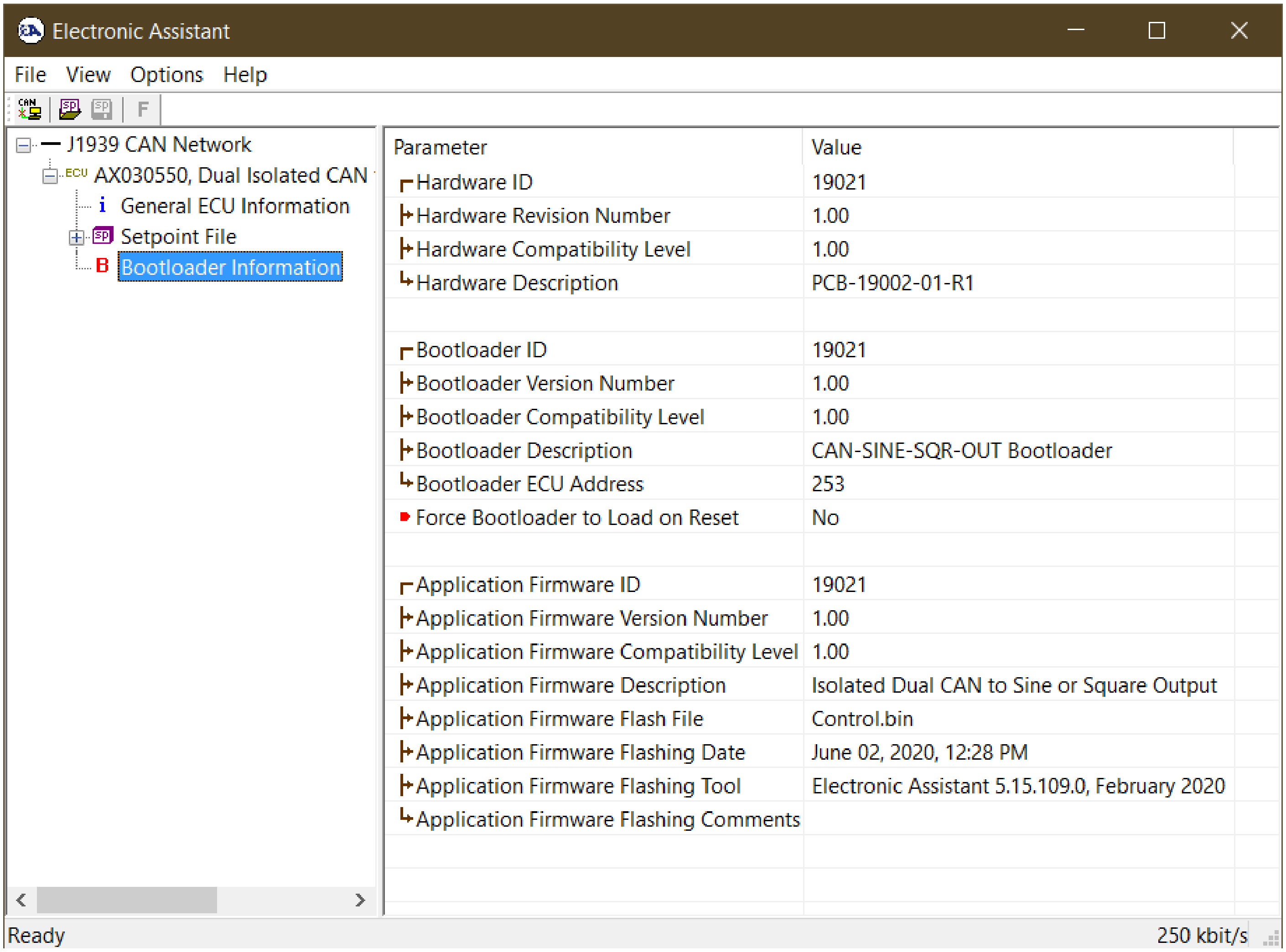
Table 24 – CAN Transmit Setpoints

5. REFLASHING OVER CAN WITH THE AXIOMATIC EA BOOTLOADER

The AX030550 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.

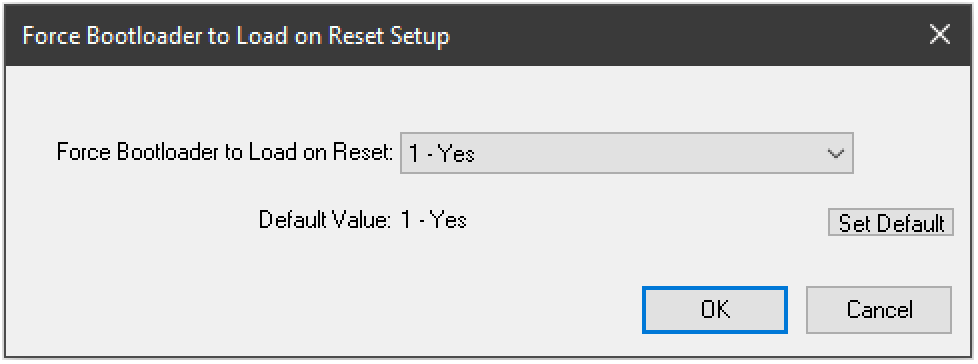
Note: To upgrade the firmware use Axiomatic Electronic Assistant V5.13.88.0 or higher.

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



Parameter	Value
Hardware ID	19021
Hardware Revision Number	1.00
Hardware Compatibility Level	1.00
Hardware Description	PCB-19002-01-R1
Bootloader ID	19021
Bootloader Version Number	1.00
Bootloader Compatibility Level	1.00
Bootloader Description	CAN-SINE-SQR-OUT Bootloader
Bootloader ECU Address	253
Force Bootloader to Load on Reset	No
Application Firmware ID	19021
Application Firmware Version Number	1.00
Application Firmware Compatibility Level	1.00
Application Firmware Description	Isolated Dual CAN to Sine or Square Output
Application Firmware Flash File	Control.bin
Application Firmware Flashing Date	June 02, 2020, 12:28 PM
Application Firmware Flashing Tool	Electronic Assistant 5.15.109.0, February 2020
Application Firmware Flashing Comments	

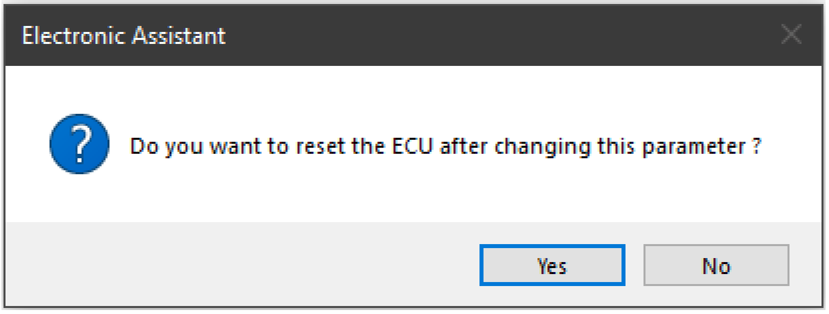
2. To use the bootloader for upgrading the firmware running on the ECU, change the variable **“Force Bootloader To Load on Reset**” to *Yes*. Even if the selection times out, the parameter will still be changed, and the unit will load the bootloader on reset.



Force Bootloader to Load on Reset: 1 - Yes

Default Value: 1 - Yes

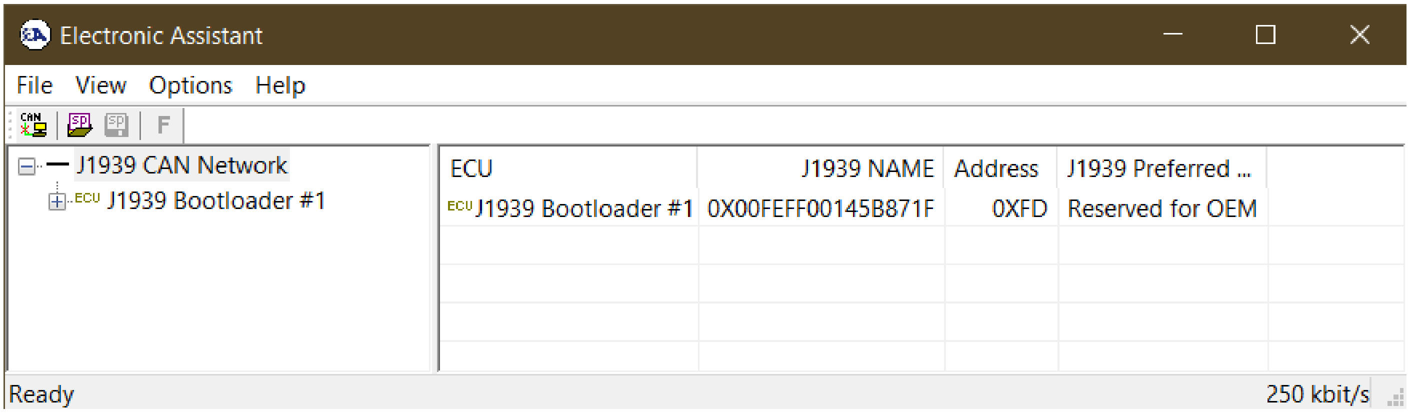
3. When the prompt box asks if you want to reset the ECU, select *Yes*.



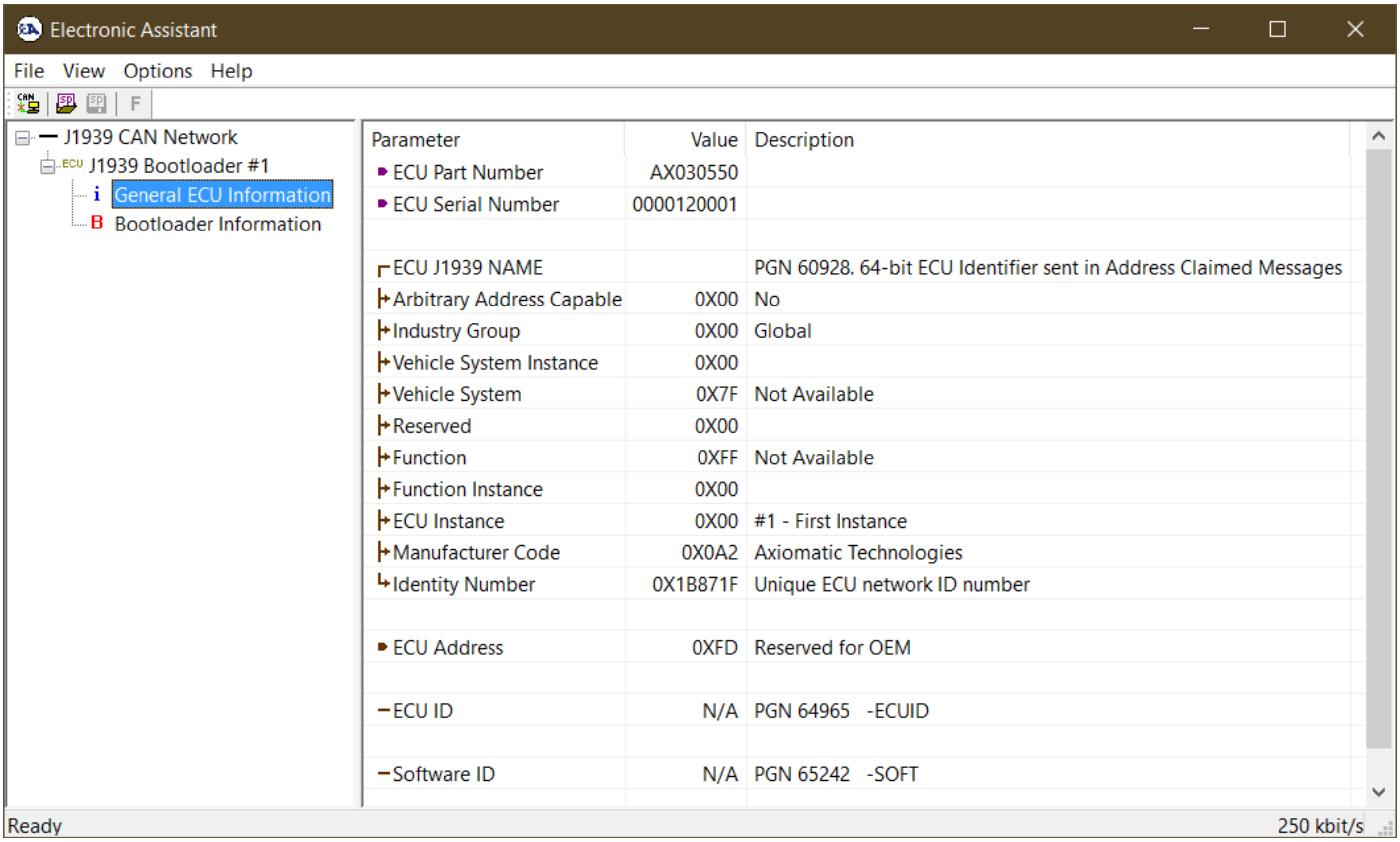
Do you want to reset the ECU after changing this parameter ?

4. The bootloader only operates on the CAN 1 interface, so switch to the correct interface by going to Options > CAN Interface Setup, and selecting the correct interface in the *Axiomatic USB-CAN Converter* drop down.

5. Upon reset, the ECU will no longer show up on the J1939 network as an AX030550 but rather as **J1939 Bootloader #1**.



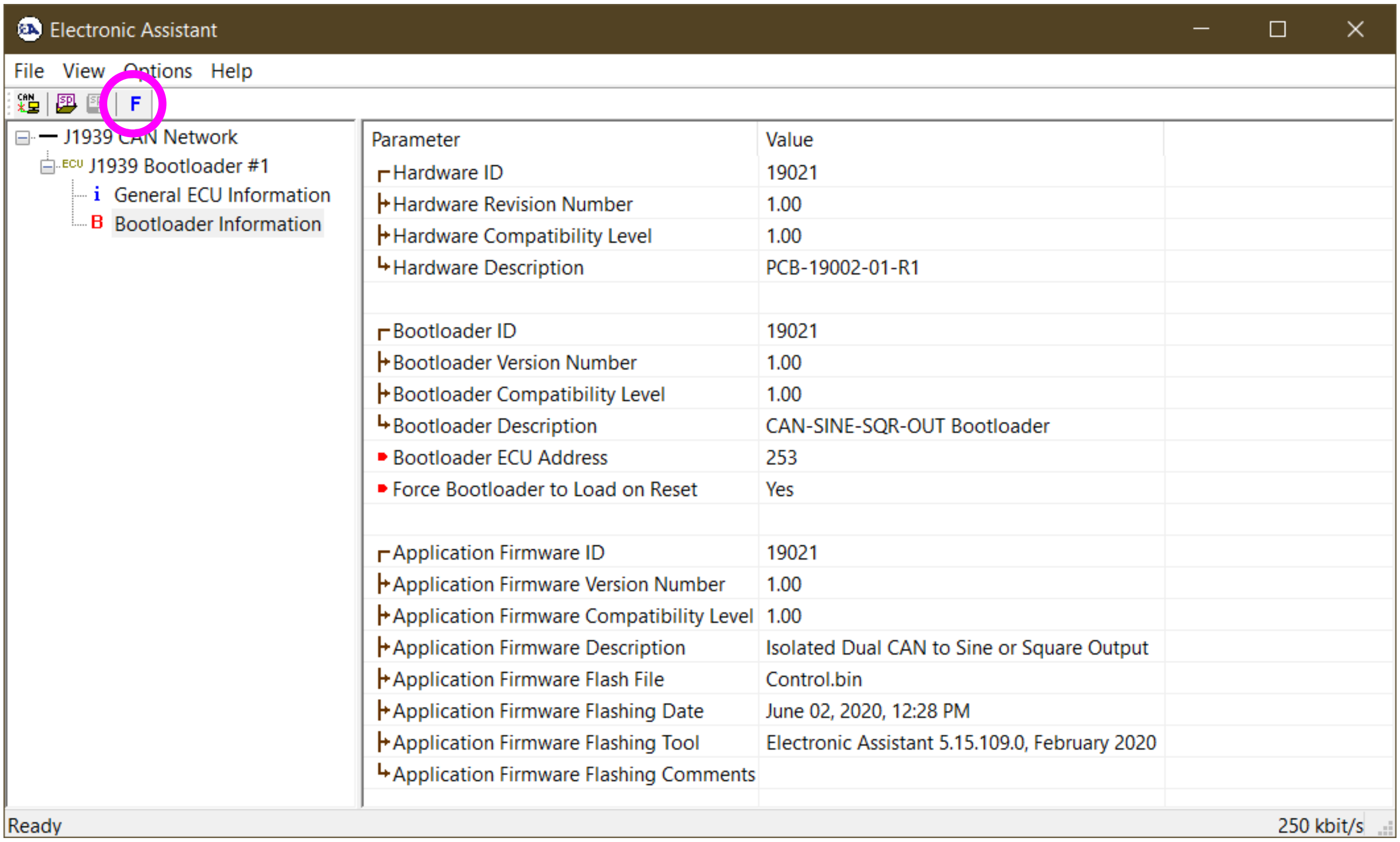
ECU	J1939 NAME	Address	J1939 Preferred ...
J1939 Bootloader #1	0X00FEFF00145B871F	0XFD	Reserved for OEM



Parameter	Value	Description
ECU Part Number	AX030550	
ECU Serial Number	0000120001	
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	0X1B871F	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

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.

6. When the **Bootloader Information** section is selected, the same information is shown as when it was running the AX030550 firmware, but in this case the **F**lashing feature has been enabled.

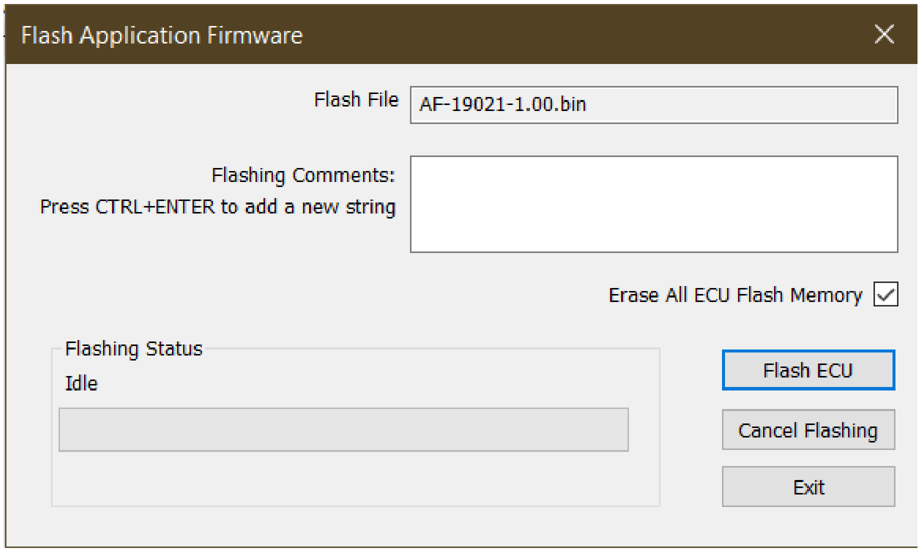


Parameter	Value
Hardware ID	19021
Hardware Revision Number	1.00
Hardware Compatibility Level	1.00
Hardware Description	PCB-19002-01-R1
Bootloader ID	19021
Bootloader Version Number	1.00
Bootloader Compatibility Level	1.00
Bootloader Description	CAN-SINE-SQR-OUT Bootloader
Bootloader ECU Address	253
Force Bootloader to Load on Reset	Yes
Application Firmware ID	19021
Application Firmware Version Number	1.00
Application Firmware Compatibility Level	1.00
Application Firmware Description	Isolated Dual CAN to Sine or Square Output
Application Firmware Flash File	Control.bin
Application Firmware Flashing Date	June 02, 2020, 12:28 PM
Application Firmware Flashing Tool	Electronic Assistant 5.15.109.0, February 2020
Application Firmware Flashing Comments	

7. Select the <u>F</u>lashing button and navigate to where you had saved the **AF-19021-X.XX.bin** file sent from Axiomatic. (Note: only binary (.bin) files can be flashed using the Axiomatic EA tool.)

8. 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.



Flash File: AF-19021-1.00.bin

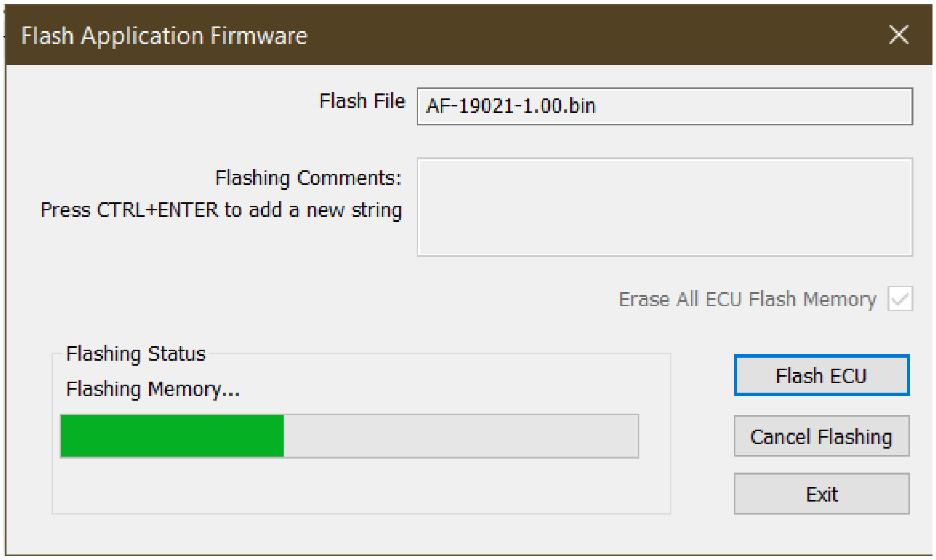
Flashing Comments:
Press CTRL+ENTER to add a new string

Erase All ECU Flash Memory ☑

Flashing Status
Idle

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 from Axiomatic 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.



Flash Application Firmware

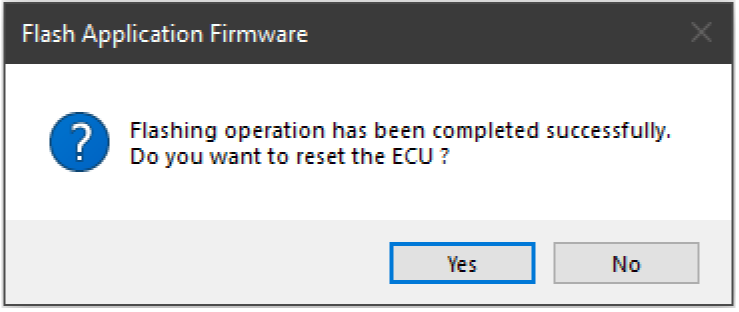
Flash File: AF-19021-1.00.bin

Flashing Comments:
Press CTRL+ENTER to add a new string

Erase All ECU Flash Memory ☑

Flashing Status
Flashing Memory...

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 AX030550 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 AX030550 application will run rather than the bootloader function.



Flash Application Firmware

Flashing operation has been completed successfully.
Do you want to reset the ECU ?

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

Technical Specifications:

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

Input Specifications

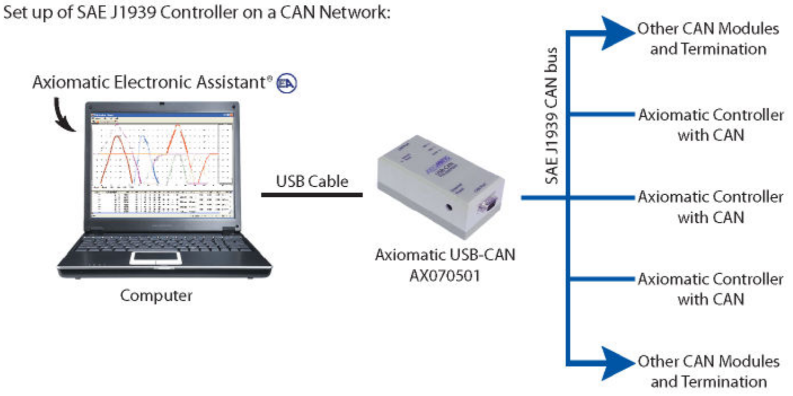
Power Supply Input - Nominal	12V or 24Vdc nominal (9…36 VDC power supply range)
Protection	Surge and reverse polarity protection are provided. Load dump protection for 12V systems
Under-voltage Protection	Hardware shuts down at 6V.
Over-voltage Protection	Hardware shuts down at 45V.
Voltage Reference	1 +5V +/- 0.5%, 100 mA maximum

Output Specifications

Signal Output	1 Signal output configurable as: SINE wave Square wave Frequency is user selectable from 10 Hz to 20 kHz User selectable: The output can be capacitively coupled through software. The load impedance must be higher than 50 kΩ.
PWM Output	1 PWM Output from 0 to 36Vps 1 Hz to 1 kHz Frequency Current limited to 200 mA
Output Accuracy	+/-1%
Ground Connection	One (1) analog GND connection is provided to be used as the sinusoidal signal output return. Two (2) Ground connections are provided for the Voltage Reference GND and PWM GND. All ground connections are connected internally.
Protection for Output + Terminal	Fully protected against short circuit to ground Unit will fail safe in the case of a short circuit condition, self-recovering when the short is removed.

General Specifications

Microprocessor	STM32F405RGT7 32-bit, 1 MByte flash program memory
Control Logic	Standard embedded software is provided.
CAN	2 CAN ports (SAE J1939) For baud rate, refer to the table below. *Model P/N* | *Baud Rate* | *Standard Reference* AX030550 | 250 kBit/s | J1939/11, J1939/15.
User Interface (PC-based)	The Axiomatic Electronic Assistant KIT, P/N: AX070502 or AX070506K
Quiescent Current Draw	82 mA @ 12V and full load 48 mA @ 24V and full load
Response Time	Contact Axiomatic.
Weight	Contact Axiomatic.
Operating Conditions	-40 to 85 °C (-40 to 185 °F)
Storage Temperature	-55 to 125 °C (-67 to 257°F)
Vibration and Shock Compliance	pending
Protection	IP67, PCB is conformal coated and protected by the housing.
Enclosure and Dimensions	Aluminum enclosure, Integral TE Deutsch equivalent connector, Encapsulation Refer to dimensional drawing.
Mounting	Mounting holes sized for #10 or M4.5 bolts. The bolt length will be determined by the end-user's mounting plate thickness. The mounting flange of the controller is 0.19 inches (4.75 mm) thick. If the module is mounted without an enclosure, it should be mounted to reduce the likelihood of moisture entry. 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).

<table>
<tr><td></td><td>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 of the module.
All chassis grounding should go to a single ground point designated for the machine and all related equipment.</td></tr>
<tr><td>Network Termination</td><td>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.</td></tr>
<tr><td>User Interface</td><td>The Axiomatic Electronic Assistant KIT, P/N: AX070502 or AX070506K
Set up of SAE J1939 Controller on a CAN Network:
 </td></tr>
</table>

<table>
<tr><td>Pinout</td><td>12-pin receptacle (equivalent TE Deutsch P/N: DT15-12PA)
A mating plug kit is available as Axiomatic P/N: AX070105.
<table>
<tr><th colspan="2">CAN and I/O Connector</th></tr>
<tr><th>Pin #</th><th>Description</th></tr>
<tr><td>1</td><td>+5V Reference</td></tr>
<tr><td>2</td><td>Ground</td></tr>
<tr><td>3</td><td>PWM Output</td></tr>
<tr><td>4</td><td>Ground</td></tr>
<tr><td>5</td><td>CAN_L</td></tr>
<tr><td>6</td><td>CAN_H</td></tr>
<tr><td>7</td><td>Signal Output</td></tr>
<tr><td>8</td><td>Signal Ground</td></tr>
<tr><td>9</td><td>CAN 2_H</td></tr>
<tr><td>10</td><td>CAN 2_L</td></tr>
<tr><td>11</td><td>BATT-</td></tr>
<tr><td>12</td><td>BATT+</td></tr>
</table></td></tr>
</table>

OUR PRODUCTS

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Engine Temperature Scanners

Ethernet/CAN Converters, Gateways, Switches

Fan Drive Controllers

Gateways, CAN/Modbus, RS-232

Gyroscopes, Inclinometers

Hydraulic Valve Controllers

Inclinometers, Triaxial

I/O Controls

LVDT Signal Converters

Machine Controls

Modbus, RS-422, RS-485 Controls

Motor Controls, Inverters

Power Supplies, DC/DC, AC/DC

PWM Signal Converters/Isolators

Resolver Signal Conditioners

Service Tools

Signal Conditioners, Converters

Strain Gauge CAN Controls

Surge Suppressors

OUR COMPANY

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

QUALITY DESIGN AND MANUFACTURING

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

WARRANTY, APPLICATION APPROVALS/LIMITATIONS

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

COMPLIANCE

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

SAFE USE

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

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

SERVICE

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

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

DISPOSAL

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

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