USER MANUAL UMAX189000
Version 1.01

Thermocouple Module, 1 Channel, 2 Universal Inputs
Dual CAN Controller with SAE J1939

USER MANUAL

P/N: AX189000

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ACRONYMS

ACK	Positive Acknowledgement
CSR	CAN Status Report
DM	Diagnostic Message (from SAE J1939 standard)
DTC	Diagnostic Trouble Code
FMI	Failure Mode Identifier
OC	Occurrence Count
EA	The Axiomatic Electronic Assistant (A Service Tool for Axiomatic ECUs)
ECU	Electronic Control Unit (from SAE J1939 standard)
MAP	Memory Access Protocol
NAK	Negative Acknowledgement
PDU1	A format for messages that are to be sent to a destination address, either specific or global
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)
PropB	Message that uses a Proprietary B PGN
SPN	Suspect Parameter Number (from SAE J1939 standard)

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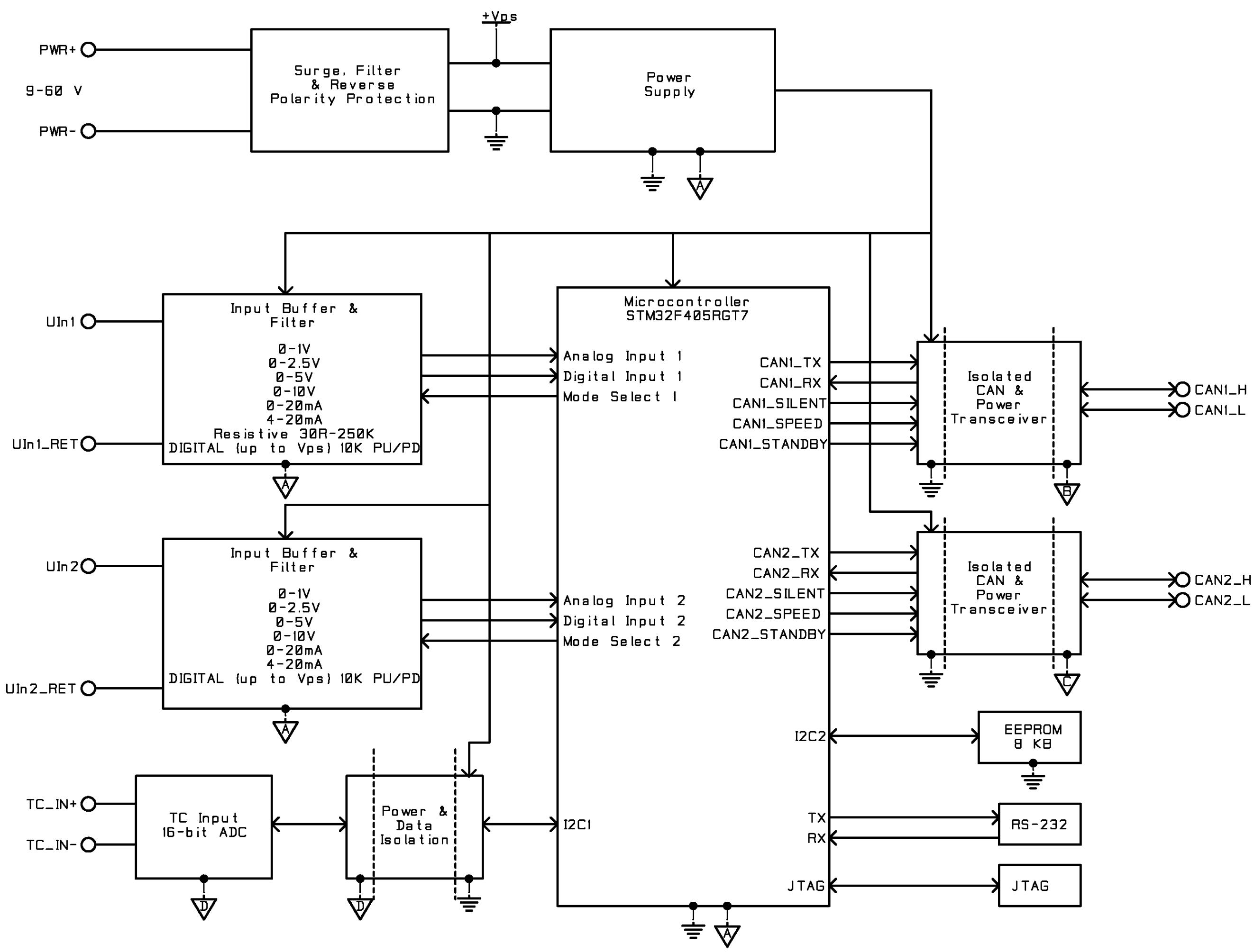
1. GENERAL INFORMATION

1.1. Introduction to AX189000 Features

The 1TC-2UIN-2CAN electronic control unit (ECU) is designed to provide a simple interface for Thermocouple and Universal Inputs over a Dual J1939 CAN Network, to be used in a power generator set or industrial environment. The hardware supports 1 Thermocouple Input, and 2 Universal Inputs. The Thermocouple Input also includes Cold Junction compensation.

The ECU has been designed to allow the maximum amount of versatility to optimize the performance of the machine. Numerous configurable variables, called setpoints, have been provided which are accessible using Axiomatic Technologies' Electronic Assistant. Information about the setpoint defaults and ranges is outlined in Section 3. The Axiomatic EA communicates with the controller over either J1939 CAN bus and uses Memory Access Protocol (MAP) to read/write each setpoint. Once the ECU has been setup as desired, the setpoints can be saved to a file, and flashed into other controllers using the EA. If both CAN ports are connected either bus may be used to connect to the EA, however if only one of the ports is being used be sure to use CAN1, as CAN2 will not work without CAN1 being connected. CAN2 must be connected to the network upon initialization if it is to be in use.

The ECU is an arbitrary address capable ECU, which can perform dynamic address allocation at the run time. It also provides all necessary network support required by the J1939 standard.



1.2. J1939 Network – Diagnostic Broadcast

Diagnostic messages are triggered by the internal function blocks and then broadcasted on the CAN bus network. However, in some applications this broadcast may not be required and so the user has the option to disable or enable this feature. Section 3.1 and 3.14 shows the configuration of this feature by using the Axiomatic Electronic Assistant tool.

1.3. Control Sources

The different function blocks in the ECU are commanded by a set of Control Sources. This section lists the different available control sources for these functions and their respective ranges.

Value	Meaning	Source Range
0	Control Not Used	[0]
1	Thermocouple Input Temperature	[1]
2	Thermocouple Input mV Data	[1]
3	Thermocouple Input Raw Data	[1]
4	Cold Junction Temperature	[1]
5	Cold Junction mV Data	[1]
6	Universal Input	[1…2]
7	CAN Receive	[1…5]
8	Constant Data	[1…4]
9	Math Block	[1…4]
10	Programmable Logic Block	[1…2]
11	Lookup Table	[1…6]
12	Conditional Logic Block	[1…10]
13	Set-Reset Latch	[1…3]

Table 1: Control Sources

While these sources are available for all functional blocks, it is not recommended to use Constant Data as a source in the Set-Reset Latch block.

1.4. Thermocouple Input Function Block

The ECU has 1 Thermocouple input, which can be configured to read the input data and react in a variety of different ways.

The first parameter, **Thermocouple Type**, is used to configure what type of Thermocouple the input is.

Value	Meaning
0	Input Disabled
1	B Type
2	E Type
3	J Type
4	K Type
5	N Type
6	R Type

7	S Type
8	T Type

Table 2: Thermocouple Types

1.4.1. Thermocouple Input Cold Junction Compensation

A high accuracy digital temperature sensor is placed next to thermocouple connectors to provide cold junction compensation. Cold Junction Compensation can be enabled or disabled for the Thermocouple Input using the **Cold Junction Enabled** setpoint. Regardless of this parameter being enabled, output data from the cold junction will still be available as a control source for outputs or other logic blocks.

1.4.2. Thermocouple Input Diagnostic Parameters

The **Generate Diagnostic Messages**, and **SPN for Diagnostics** setpoints are directly linked to all Diagnostic blocks related to the Thermocouple. This serves as a way to unilaterally change all these parameters at once for the affected diagnostics. See Section 1.7 for more details.

1.4.3. Thermocouple Input Warning and Shutdown

The temperature levels at which the Shutdown and Warning messages are triggered are configurable. The **High Shutdown Temperature** and **Low Shutdown Temperature** parameters are used to set the upper and lower bound for when a Shutdown Diagnostic message is sent. The **High Warning Temperature** and **Low Warning Temperature** parameters are used to set the upper and lower bound for when a Warning Diagnostic message is sent.

The **Shutdown Delay** and **Warning Delay** parameters are used to set the delay between the trigger and actual output of a diagnostic message. These parameters are directly linked to the **Delay Before Sending DM1** setpoint for their respective diagnostic block.

1.5. Universal Input Function Blocks

The 2 universal inputs of the controller can each be configured as a variety of different input types. The inputs can be used as control sources for CAN output, as well as other logic blocks. The sub sections below explain in more detail the functionality and available setpoints/parameters of the universal inputs.

1.5.1. Universal Input Type

The **Input Type** parameter allows the user to select how the controller responds to the behaviour of the input. Table 2 shows the different options for each input, however it should be noted that the Resistive Input is only available on Universal Input 1.

Value	Meaning
0	Input Disabled
1	Voltage Input
2	Current Input

3	Digital Input
4	Frequency Input
5	PWM Input
6	Resistive Input *Only on Input 1

Table 3: Universal Input Types

1.5.2. Universal Input Range

The **Input Range** parameter is used to specify the expected range of Voltage or Current inputs. It is disabled for other input types. Table 4 shows the options available for this parameter when a Voltage Input is selected, and Table 5 show the options for a Current Input.

Value	Meaning
0	0 - 1V Analog Input
1	0 - 2.5V Analog Input
2	0 - 5V Analog Input
3	0 - 10V Analog Input

Table 4: Voltage Input Ranges

Value	Meaning
0	0 - 20mA Analog Input
1	4 - 20mA Analog Input

Table 5: Current Input Ranges

1.5.3. Universal Input Analog Filter

The **Analog Filter** parameter is only applicable when a voltage or a current type is being measured. In these cases, the ADC will automatically filter as per Table 6, and is set for 50Hz noise rejection by default.

Value	Meaning
0	Input Filter Off
1	Filter 50Hz
2	Filter 60Hz
3	Filter 50Hz and 60Hz

Table 6: Analog Filter

1.5.4. Universal Input Error and Range

Each Input can have different Input Ranges which can be configured. The **Range Min** and **Range Max** parameters are used to set the range for the input. The **Error Min** and **Error Max** parameters are used to set when the accompanying diagnostic message will be triggered.

1.5.5. Universal Input Digital Input Parameters

If the Input is configured as a Digital Input, the following setpoints become available to help configure the input.

The **Pull Up/Down** parameter is used to change the configuration of internal resistors with the following options.

Value	Meaning
0	No Pull
1	Pull Up Network
2	Pull Down Network

Table 7: Digital Input Pull Up/Down

The **Logic Type** parameter is used to determine how the input is received when configured as a Digital Input.

Value	Meaning
0	Input Not Implemented
1	Normal Logic
2	Inverse Logic
3	Latched Logic
4	Inverse Latched Logic

Table 8: Digital Input Logic Type

By default, the *Normal Logic* type is used for the digital input.

In *Normal Logic* mode, the input state is 1 in case the input signal is interpreted as an ON-signal. The input state turns 0 if the input signal is interpreted as an OFF-signal.

For the *Inverse Logic* type, the opposite behavior applies. If the input signal is ON, the state turns 0 and if the input signal is OFF, the state turns 1.

Setting the Input to *Latched Logic*, the input state is toggled between 1 and 0 every time the input signal of the respective digital input changes from OFF to ON.

In *Inverse Latched Logic* mode, the opposite behaviour applies. The input state toggles between 1 and 0 every time the input signal changes from ON to OFF.

The Digital Input **Debounce Time** parameter is a useful parameter in cases where the digital input signal coming into the controller is noisy. Figure 1 shows how the Debounce Time helps detect a correct input signal.

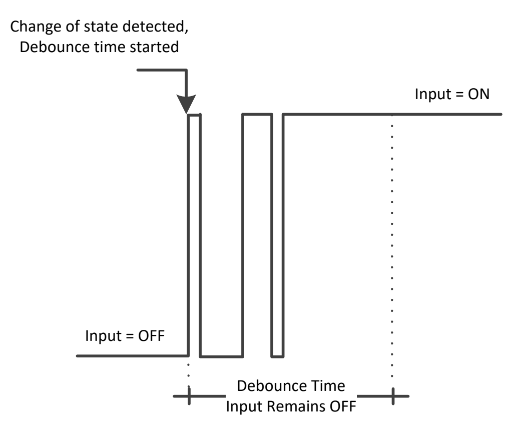


Figure 1: Digital Input Debounce Time

1.5.6. Universal Input Frequency/PWM Parameters

If the Input is configured as either a Frequency Input or a PWM Input, then the following parameters become available.

The **PWM Debounce Filter** is applied to the input before the state is read by the processor. The options for this setpoint are shown in Table 9.

Value	Meaning
0	Filter Disabled
1	Filter 111ns
2	Filter 1.78 us
3	Filter 14.22 us

Table 9: PWM Debounce Filter

The **Number of Pulses per Revolution** parameter, if greater than 0, will convert a frequency input into RPM instead of Hertz, based on the value entered.

1.5.7. Universal Input Data Filter

All analog inputs (Voltage or Current) can be further filtered once the raw data has been measured. The **Data Filter Type** parameter determines what kind of filter is used per Table 6. By default, additional software filtering is disabled.

Value	Meaning
0	No Filter
1	Moving Average
2	Repeating Average

Table 10: Data Filter Type

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

Calculation with no filter:
Value = Input
The data is simply a 'snapshot' of the latest value measured by the ADC or timer.

Calculation with the moving average filter:

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

This filter is called every 1ms

Calculation with the repeating average filter:

$$Value = \frac{\sum Input_N}{N}$$

At every reading of the input value, it is added to the sum. At every N^{th} read, the sum is divided by N, and the result is the new input value. The value and counter will be set to zero for the next read. This filter is called every 1ms.

1.5.8. Universal Input Diagnostic Parameters

The **Error Detection Enabled** setpoint allows for diagnostic warnings for the input to be triggered or be disabled. If enabled, the **Error Clear Hysteresis** is used to set the hysteresis value at which an input error can be cleared. Lastly, the **Error Delay** setpoint is directly linked to the same parameter for the all diagnostics associated with the particular Universal Input, and can be used to set all of them to the same value.

1.6. Miscellaneous

The Miscellaneous function block contains various parameters that affect the general diagnostic performance of the ECU.

The **Undervoltage Threshold**, **Overvoltage Threshold**, and **Shutdown Temperature** setpoints are used to set the limits for when their respective diagnostic messages are triggered.

Lastly, the **CAN Diagnostic Setting** parameter is used to control all diagnostics with one general setting for each CAN Interface independent of the other. This can be used to disable diagnostics entirely, only transmit messages without a blank SPN, or transmit diagnostic messages normally.

1.7. Diagnostics

The Diagnostic function block includes twenty-six faults, each representing a diagnostic message that the ECU is able to produce. Each Digital Output has a set of accompanying faults, all six outputs have an Open Circuit, Short To VCC, and Short To Ground fault. While the two low-sourced outputs have an additional Overcurrent fault. The remaining faults cover VPS Overvoltage and Undervoltage, Overtemperature, and other faults.

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's 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 11. 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 11: 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.

1.8. Constant Data

The Constant Data Block contains four configurable constant data setpoints which can be used as a control source for other functions. While they are available as a control source to all functions, it is recommended not to use constant data as a control source for the Set-Reset Latch Block.

1.9. Math Function Block

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

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

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 12: 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.

1.10. Programmable Logic Function Block

The Programmable Logic Function Block is a powerful tool. Programmable Logic can be linked to up to three Lookup Tables, any of which would be selected only under given conditions. Thus, the output of a Programmable Logic at any given time will be the output of the Lookup Table selected by the defined logic. Therefore, up to three different responses to the same input, or three different responses to different inputs, can become the input to another function block.
In order to enable any one of the Programmable Logic blocks, the "**Logic Enabled**" setpoint must be set to '*True*'. By default, all Logic blocks are disabled.
The three associated tables are selected by setting "**Table Number X**" setpoint to desired Lookup Table number, for example selecting *1* would set Lookup Table 1 as TableX.
For each TableX there are three conditions that define the logic to select the associated Lookup Table as Logic output. Each condition implements function $Argument1\ Operator\ Argument2$ where Operator is logical operator defined by setpoint "**Table X – Condition Y Operator**". Setpoint options are listed in Table 12. 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 13: 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 13, 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 14: 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.

1.11. Lookup Table Function Block

Lookup Tables are used to give output response up to 10 slopes per input. If more than 10 slopes are required, A Programmable Logic Block can be used to combine up to three tables to get 30 slopes as described in Section 1.11.
Lookup tables have two differing modes defined by "**X-Axis Type**" setpoint, given in Table 14. 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 15: 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 15. '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 16: 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, Section 1.1). Ignored points are not considered for min and max values.

1.12. Conditional Block

The Conditional Block compares up to four different input sources with different logical or relational operators. The result of each block can therefore only be true (1) or false (0). Figure 2 demonstrates the connections between all parameters.

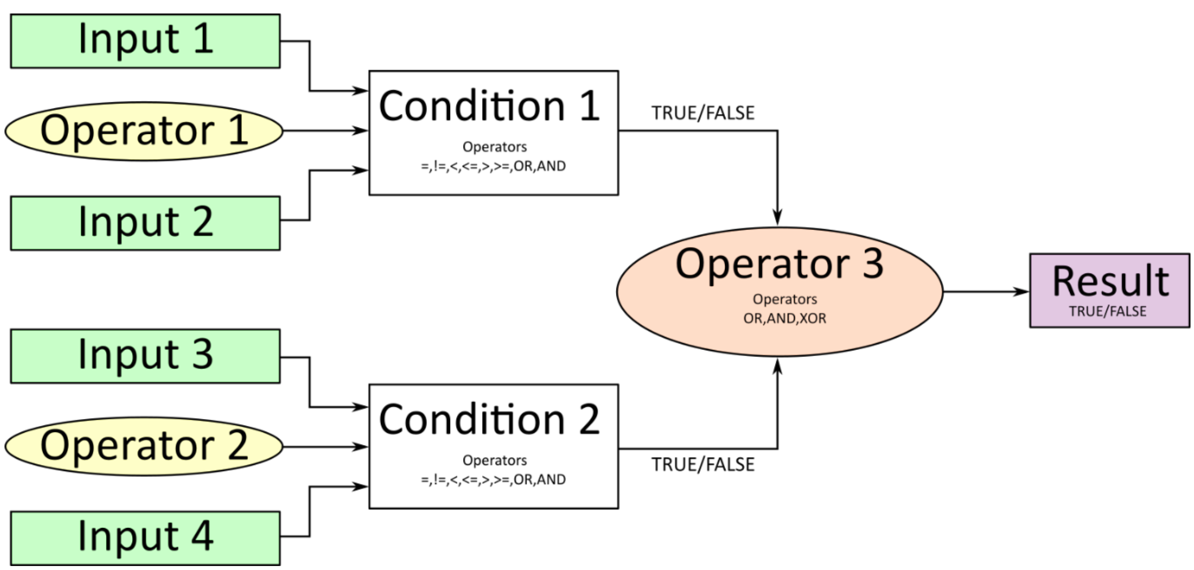


Figure 2: Conditional Block Diagram

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

value of each source will then be compared to each other with an operator of Table 16. If no source is selected, the output value of an Input will be zero.

Value	Meaning
0	==, True when Argument 1 is equal to Argument 2

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

Table 17: Input Operator Options

Operator 1 and Operator 2 are configured to OR by default. The table above cannot be used for comparing the conditions because they can only be compared with logical operators, which are listed in Table 17.

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

Table 18: Condition Operator Options

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

1.13. Set / Reset Latch Function Block

Set-Reset Block consists of only 2 control sources: **Reset Source** and **Set Source**. The purpose of these blocks is to simulate a modified latching function in which the 'Reset Signal' has more precedence. The 'latching' function works as per the Table 18 below.

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

Table 19 – Set-Reset Function block operation

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

As seen in Table 18 above, the 'Reset Signal' has more precedence over the 'Set Signal' - if the state of 'Reset Signal' is *ON*, the state of 'Set-Reset Block Output' will be *OFF*. To create an *ON* state in 'Set-Reset Block Output' the state of 'Reset Signal' must be *OFF* while the state of 'Set Signal' is *ON*. In this case, the state of 'Set-Reset Block Output' will remain *ON* even if 'Set Signal' turns *OFF* as long as 'Reset Signal' remains *OFF.* As soon as the 'Reset Signal' turns *ON* the 'Set-Reset Block Output' will turn *OFF* regardless of the state of 'Set Signal'.

1.14. CAN Transmit Function Block

The ECU provides up to 5 fully configurable CAN Transmit messages. Each block can be designated to a **CAN Interface**, and has its own **PGN**. Different transmit messages that share a PGN will be broadcast together as one message.

The CAN transmit message is always enabled and the **Repetition Rate** defines which time in milliseconds the CAN transmit message is repeated. The CAN message will not transmit on the J1939 network in case all CAN transmits have the same PGN and the **Repetition Rate** of the first CAN transmit is set to zero. In the case of shared PGNs the rate of the lowest number CAN Transmit is used, i.e. if CAN Transmit 1 and CAN Transmit 4 share a PGN, the Repetition Rate of CAN Transmit 1 is used.

The CAN Transmit messages can be sent on any Proprietary A or B PGN as broadcast messages. By default, the **Message Priority** is set to 6 (low priority).

The **Destination Address** of the J1939 Identifier can be changed to any value between 0…255.

The **Data Size**, **Data Index in Array (LSB)**, **Bit Index in Byte (LSB), Resolution**, and **Offset** can all be used to map any SPN supported message by the J1939 standard from any **Data Source/Number** of the Transmit Function Block.

1.15. CAN Receive Function Block

The ECU supports up to 5 unique fully configurable CAN Receive Messages. The CAN Receive function block is designed to take any SPN from the J1939 network and use it as a **Control Source** for any relay outputs or CAN transmits.

The input must specify which **CAN Interface** is to be used to receive data.

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 within the **Receive Message Timeout** period if this has been set to 10ms or higher. This will trigger a Lost Communication event and the output data of the CAN Receive message will be set to 0. To avoid timeouts (if set to 10ms or higher) 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 timeout and will never trigger a Lost Communication event.

By default, all control messages are expected to be sent to the ECU on Proprietary B PGNs. However, should a PDU1 message be selected, the ECU can be configured 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 **Data Size**, **Data Index in Array (LSB)**, **Bit Index in Byte (LSB)**, **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.

The **Data Min** (Off Threshold) and **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 level types. These values are in whatever units the incoming data is **after** the resolution and offset are applied to the CAN Receive signal.

To have a CAN Receive message trigger, a relay output ON or OFF is to make sure the **Data Min (OFF Threshold)** and **Data Max (ON Threshold)** parameters are adjusted to the user's application. When the CAN Receive message (after having the resolution and offset applied to it), anything at **Data Max (ON Threshold)** parameter or higher, will trigger an ON command. Similarly, anything at **Data Min (OFF Threshold)** parameter or lower will trigger an OFF command. Any data in between will not change the state, thus providing a hysteresis. Figure 3 illustrates this behaviour.

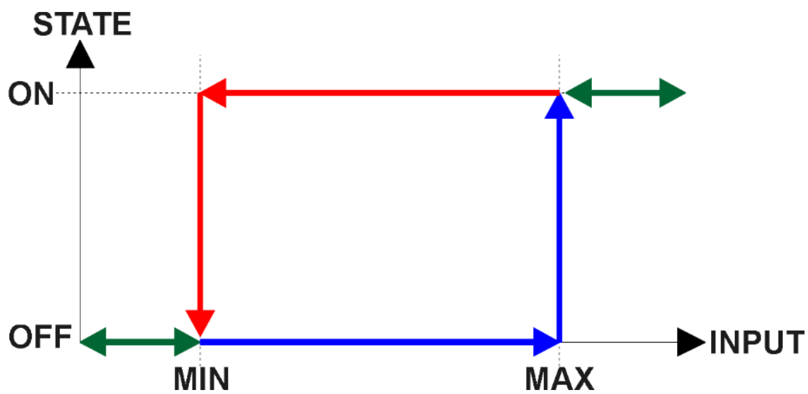


Figure 3: CAN Receive Message to Digital Output State

2. OVERVIEW OF J1939 FEATURES

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

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

2.1. Introduction To Supported Messages

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

From J1939-21 - Data Link Layer

- Request 59904 ($00EA00)
- Acknowledgment 59392 ($00E800)
- Transport Protocol – Connection Management 60416 ($00EC00)
- Transport Protocol – Data Transfer Message 60160 ($00EB00)
- PropB Transmit, Default Digital I/O State Feedback 65280 ($00FF00)
- PropB Receive, Default Control Source Data Message 65408 ($00FF80)
- PropB Receive, Default Control Source Data Message 65409 ($00FF81)
- PropB Receive, Default Control Source Data Message 65410 ($00FF82)
- PropB Receive, Default Control Source Data Message 65411 ($00FF83)
- PropB Receive, Default Control Source Data Message 65412 ($00FF84)
- PropB Receive, Default Control Source Data Message 65413 ($00FF85)
- PropB Receive, Default Control Source Data Message 65414 ($00FF86)
- PropB Receive, Default Control Source Data Message 65415 ($00FF87)

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

From J1939-73 - Diagnostics

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

From J1939-81 - Network Management

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

Commanded Address 65240 ($00FED8)

From J1939-71 – Vehicle Application Layer

- Software Identification 65242 ($00FEDA)

None of the application layer PGNs are supported as part of the default configurations, but they can be selected as desired for either transmit or received function blocks.
Setpoints are accessed using standard Memory Access Protocol (MAP) with proprietary addresses. The Axiomatic Electronic Assistant (EA) allows for quick and easy configuration of the unit over the CAN network.

2.2. J1939 Name, Address and Software ID

The controller has a J1939 name which is broadcasted at power up and/or when its ECU Address has been changed. The Software ID PGN gives useful information regarding the controller.

2.2.1. J1939 Name

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

Arbitrary Address Capable	Yes
Industry Group	0, Global
Vehicle System Instance	0
Vehicle System	0, Non-specific system
Function	128, Axiomatic I/O Controller
Function Instance	16, AX189000 1TC-2UIN-2CAN
ECU Instance	**0, First Instance**
Manufacture Code	162, Axiomatic Technologies Corporation
Identity Number	Variable, uniquely assigned during factory programming for each ECU

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

2.2.2. ECU Address

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

2.2.3. Software Identifier

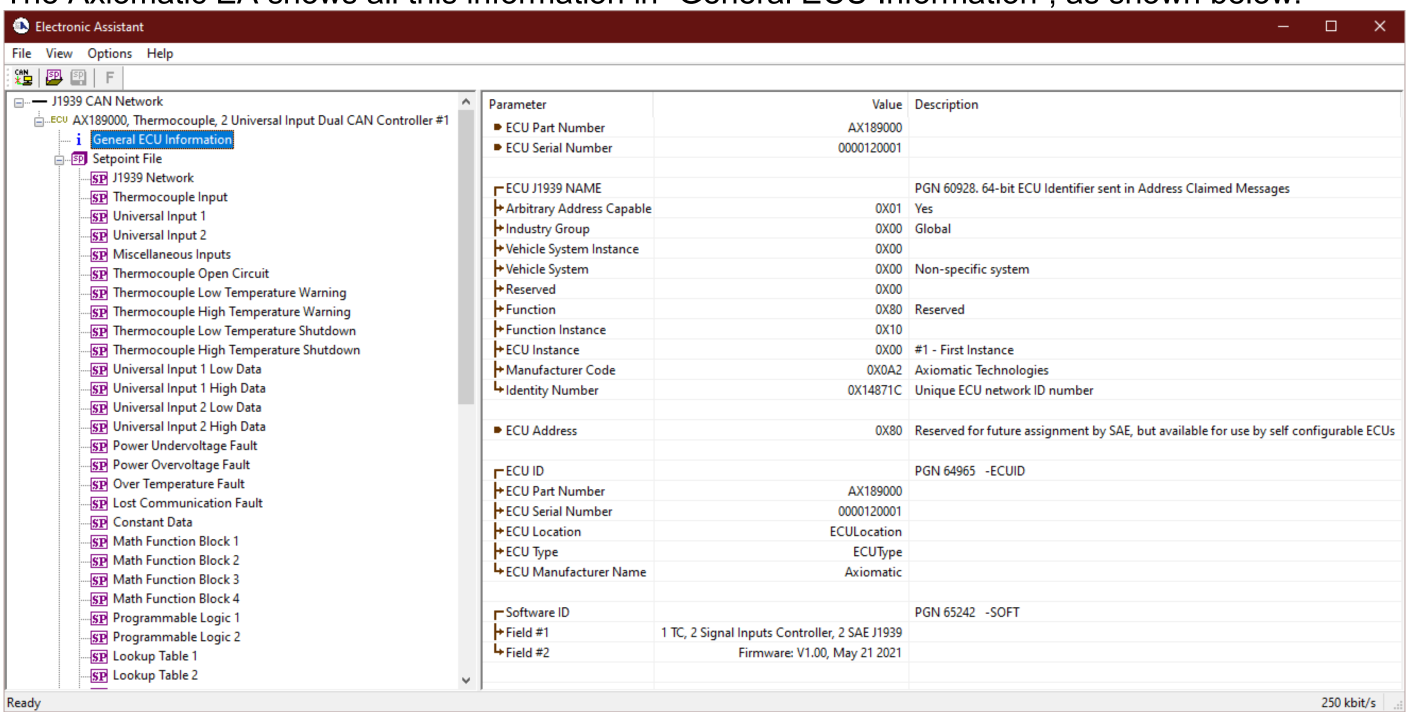
PGN 65242	Software Identification	- SOFT
Transmission Repetition Rate:	On request	
Data Length:	Variable	
Extended Data Page:	0	
Data Page:	0	
PDU Format:	254	
PDU Specific:	218 PGN Supporting Information:	
Default Priority:	6	
Parameter Group Number:	65242 (0xFEDA)	

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

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

(Version)*

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.

3. ECU SETPOINTS ACCESSED WITH THE AXIOMATIC ELECTRONIC ASSISTANT

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

3.1. J1939 Network Setpoints

The J1939 Network setpoints deal with the setpoints such as *ECU Instance Number* and *ECU Address*. Figure 4 and Table 20 below will explain these setpoints and their ranges.

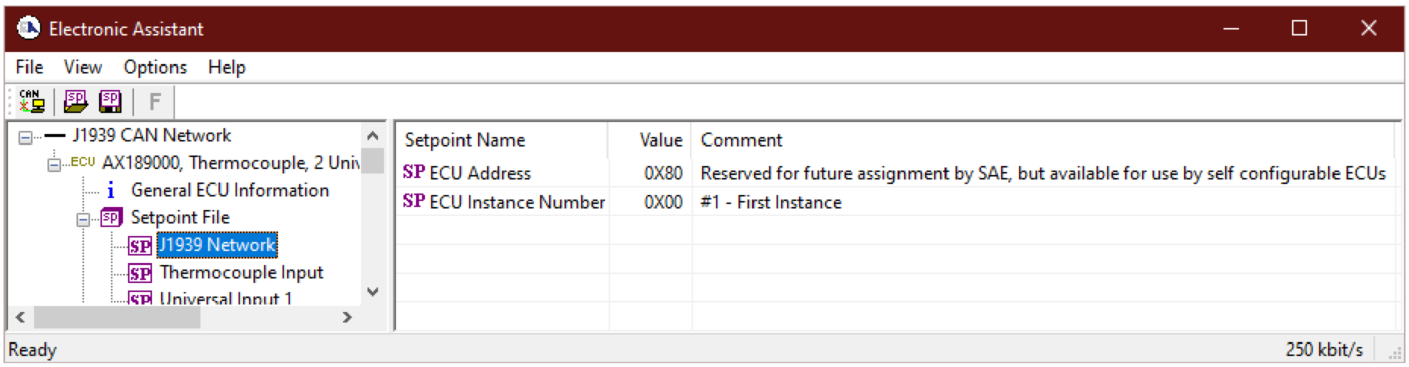


Figure 4: Screen Capture of Default J1939 Network Setpoints

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

Table 20: Default J1939 Network Setpoints

3.2. Thermocouple Input Setpoints

The Thermocouple Input setpoints are defined in section 1.4. Refer to that section for detailed information on how these setpoints are used. The screen capture below in Figure 5 displays the available setpoints for each of the Thermocouple Inputs. Table 21 below highlights the allowable ranges for each setpoint.

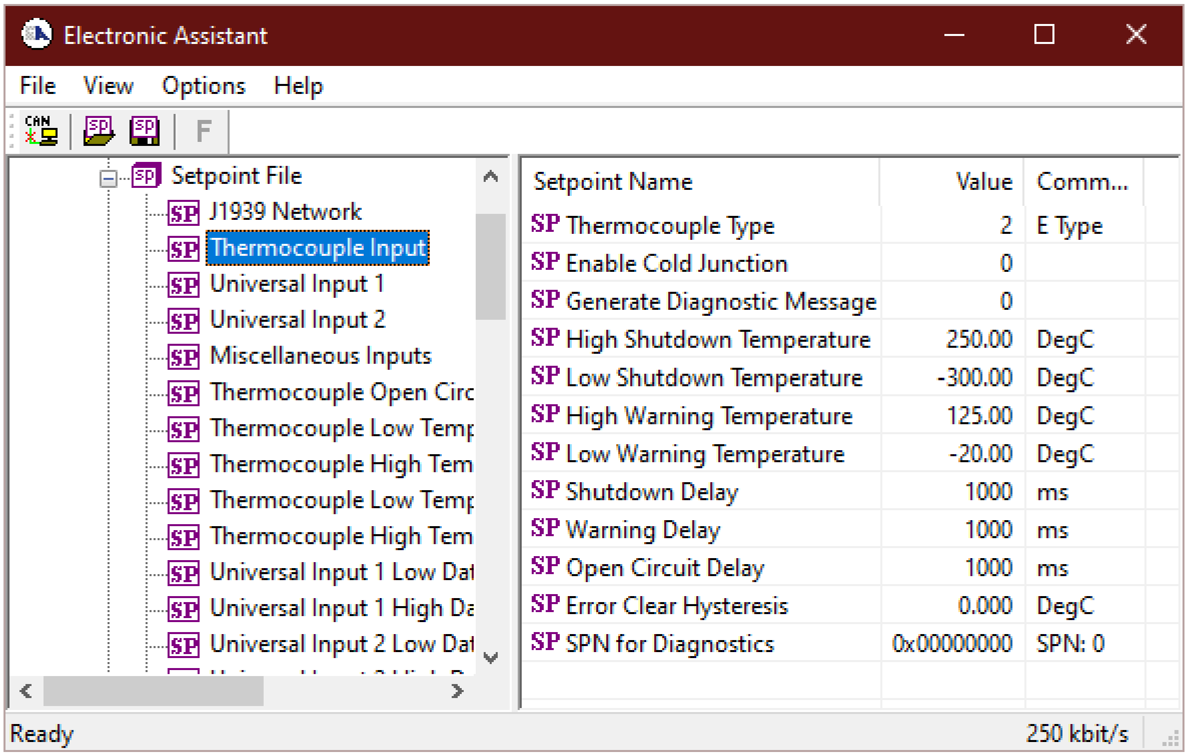


Figure 5: Screen Capture of Default Thermocouple Input Setpoints

Name	Range	Default	Notes
Thermocouple Type	Drop List	Normal Logic	Refer to Section 1.4
Enable Cold Junction	Drop List	True	Refer to Section 1.4
Generate Diagnostic Message	Drop List	False	Refer to Section 1.4
High Shutdown Temperature	100…300	250	Refer to Section 1.4, Unit in Degrees Celsius
Low Shutdown Temperature	-250...-350	-300	Refer to Section 1.4, Unit in Degrees Celsius
High Warning Temperature	100...(HighShutdownTemp - 25)	125	Refer to Section 1.4, Unit in Degrees Celsius
Low Warning Temperature	(LowShutdownTemp + 25) ..0	-25	Refer to Section 1.4, Unit in Degrees Celsius
Shutdown Delay	0...2000	1000	Refer to Section 1.4
Warning Delay	0...2000	1000	Refer to Section 1.4
Error Clear Hysteresis	0…20	0	Refer to Section 1.4
SPN for Diagnostics	0...0x7FFFF	0	Refer to Section 1.4

Table 21: Default Thermocouple Input Setpoints

3.3. Universal Input Setpoints

The Universal Input setpoints are defined in Section 1.5. Refer to that section for detailed information on how these setpoints are used. The screen capture below in Figure 6 displays the available setpoints for each of the Universal Inputs. Table 22 below highlights the allowable ranges for each setpoint.

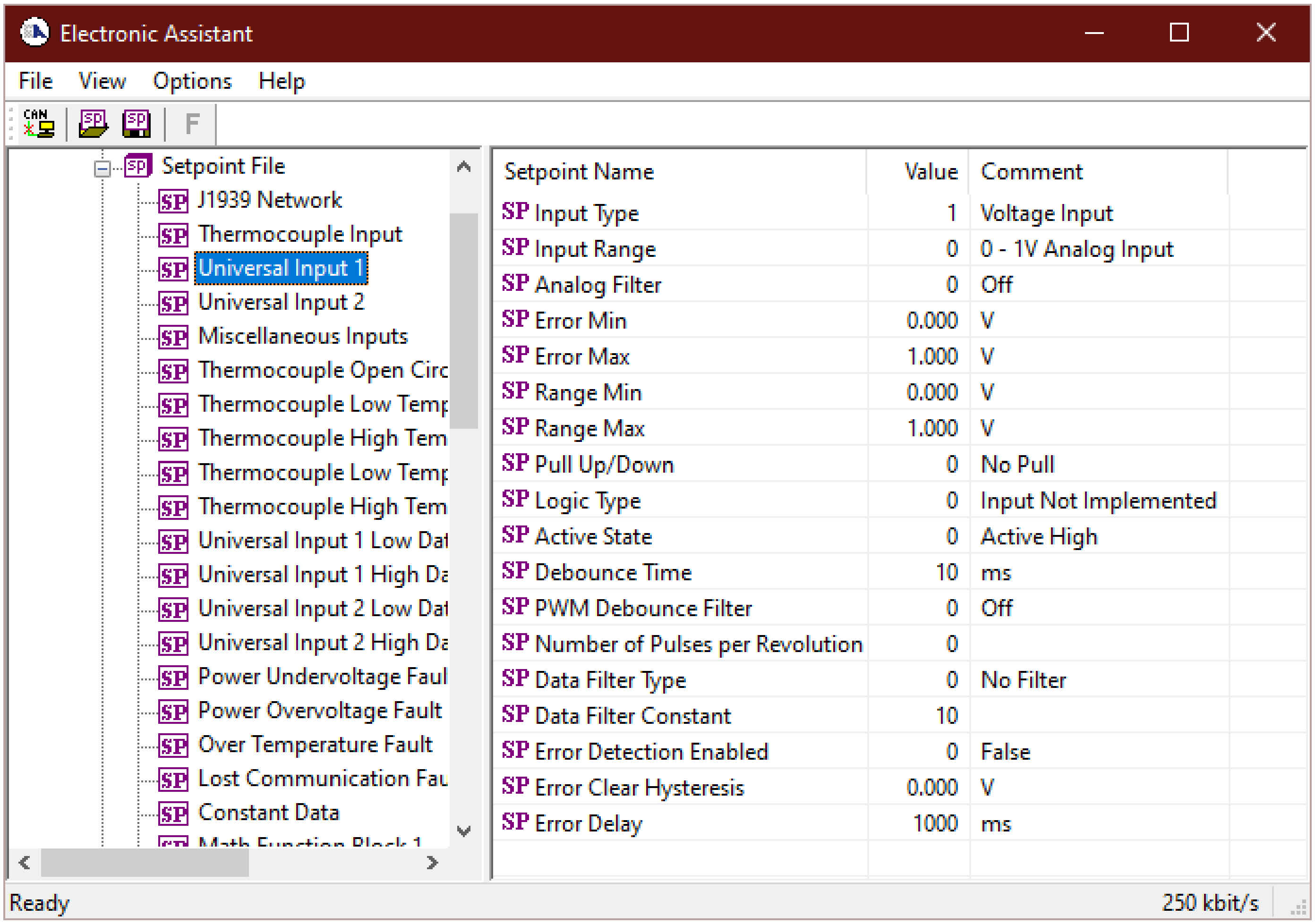


Figure 6: Screen Capture of Default Universal Input Setpoints

Name	Range	Default	Notes
Input Type	Drop List	Disabled	Refer to Section 1.5
Input Range	Drop List	0 (0-1V, or 0-20mA)	Refer to Section 1.5
Analog Filter	Drop List	Off	Refer to Section 1.5
Error Min	Depends on Input Type		Refer to Section 1.5
Error Max	Depends on Input Type		Refer to Section 1.5
Range Min	Depends on Input Type		Refer to Section 1.5
Range Max	Depends on Input Type		Refer to Section 1.5
Pull Up/Down	Drop List	No Pull	Refer to Section 1.5
Logic Type	Drop List	Input Not Implemented	Refer to Section 1.5
Active State	Drop List	Active High	Refer to Section 1.5
Debounce Time	0…65,000	10ms	Refer to Section 1.5
PWM Debounce Filter	Drop List	Off	Refer to Section 1.5
Number of Pulses per Revolution	0…1000	0	Refer to Section 1.5
Data Filter Type	Drop List	No Filter	Refer to Section 1.5
Data Filter Constant	1…1000	10	Refer to Section 1.5
Error Detection Enabled	Drop List	False	Refer to Section 1.5
Error Clear Hysteresis	Depends on Input Type	0	Refer to Section 1.5
Error Delay	0.0… 1000	1000ms	Refer to Section 1.5

Table 22: Default Universal Input Setpoints

3.4. Miscellaneous Setpoints

The Miscellaneous setpoints are defined in Section 1.7. Refer to that section for detailed information on how these setpoints are used. The screen capture below in Figure 7 displays the available setpoints. Table 23 highlights the allowable ranges for each setpoint.

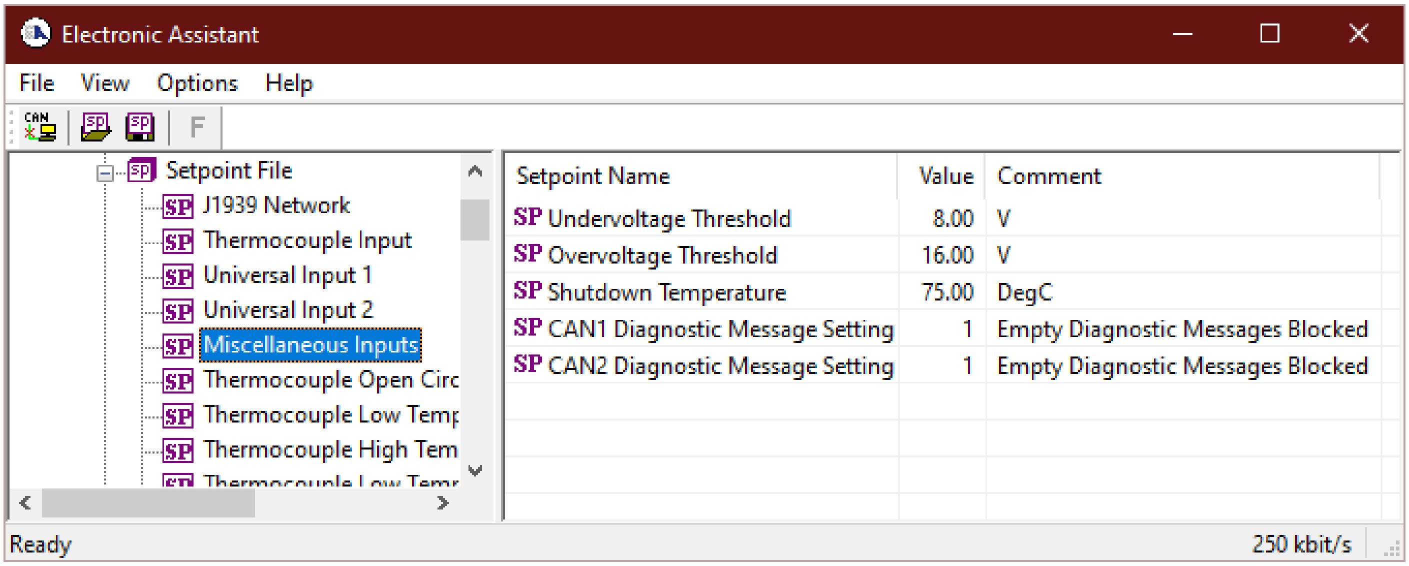


Figure 7: Screen Capture of Default Miscellaneous Setpoints

Name	Range	Default	Notes
Undervoltage Threshold	6.0…36.0	8.0	Units in [Volts]
Overvoltage Threshold	6.0…36.0	24.0	Units in [Volts]
Shutdown Temperature	40…125	85	Units in [Celsius]
Voltage Hysteresis	0.0…2.0	0.5	Units in [Volts]
Current Hysteresis	0.0…2.0	0.25	Units in [Amps]
Diagnostic Message Setting	Drop List	Diagnostics On	

Table 23: Default Miscellaneous Setpoints

3.5. Diagnostic Setpoints

The Diagnostic setpoints are defined in Section 1.7. Refer to that subsection for detailed information on how these setpoints are used. The screen capture below in Figure 8 displays the available setpoints for the Power Supply Diagnostic setpoints. Table 24 below highlights the allowable ranges for each setpoint.

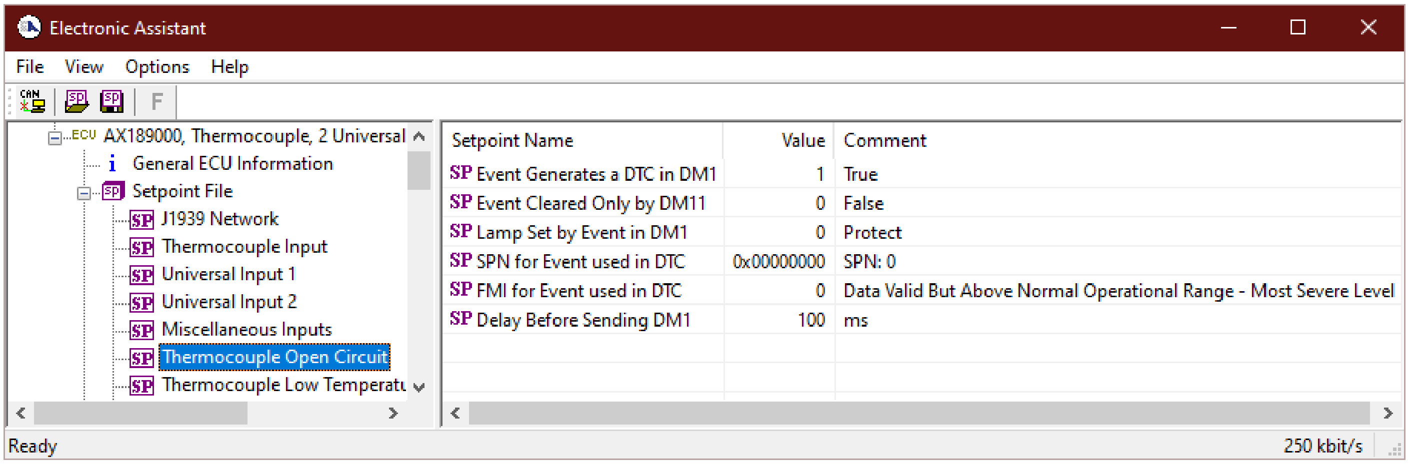


Figure 8: Screen Capture of Default Diagnostic Setpoints

Name	Range	Default	Notes
Event Generates a DTC in DM1	Drop List	False	Default changed to *True* for illustration purposes, Refer to Section 1.7
Event Cleared Only by DM11	Drop List	False	Refer to Section 1.7
Lamp Set by Event in DM1	Drop List	Amber, Warning	Refer to Section 1.7
SPN for Event used in DTC	0...524,287	520704	Refer to Section 1.7
FMI for Event used in DTC	Drop List	Voltage Below Normal, Or Shorted to Low Source	Refer to Table 11
Delay Before Sending DM1	0…84,600,000	1000	Units in [milliseconds]
Delay Before Clearing DM1	0…84,600,000	0	If digital output OFF after this time, a DTC will not be sent on a DM1 message anymore.

Table 24: Default Diagnostic Setpoints

3.6. Constant Data List Setpoints

The Constant Data List function block is provided to allow the user to select values as desired for various logic block functions. The four constants are fully user configurable to any value between +/- 1,000,000. The default values are displayed in the screen capture below.

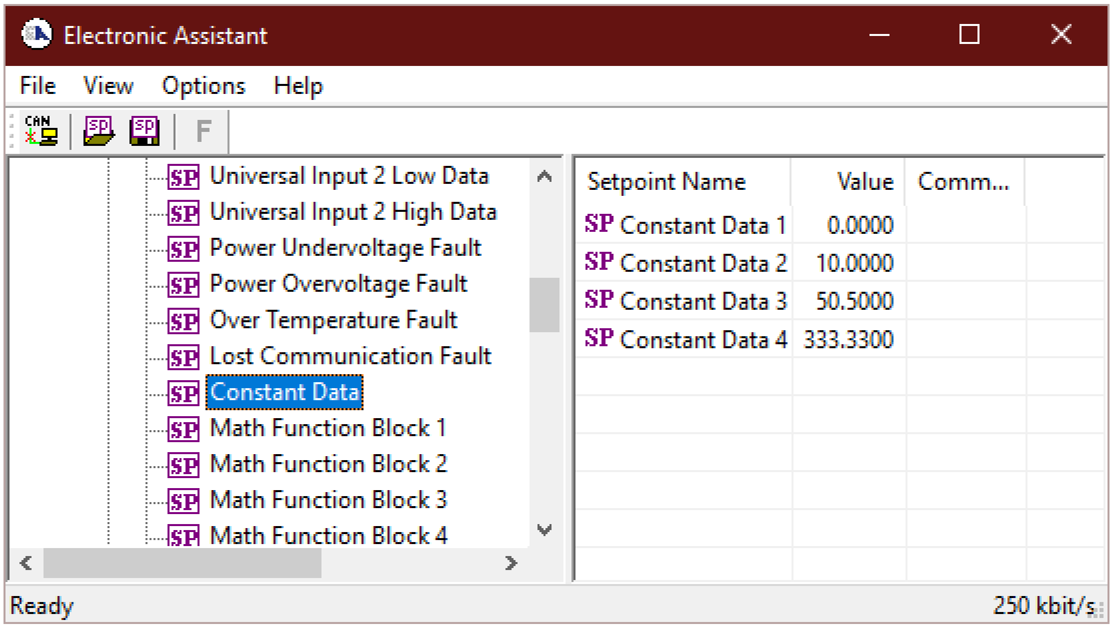


Figure 9: Screen Capture of Constant Data Setpoints

3.7. Math Functional Block Setpoints

The Math Functional Block setpoints are defined in Section 1.9. Refer to that section for detailed information on how these setpoints are used. The screen capture in Figure 10 displays the available setpoints for each of the Math Blocks. The table below the screen capture highlights the allowable ranges for each setpoint.

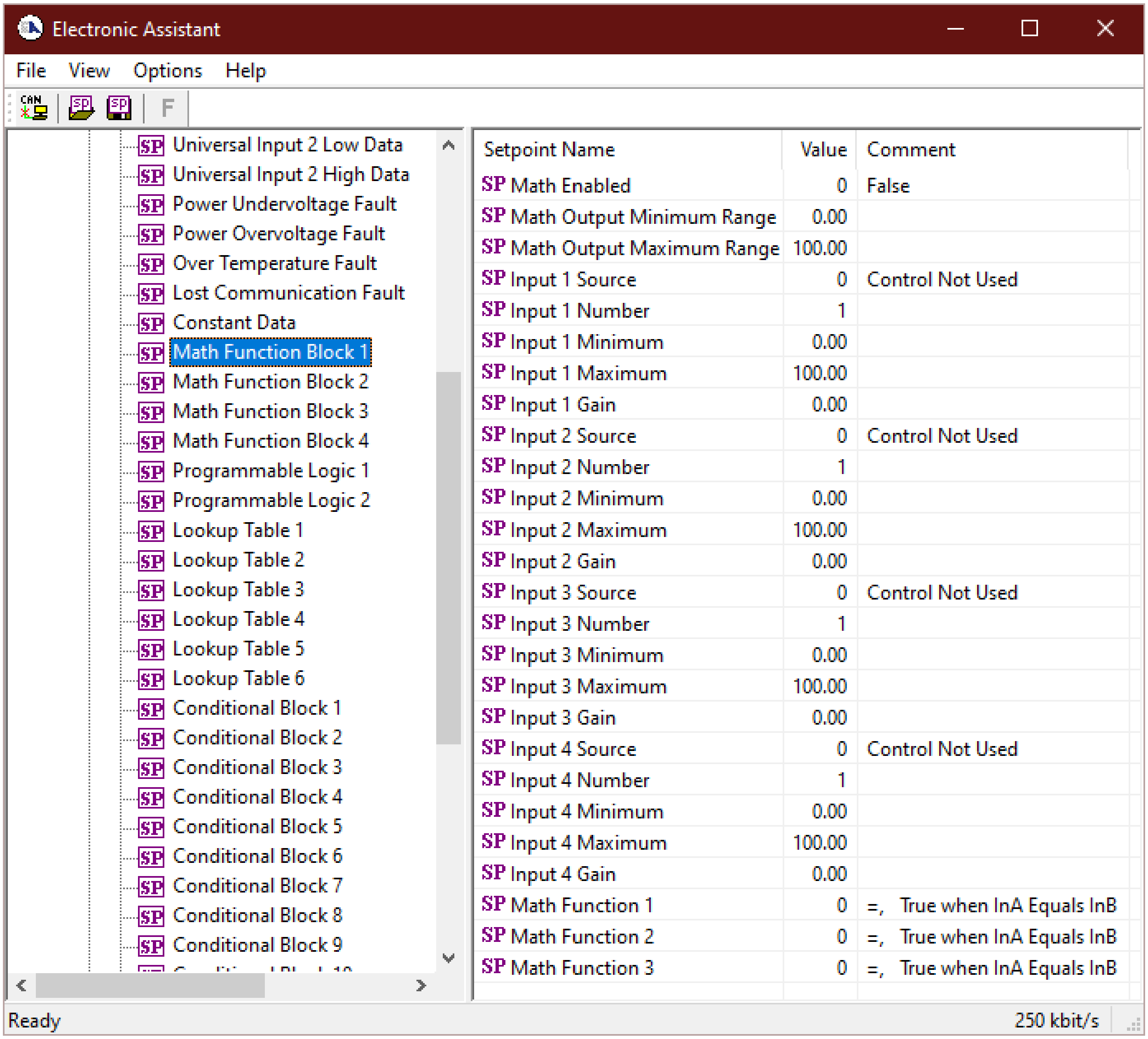


Figure 10: Screen Capture of Math Functional Block Setpoints

Name	**Range**	**Default**	**Notes**
Math Enabled	Drop List	False	
Math Output Minimum Range	-32768…32767	0	
Math Output Maximum Range	-32768…32767	100.0	
Input 1 Source	Drop List	Control not used	Refer to Table 1
Input 1 Number	Depends on control source	1	Refer to Table 1
Input 1 Minimum	$-10^{6}…10^{6}$	0.00	
Input 1 Maximum	$-10^{6}…10^{6}$	10000.00	
Input 1 Gain	-100…100	100	
Input 2 Source	Drop List	Control not used	Refer to Table 1
Input 2 Number	Depends on control source	1	Refer to Table 1
Input 2 Minimum	$-10^{6}…10^{6}$	0.00	
Input 2 Maximum	$-10^{6}…10^{6}$	10000.00	
Input 2 Gain	-100…100	100	
Input 3 Source	Drop List	Control not used	Refer to Table 1

Input 3 Number	Depends on control source	1	Refer to Table 1
Input 3 Minimum	$-10^6 \ldots 10^6$	0.00	
Input 3 Maximum	$-10^6 \ldots 10^6$	10000.00	
Input 3 Gain	-100…100	100	
Input 4 Source	Drop List	Control not used	Refer to Table 1
Input 4 Number	Depends on control source	1	Refer to Table 1
Input 4 Minimum	$-10^6 \ldots 10^6$	0.00	
Input 4 Maximum	$-10^6 \ldots 10^6$	10000.00	
Input 4 Gain	-100…100	100	
Math Function 1	Drop List	=, True When InA Equals InB	See Table 12
Math Function 2	Drop List	=, True When InA Equals InB	See Table 12
Math Function 3	Drop List	=, True When InA Equals InB	See Table 12

Table 25: Default Math Functional Block Setpoints

3.8. Programmable Logic Block Setpoints

The Programmable Logic Block setpoints are defined in Section 1.10. Refer to that section for detailed information on how these setpoints are used. The screen capture in Figure 11 displays the available setpoints for each of the Programmable Logic Blocks. The table below the screen capture highlights the allowable ranges for each setpoint.

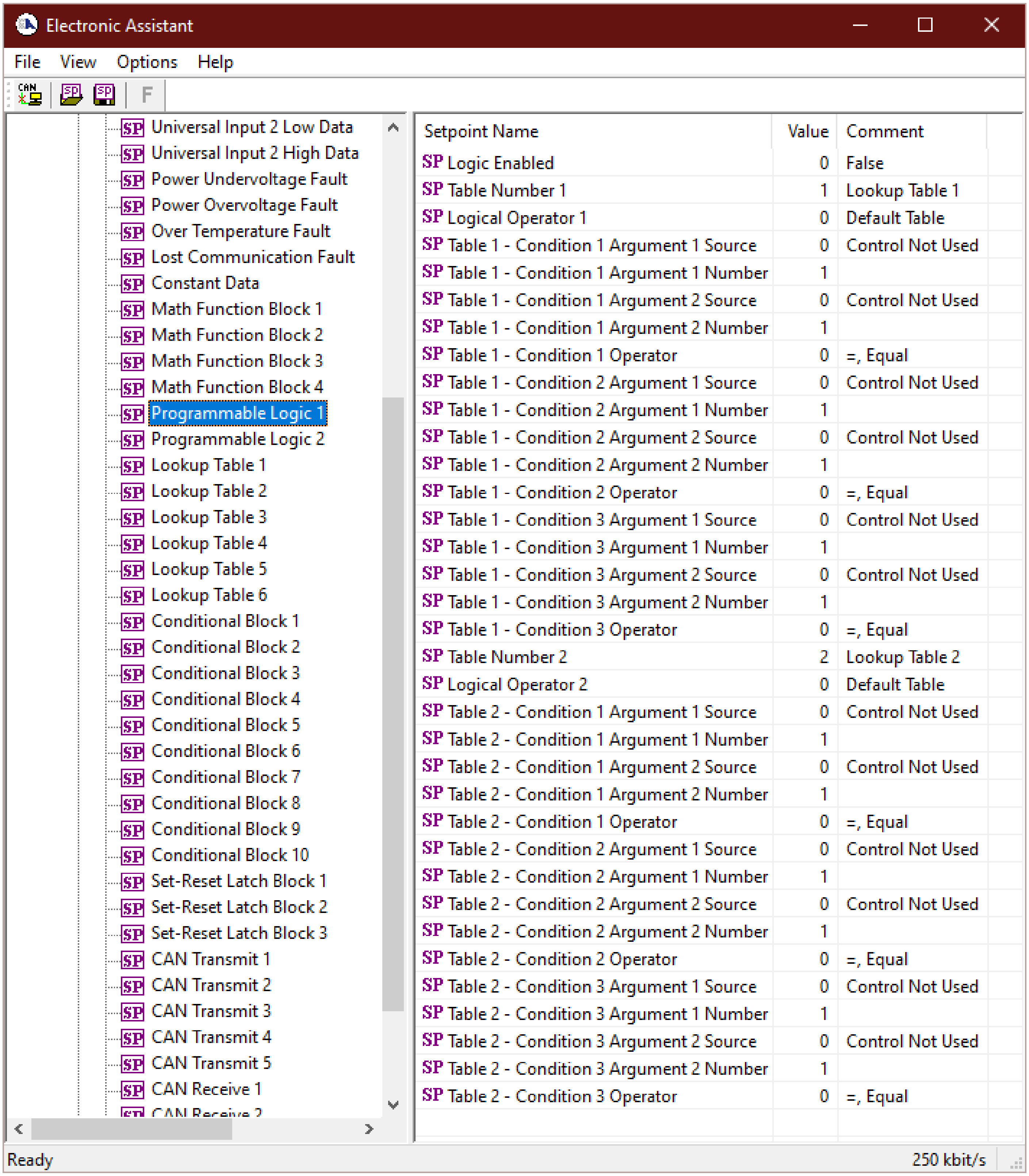


Figure 11: Screen Capture of Programmable Logic Block Setpoints

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 14

Table 1 - Condition 1 Argument 1 Source	Drop List	Control Not Used	Refer to Table 1
Table 1 - Condition 1 Argument 1 Number	Depends on control source	1	Refer to Table 1
Table 1 - Condition 1 Argument 2 Source	Drop List	Control Not Used	Refer to Table 1
Table 1 - Condition 1 Argument 2 Number	Depends on control source	1	Refer to Table 1
Table 1 - Condition 1 Operator	Drop List	=, Equal	See Table 13
Table 1 - Condition 2 Argument 1 Source	Drop List	Control Not Used	Refer to Table 1
Table 1 - Condition 2 Argument 1 Number	Depends on control source	1	Refer to Table 1
Table 1 - Condition 2 Argument 2 Source	Drop List	Control Not Used	Refer to Table 1
Table 1 - Condition 2 Argument 2 Number	Depends on control source	1	Refer to Table 1
Table 1 - Condition 2 Operator	Drop List	=, Equal	See Table 13
Table 1 - Condition 3 Argument 1 Source	Drop List	Control Not Used	Refer to Table 1
Table 1 - Condition 3 Argument 1 Number	Depends on control source	1	Refer to Table 1
Table 1 - Condition 3 Argument 2 Source	Drop List	Control Not Used	Refer to Table 1
Table 1 - Condition 3 Argument 2 Number	Depends on control source	1	Refer to Table 1
Table 1 - Condition 3 Operator	Drop List	=, Equal	See Table 13

Table 26: Default Programmable Logic Block Setpoints

3.9. Lookup Table Setpoints

The Lookup Table Block setpoints are defined in Section 1.11. Refer to that section for detailed information on how these setpoints are used. The screen capture in Figure 12 displays the available setpoints for each of the Lookup Table Setpoints. The table below the screen capture highlights the allowable ranges for each setpoint.

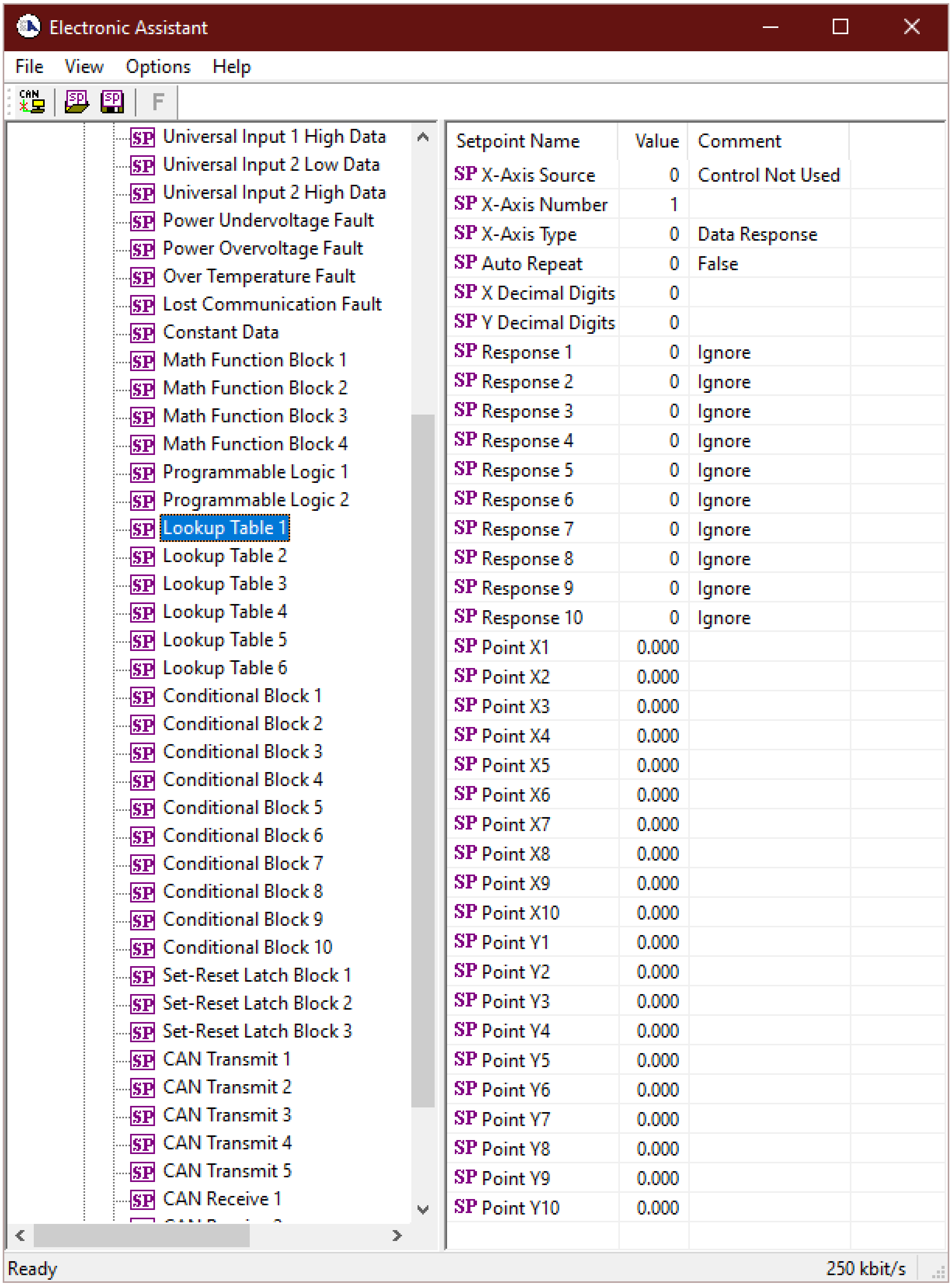


Figure 12: Screen Capture of Lookup Table Setpoints

Name	Range	Default	Notes
X-Axis Source	Drop List	Control Not Used	Refer to Table 1
X-Axis Number	Depends on control source	1	Refer to Table 1

X-Axis Type	Drop List	Data Response	See Table 15
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 16
Response 2	Drop List	Ramp To	See Table 16
Response 3	Drop List	Ramp To	See Table 16
Response 4	Drop List	Ramp To	See Table 16
Response 5	Drop List	Ramp To	See Table 16
Response 6	Drop List	Ramp To	See Table 16
Response 7	Drop List	Ramp To	See Table 16
Response 8	Drop List	Ramp To	See Table 16
Response 9	Drop List	Ramp To	See Table 16
Response 10	Drop List	Ramp To	See Table 16
Point X1	From X-Axis source minimum to Point 1 - X Value	X-Axis source minimum Depends on the Table number	See Section 1.11
Point X2	From Point 0 - X Value to Point 2 - X Value	Depends on the Table number	See Section 1.11
Point X3	From Point 1 - X Value to Point 3 - X Value	Depends on the Table number	See Section 1.11
Point X4	From Point 2 - X Value to Point 4 - X Value	Depends on the Table number	See Section 1.11
Point X5	From Point 3 - X Value to Point 5 - X Value source	Depends on the Table number	See Section 1.11
Point X6	From Point 4 - X Value to Point 6 - X Value	Depends on the Table number	See Section 1.11
Point X7	From Point 5 - X Value to Point 7 - X Value	Depends on the Table number	See Section 1.11
Point X8	From Point 6 - X Value to Point 8 - X Value	Depends on the Table number	See Section 1.11
Point X9	From Point 7 - X Value to Point 9 - X Value	Depends on the Table number	See Section 1.11
Point X10	From Point 8 - X Value to Point 10 - X Value	Depends on the Table number	See Section 1.11
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 27: Default Lookup Table Setpoints

3.10. Conditional Block Setpoints

The Conditional Block setpoints are defined in Section 1.12. Refer to that section for detailed information on how these setpoints are used. The screen capture in Figure 13 displays the available setpoints for each of the Conditional Blocks. The table below the screen capture highlights the allowable ranges for each setpoint.

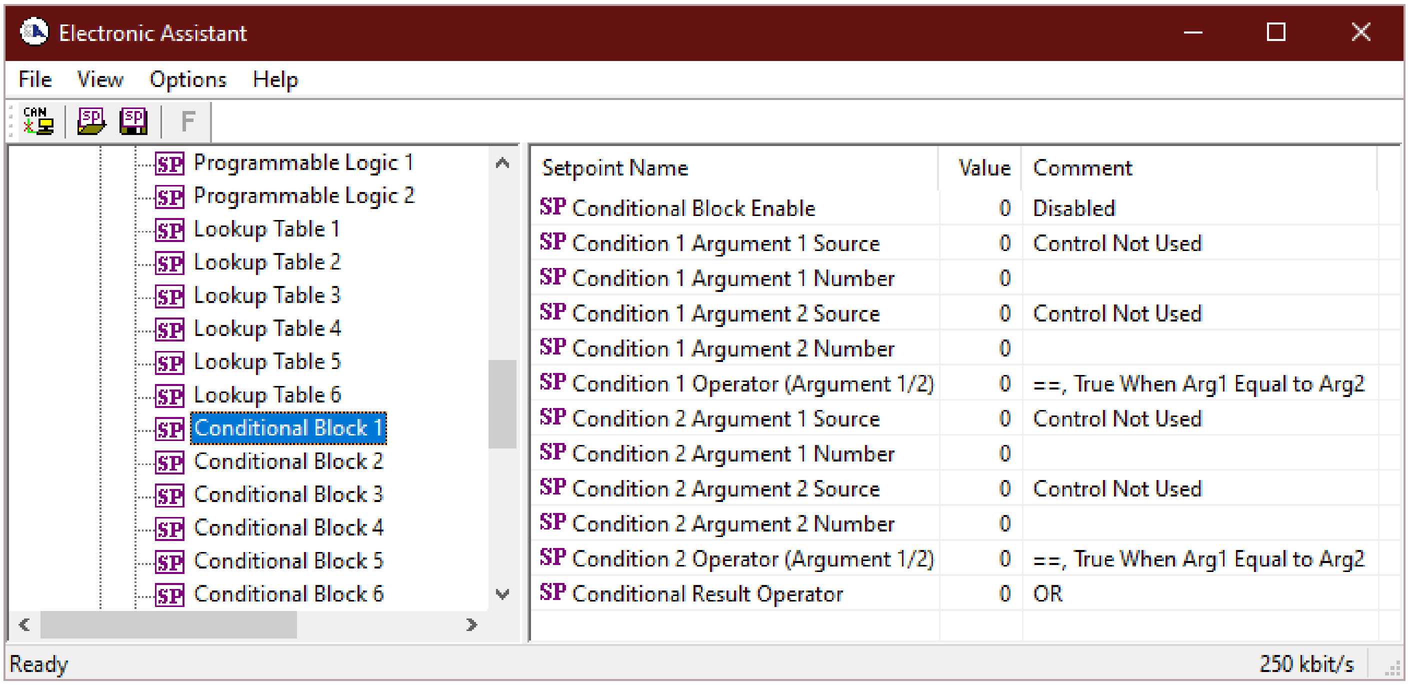


Figure 13: Screen Capture of Conditional Block Setpoints

Name	Range	Default	Notes
Conditional Function Enabled	Drop List	Disabled	
Condition 1 Argument 1 Source	Drop List	Digital Input	Refer to Table 1
Condition 1 Argument 1 Number	Depends on Source Selected	0	Refer to Table 1
Condition 1 Argument 2 Source	Drop List	Digital Input	Refer to Table 1
Condition 1 Argument 2 Number	Depends on Source Selected	0	Refer to Table 1
Condition 1 Operator (Argument 1/2)	Drop List	0	Refer to Table 17
Condition 2 Argument 1 Source	Drop List	Digital Input	Refer to Table 1
Condition 2 Argument 1 Number	Depends on Source Selected	0	Refer to Table 1
Condition 2 Argument 2 Source	Drop List	Digital Input	Refer to Table 1
Condition 2 Argument 2 Number	Depends on Source Selected	0	Refer to Table 1
Condition 2 Operator (Argument 1/2)	Drop List	0	Refer to Table 17
Conditional Result Operator	Drop List	OR	Refer to Table 18

Table 28: Default Conditional Block Setpoints

3.11. Set-Reset Latch Block

The Set-Reset Latch Block setpoints are defined in Section 1.13. Refer to that section for detailed information on how these setpoints are used. The screen capture in Figure 14 displays the available setpoints for each of the Set-Reset Latch Blocks. The table below the screen capture highlights the allowable ranges for each setpoint.

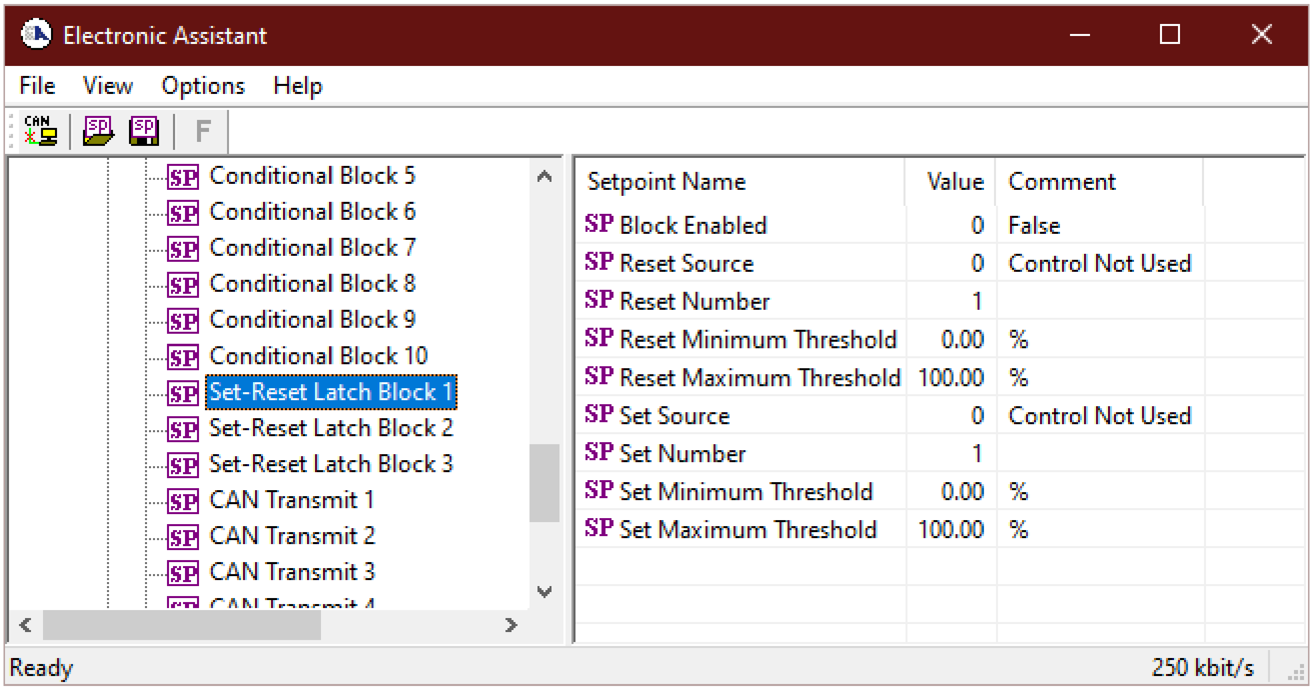


Figure 14: Screen Capture of Set-Reset Latch Block Setpoints

Name	Range	Default	Notes
Block Enabled	Drop List	False	
Reset Source	Drop List	Control Not Used	Refer to Table 1
Reset Number	Depends on Source Selected	1	Refer to Table 1
Reset Minimum Threshold	Drop List	0%	Refer to Section 1.13
Reset Maximum Threshold	Depends on Source Selected	100%	Refer to Section 1.13
Set Source	Drop List	Control Not Used	Refer to Table 1
Set Number	Drop List	1	Refer to Table 1
Set Minimum Threshold	Depends on Source Selected	0%	Refer to Section 1.13
Set Maximum Threshold	Drop List	100%	Refer to Section 1.13

Table 29: Default Set-Reset Latch Block Setpoints

3.12. CAN Transmit Setpoints

The CAN Transmit setpoints are defined in Section 1.14. Refer to that section for detailed information on how these setpoints are used. The screen capture below in Figure 15 displays the available setpoints for the CAN Transmit setpoints. Table 30 below highlights the allowable ranges for the first CAN Transmit setpoint.

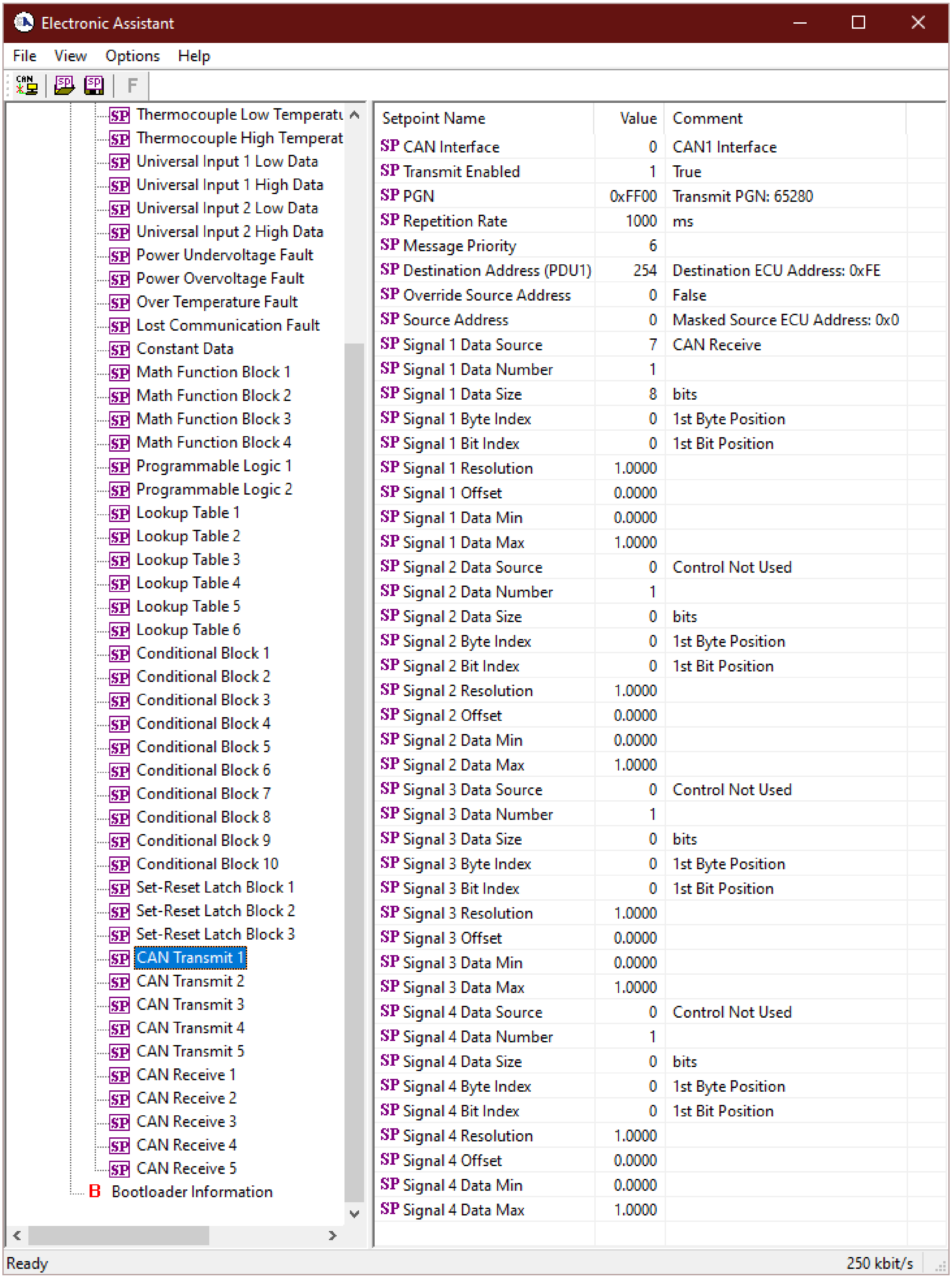

Electronic Assistant
File View Options Help
Thermocouple Low Temperatu
Thermocouple High Temperat
Universal Input 1 Low Data
Universal Input 1 High Data
Universal Input 2 Low Data
Universal Input 2 High Data
Power Undervoltage Fault
Power Overvoltage Fault
Over Temperature Fault
Lost Communication Fault
Constant Data
Math Function Block 1
Math Function Block 2
Math Function Block 3
Math Function Block 4
Programmable Logic 1
Programmable Logic 2
Lookup Table 1
Lookup Table 2
Lookup Table 3
Lookup Table 4
Lookup Table 5
Lookup Table 6
Conditional Block 1
Conditional Block 2
Conditional Block 3
Conditional Block 4
Conditional Block 5
Conditional Block 6
Conditional Block 7
Conditional Block 8
Conditional Block 9
Conditional Block 10
Set-Reset Latch Block 1
Set-Reset Latch Block 2
Set-Reset Latch Block 3
CAN Transmit 1
CAN Transmit 2
CAN Transmit 3
CAN Transmit 4
CAN Transmit 5
CAN Receive 1
CAN Receive 2
CAN Receive 3
CAN Receive 4
CAN Receive 5
Bootloader Information
Setpoint Name | Value | Comment
CAN Interface | 0 | CAN1 Interface
Transmit Enabled | 1 | True
PGN | 0xFF00 | Transmit PGN: 65280
Repetition Rate | 1000 | ms
Message Priority | 6
Destination Address (PDU1) | 254 | Destination ECU Address: 0xFE
Override Source Address | 0 | False
Source Address | 0 | Masked Source ECU Address: 0x0
Signal 1 Data Source | 7 | CAN Receive
Signal 1 Data Number | 1
Signal 1 Data Size | 8 | bits
Signal 1 Byte Index | 0 | 1st Byte Position
Signal 1 Bit Index | 0 | 1st Bit Position
Signal 1 Resolution | 1.0000
Signal 1 Offset | 0.0000
Signal 1 Data Min | 0.0000
Signal 1 Data Max | 1.0000
Signal 2 Data Source | 0 | Control Not Used
Signal 2 Data Number | 1
Signal 2 Data Size | 0 | bits
Signal 2 Byte Index | 0 | 1st Byte Position
Signal 2 Bit Index | 0 | 1st Bit Position
Signal 2 Resolution | 1.0000
Signal 2 Offset | 0.0000
Signal 2 Data Min | 0.0000
Signal 2 Data Max | 1.0000
Signal 3 Data Source | 0 | Control Not Used
Signal 3 Data Number | 1
Signal 3 Data Size | 0 | bits
Signal 3 Byte Index | 0 | 1st Byte Position
Signal 3 Bit Index | 0 | 1st Bit Position
Signal 3 Resolution | 1.0000
Signal 3 Offset | 0.0000
Signal 3 Data Min | 0.0000
Signal 3 Data Max | 1.0000
Signal 4 Data Source | 0 | Control Not Used
Signal 4 Data Number | 1
Signal 4 Data Size | 0 | bits
Signal 4 Byte Index | 0 | 1st Byte Position
Signal 4 Bit Index | 0 | 1st Bit Position
Signal 4 Resolution | 1.0000
Signal 4 Offset | 0.0000
Signal 4 Data Min | 0.0000
Signal 4 Data Max | 1.0000
Ready
250 kbit/s

Figure 15: Screen Capture of Default CAN Transmit Setpoints

Name	Range	Default	Notes
PGN	0…65,535	65,280	Refer to Section 1.14
Repetition Rate	0…60,000	1000	Refer to Section 1.14
Message Priority	0...7	6	Refer to Section 1.14
Destination Address (PDU1)	0...255	254	Refer to Section 1.14
Data Source	Drop List	CAN Status Report	Refer to Table 1
Data Number	Depends on Source Selected	1	Refer to Table 1
Data Size	0…32	0 bits	Refer to Section 1.14
Pos Byte	Depends on Source Selected	0	Refer to Section 1.14
Pos Bit	Depends on Source Selected	65,280	Refer to Section 1.14
Resolution	-100,000...100,000	1	Refer to Section 1.14
Offset	-100,000...100,000	0	Refer to Section 1.14

Table 30: Default CAN Transmit Setpoints

3.13. CAN Receive Setpoints

The CAN Receive setpoints are defined in Section 1.15. Refer to that section for detailed information on how these setpoints are used. The screen capture below in Figure 16 displays the available setpoints for the CAN Receive setpoints. Table 31 below highlights the allowable ranges for each setpoint.

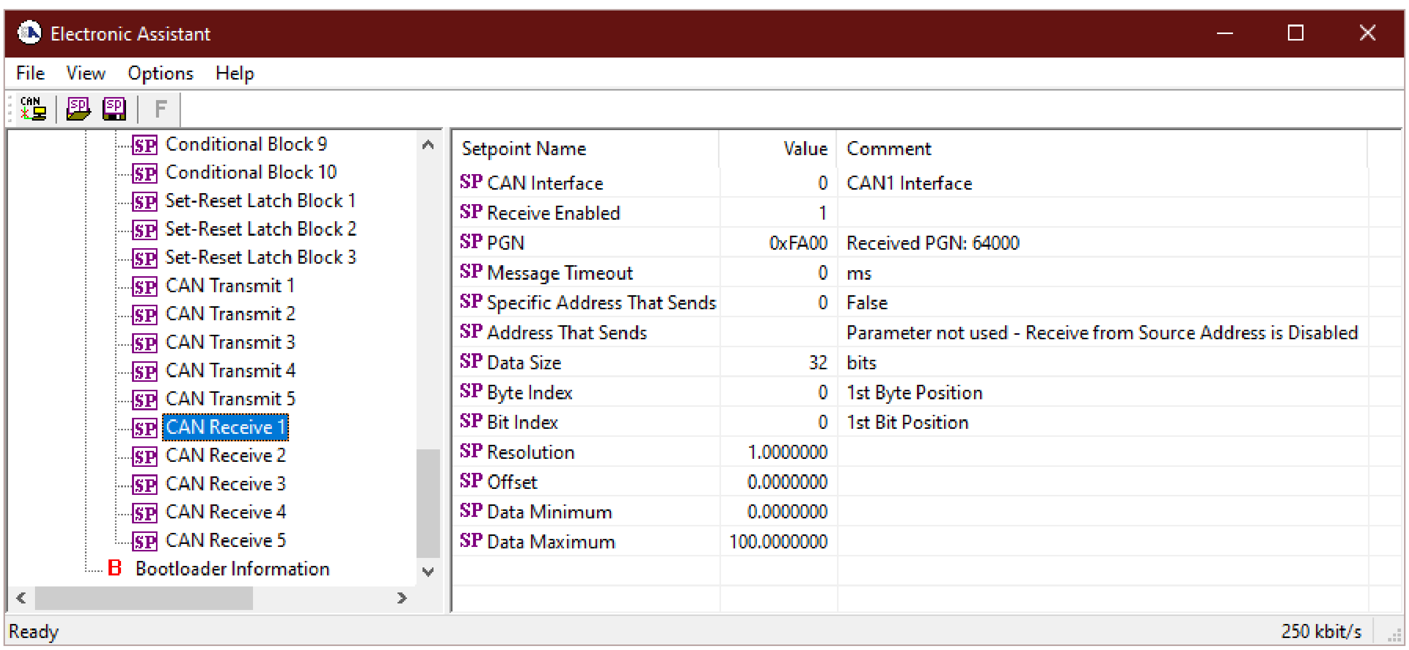


Figure 16: Screen Capture of Default CAN Receive Setpoints

Name	Range	Default	Notes
Message Enabled	Drop List	False	Default changed to *True* for illustration purposes. Refer to Section 1.15
PGN	0…65,535	65280	Refer to Section 1.15
Message Timeout	0...60,000	3000	Refer to Section 1.15

Data Size	0…32	0 bits	Refer to Section 1.15
Pos Byte	0…7	0	Refer to Section 1.15
Pos Bit	0…7	0	Refer to Section 1.15
Resolution	-0xFFFFFFFF…0xFFFFFFFF	1.0	Refer to Section 1.15
Offset	-0xFFFFFFFF…0xFFFFFFFF	0.0	Refer to Section 1.15
Data Minimum	-0xFFFFFFFF…Data Max	0.0	Refer to Section 1.15
Data Maximum	Data Min…0xFFFFFFFF	1.0	Refer to Section 1.15

Table 31: Default CAN Receive Setpoints

4. Reflashing over CAN with the Axiomatic Electronic Assistant Bootloader

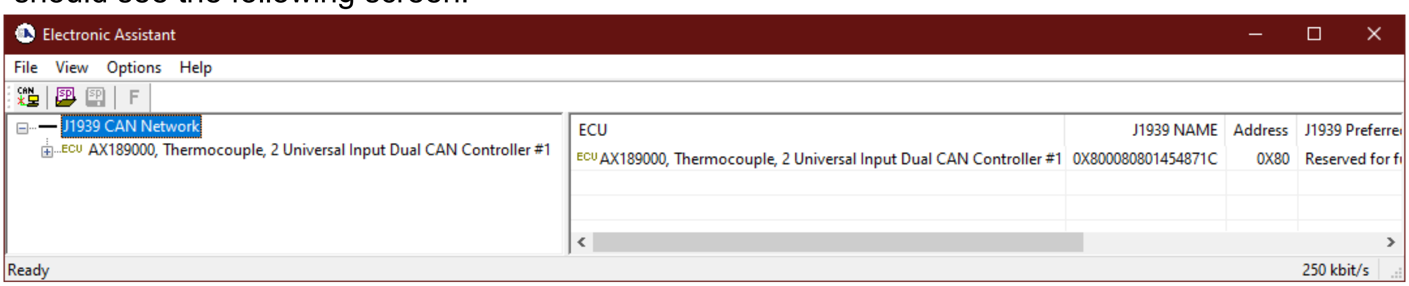
This chapter describes a procedure of re-programming an application firmware in CANJ1939 in the field.

4.1. Prerequisites

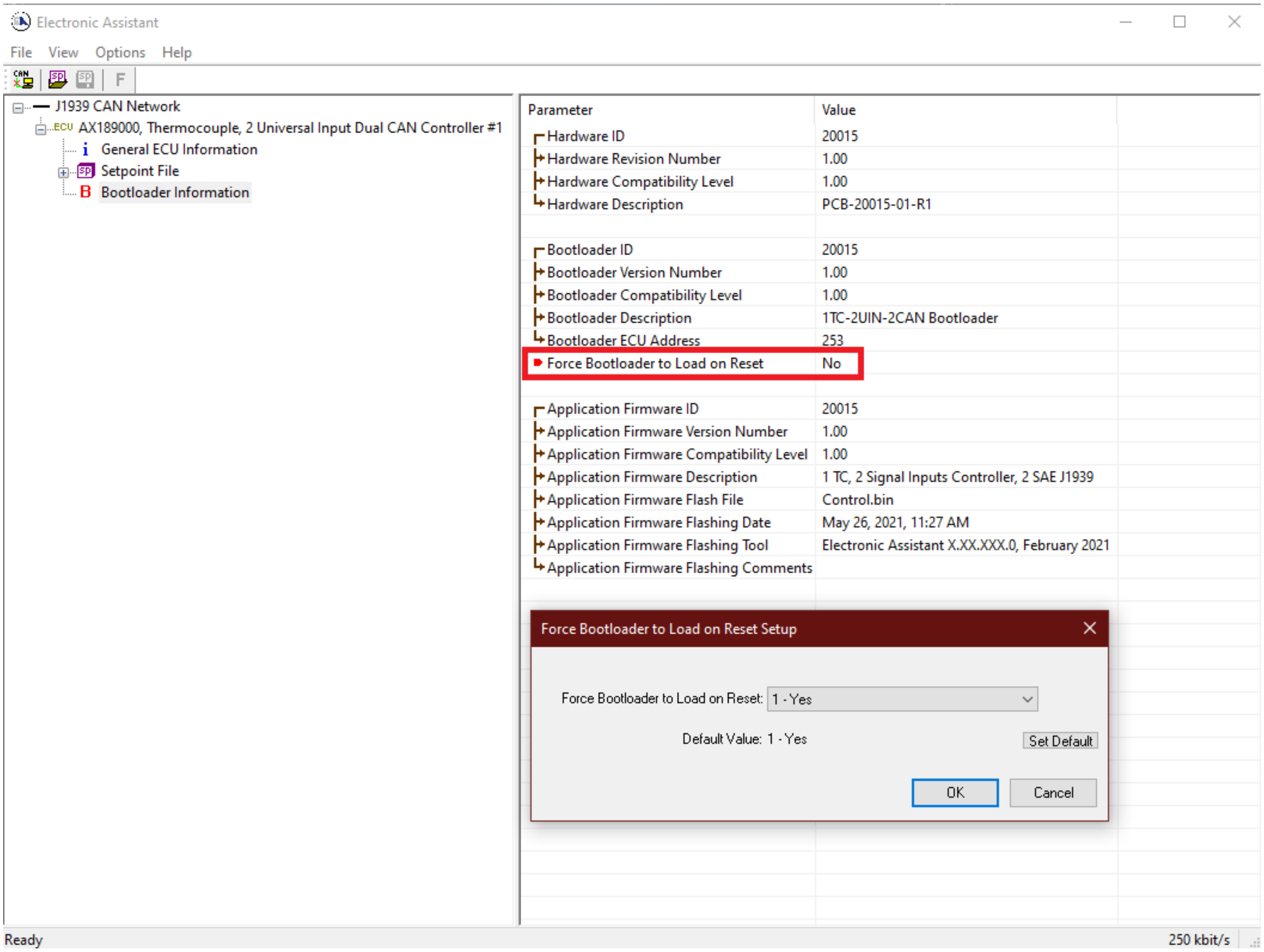
- A personal computer with a USB port running Windows operating system.
- A flash file for 1TC-2UIN-2CAN. It should have the following name: AF-20015-x.xx.bin, where x.xx – firmware version number, and sss are file comments information purposes.
- Axiomatic Electronic Assistant (EA) software, P/N: AX070500.
- Axiomatic CAN Assistant – Scope software, P/N: AX070501SCO.
- Axiomatic USB-CAN Converter, P/N: AX070501. It should be connected to the USB port of the personal computer.
- Power supply to power the controllers.
- Wire harness to connect the controllers to the power supply and to the CAN port of the Axiomatic USB-CAN converter with proper termination resistance.

4.2. Re-flashing Procedure

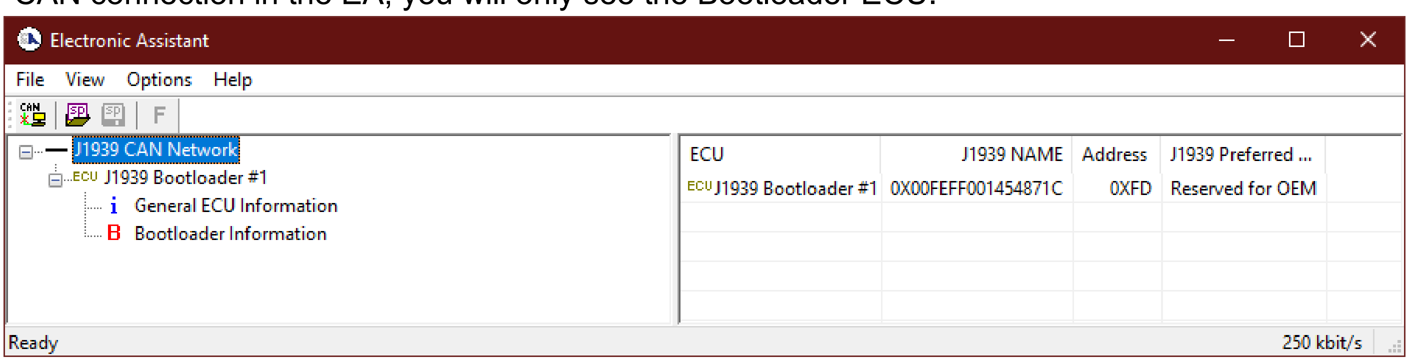
1. Connect the ECU to the power supply and Axiomatic USB-CAN converter.
2. Open CAN port and start monitoring the CAN bus in CAN Assistant – Scope.
3. Power-up the controller.
4. Run the Axiomatic Electronic Assistant (EA) software and connect to the CAN port. The user should see the following screen:



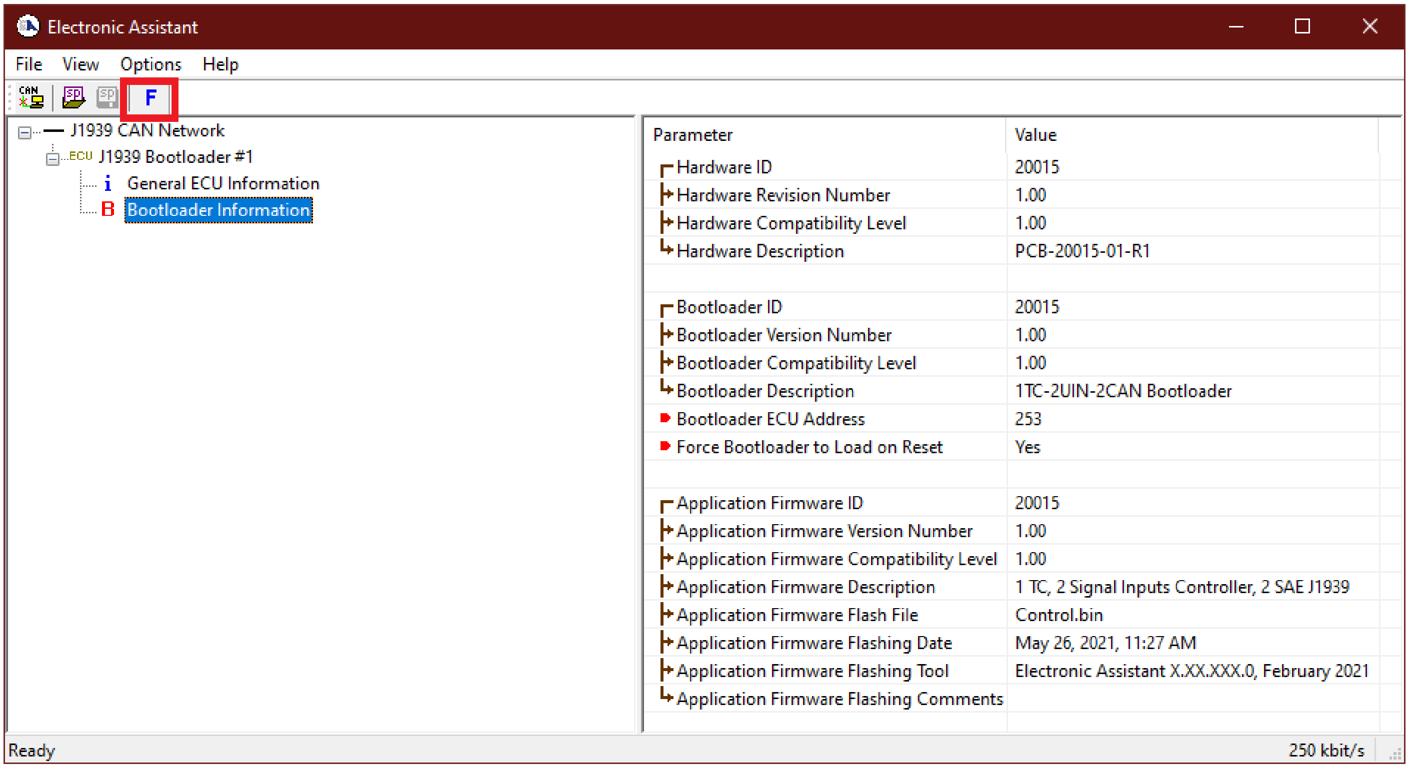
5. Click on *Bootloader Information* group in the left panel and then double click on *Force Bootloader to Load on Reset* and another window pops up. Select *OK* to switch to Bootloader Mode.



6. Cycle the power on to run the unit in Bootloader Mode. If you disconnect and reconnect the CAN connection in the EA, you will only see the Bootloader ECU.

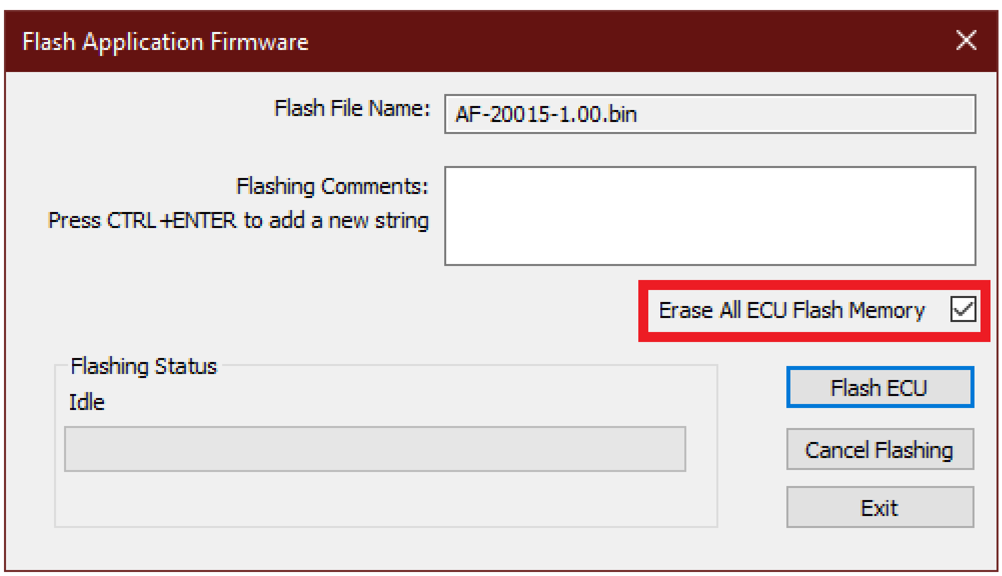


7. Click on the *Bootloader Information* group again and then on the ***F*** button in the Axiomatic EA toolbar. Select the flash file:

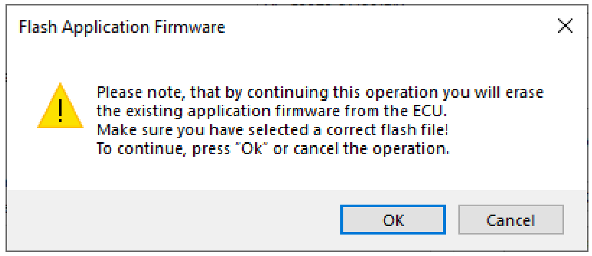


8. Open the flash file and start flashing operation by pressing the *Flash ECU* button. Make sure *Erase All ECU Flash Memory* is checked.

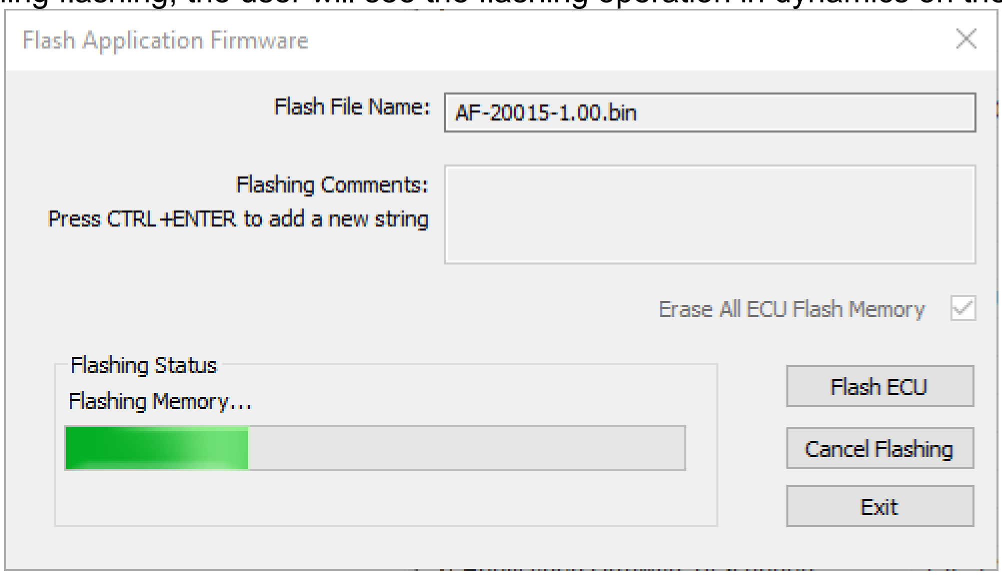
   Optionally, the user can write their comments in the *Flashing Comments* field.



9. Confirm the warning message from the EA.

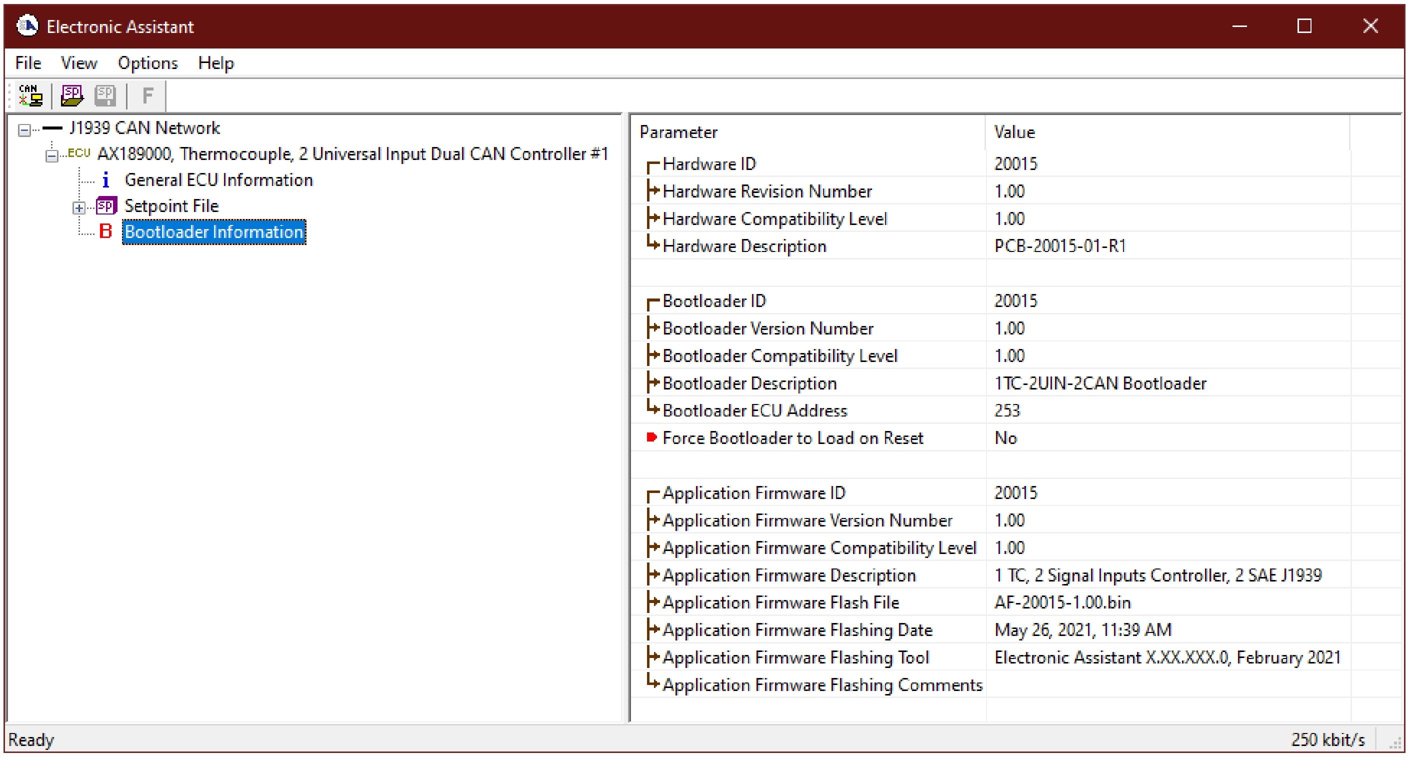


After confirming flashing, the user will see the flashing operation in dynamics on the EA screen.

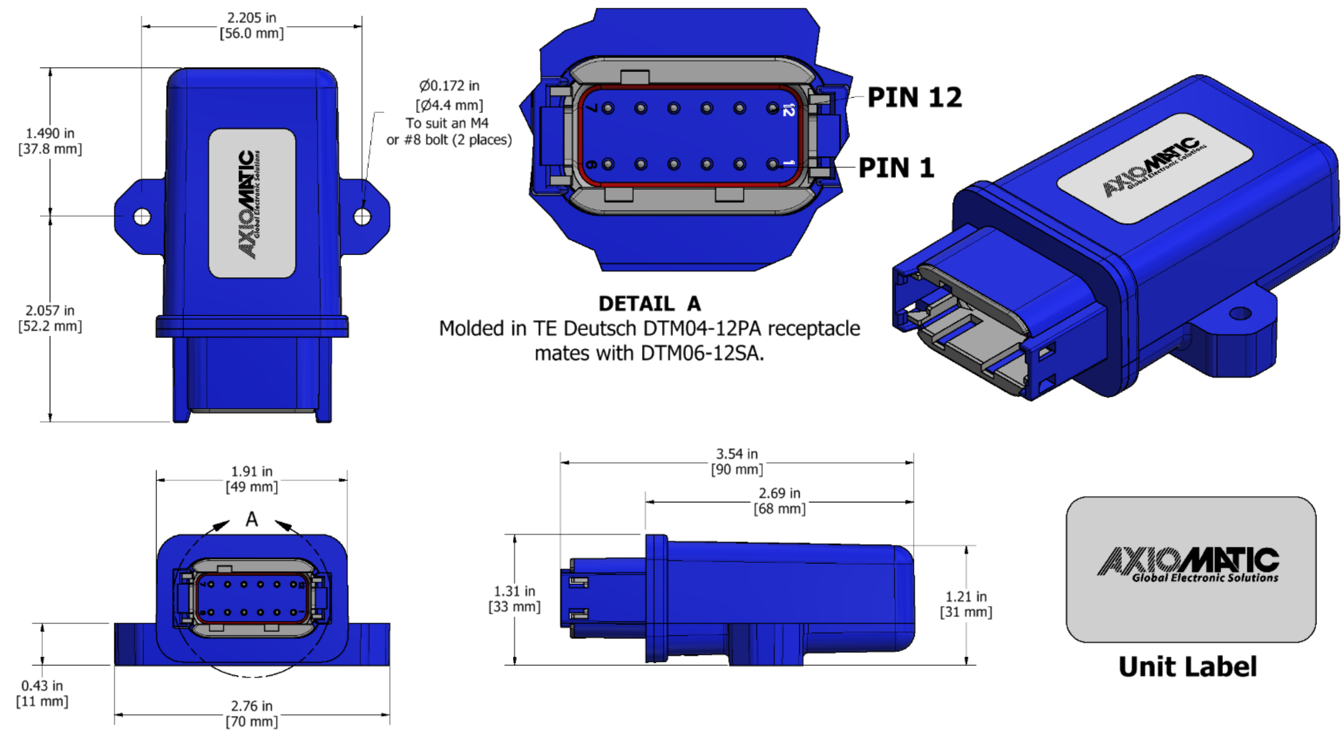


10. When flashing is done, reset the ECU and disconnect and reconnect the CAN connection.

The new firmware version should now be running on the unit, which can be reviewed by selecting Bootloader Information. The user can check the field *Application Firmware Flash File* to make sure that the uploaded firmware version is running on the unit.


Electronic Assistant
File View Options Help
J1939 CAN Network
AX189000, Thermocouple, 2 Universal Input Dual CAN Controller #1
General ECU Information
Setpoint File
Bootloader Information
Parameter
Value
Hardware ID
20015
Hardware Revision Number
1.00
Hardware Compatibility Level
1.00
Hardware Description
PCB-20015-01-R1
Bootloader ID
20015
Bootloader Version Number
1.00
Bootloader Compatibility Level
1.00
Bootloader Description
1TC-2UIN-2CAN Bootloader
Bootloader ECU Address
253
Force Bootloader to Load on Reset
No
Application Firmware ID
20015
Application Firmware Version Number
1.00
Application Firmware Compatibility Level
1.00
Application Firmware Description
1 TC, 2 Signal Inputs Controller, 2 SAE J1939
Application Firmware Flash File
AF-20015-1.00.bin
Application Firmware Flashing Date
May 26, 2021, 11:39 AM
Application Firmware Flashing Tool
Electronic Assistant X.XX.XXX.0, February 2021
Application Firmware Flashing Comments
Ready
250 kbit/s

5. INSTALLATION INSTRUCTIONS



<table>
<tr><td>Enclosure and Dimensions</td><td>Molded Enclosure, integral connector
Nylon 6/6, 30% glass
Ultrasonically welded
3.54 x 2.75 x 1.31 inches (90.09 x 70.00 x 33.35 mm)
L x W x H including integral connector
Refer to the dimensional drawing.</td></tr>
<tr><td>Electrical Connections</td><td>Integral 12-pin receptacle (equivalent TE Deutsch P/N: DTM04-12PA)

<table>
<tr><th>PIN #</th><th>FUNCTION</th></tr>
<tr><td>1</td><td>Universal Input 1 GND</td></tr>
<tr><td>2</td><td>Universal Input 1</td></tr>
<tr><td>3</td><td>Universal Input 2</td></tr>
<tr><td>4</td><td>Universal Input 2 GND</td></tr>
<tr><td>5</td><td>TC Input</td></tr>
<tr><td>6</td><td>TC Input Return</td></tr>
<tr><td>7</td><td>CAN 2_L</td></tr>
<tr><td>8</td><td>CAN 2_H</td></tr>
<tr><td>9</td><td>CAN 1_L</td></tr>
<tr><td>10</td><td>CAN 1_H</td></tr>
<tr><td>11</td><td>Power -</td></tr>
<tr><td>12</td><td>Power +</td></tr>
</table>
</td></tr>
</table>

6. 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/.

Power Supply:

Power Supply Input	12V, 24V or 48Vdc nominal (9…60Vdc power supply range)
Surge and Transients	Surge and transient protection up to 120 V is provided.
Reverse Polarity	Reverse polarity protection is provided up to 100V.
Under-voltage	Under-voltage protection is provided. Hardware shuts down at 5V.
Over-voltage	Over-voltage protection is provided. Hardware shuts down at 62 V.

Input Specifications

Universal Inputs	2 Universal Signal Inputs configurable as: Voltage, Current, PWM, Digital or Resistive (for Input 1 only)
TC Input	One (1) Type J, K, B, E, N, R, S or T The device reads mV signals from the supported Thermocouples. B = 0 to 13.82 mV E = -9.835 to 76.373 mV J = -8.095 to 69.553 mV K = -6.458 to 54.886 mV N = -4.345 to 47.513 mV R = -0.226 to 21.101 mV S = -0.236 to 18.693 mV T = -6.258 to 20.872 mV (Other TC types are available on request.)
Resolution	Temperature data is measured with a resolution of 0.1 °C. When sending data to the J1939 bus, one-byte parameters have a resolution of 1°C/ bit, an offset of -40°C and a range of -40 °C to 210 °C. Two-byte parameters have resolution of 0.03125 °C / bit and a range of -273 °C to 1735 °C.
Drift	Overall drift with temperature is 50ppm/°C of span (maximum).
Accuracy	+/-1 °C throughout the entire range of the thermocouple input
Input Functionality	Temperature is measured in °C with a 0.1°C resolution. All inputs send a message to the J1939 bus. *To use the J1939 capabilities, refer to the user manual for details.*
Measurement Rate	The measurement rate is 5 scans/Sec. All channels are measured simultaneously. The update rate is 200 mSec.
Common Mode	Common mode rejection is >110 db@ 5V p-p (programmable for either 50 or 60 Hz). Common mode input range is +/- 4 V minimum.
Ground	2 analog ground connections are provided.

Parameter	Value
Universal Inputs	Two (2) Universal Signal Inputs are provided. Configurable as: Voltage, Current, PWM, Digital or Resistive (for Input 1 only)
Analog Input Modes	Voltage, Current, Resistance 12-bit Analog to Digital

<table>
<tr><th>Parameter</th><th>Value</th></tr>
<tr><td>Voltage Input</td><td>
<table>
<tr><th>Input Range</th><th>Input Impedance</th><th>Resolution</th><th>Accuracy</th></tr>
<tr><td>0…1V</td><td>>1 MOhm (High Z)[1]</td><td>1 mV</td><td>+/- 1%</td></tr>
<tr><td>0…2.5V</td><td>>1 MOhm (High Z)[1]</td><td>1 mV</td><td>+/- 1%</td></tr>
<tr><td>0…5V</td><td>204 kOhm[1]</td><td>1 mV</td><td>+/- 1%</td></tr>
<tr><td>0…10V</td><td>136 kOhm[1]</td><td>1 mV</td><td>+/- 1%</td></tr>
</table>
[1]10kOhm LoZ option is available.
</td></tr>
<tr><td>Current Input</td><td>
<table>
<tr><th>Input Range</th><th>Input Impedance</th><th>Resolution</th><th>Accuracy</th></tr>
<tr><td>0…20mA</td><td rowspan="2">124Ohm</td><td rowspan="2"><12uA</td><td rowspan="2">+/- 1%</td></tr>
<tr><td>4…20mA</td></tr>
</table>
</td></tr>
<tr><td>Resistive Input</td><td>
The Resistive Input is only available on Universal Input 1.
<table>
<tr><th>Input Range</th><th>Resolution</th><th>Accuracy</th></tr>
<tr><td>Auto Range 10…250kOhm[1,2]</td><td>–</td><td>–</td></tr>
<tr><td>30Ohm…250kOhm[2]</td><td><0.15 Ohm</td><td>+/- 2%</td></tr>
</table>
[1] Resolution and accuracy depend on the automatically selected Input Range.
[2] Resistance <10 Ohm is measured as 0.
</td></tr>
<tr><td>Analog Update Rate</td><td>1.67ms minimum[1].
[1] Depends on the analog filter settings. In resistive mode also depends on the number of resistive inputs.</td></tr>
<tr><td>Digital Input Modes</td><td>Discrete Voltage Level, Frequency, PWM Duty Cycle</td></tr>
<tr><td>Input Polarity</td><td>Active High up to 5.5V, Active Low to Ground</td></tr>
<tr><td>Input Amplitude</td><td>0V to +Vps</td></tr>
<tr><td>Input Impedance</td><td>>1MOhm – High Z, 10kOhm pull down, 10kOhm pull-up to +5.5V</td></tr>
<tr><td>Input Level</td><td>5V CMOS Compatible. A direct connection to the power supply is acceptable.</td></tr>
<tr><td>Discrete Voltage Level Input</td><td>1ms sampling rate. Configurable debouncing</td></tr>
<tr><td>Frequency Input</td><td>
<table>
<tr><th>Input Number</th><th>Counter Resolution</th><th>Frequency Range</th><th>Resolution</th><th>Accuracy</th></tr>
<tr><td rowspan="3">Universal Input #1…2</td><td rowspan="3">16-bit</td><td>100Hz…10kHz</td><td rowspan="3"><0.0015…0.15%</td><td rowspan="3">+/- 1%</td></tr>
<tr><td>10Hz…1kHz</td></tr>
<tr><td>1Hz…100Hz</td></tr>
</table>
</td></tr>
<tr><td>PWM Duty Cycle Input</td><td>
<table>
<tr><th>Input Number</th><th>Counter Resolution</th><th>Frequency Range</th><th>Resolution</th><th>Accuracy</th></tr>
<tr><td rowspan="3">Universal Input #1…2</td><td rowspan="3">16-bit</td><td>100Hz…10kHz</td><td rowspan="3"><0.0015…0.15%</td><td>+/- 1%</td></tr>
<tr><td>10Hz…1kHz</td><td>+/- 1%</td></tr>
<tr><td>1Hz…100Hz</td><td>+/- 1%</td></tr>
</table>
0…100% Duty Cycle Range. DC is included.
</td></tr>
<tr><td>Protection</td><td>+36V maximum. Forward voltage only. No reverse polarity protection. Protected against shorts to GND or +Supply</td></tr>
</table>

Control Logic:

Software Platform	Pre-programmed with standard logic. Refer to the user manual. (Application-specific control logic is available on request.)

Function Blocks	For more details on control logic, refer to the User Manual. Setpoint configuration files can be saved and used to program additional controllers.
FMI	There are four FMIs associated with the thermocouple input channel and include the following functions: High Temperature Shutdown; High Temperature Warning; Low Temperature Warning; and Thermocouple Open Circuit.
Diagnostics	The controller stores diagnostic data in a non-volatile log. There are four diagnostic log entries associated with each input channel. Each entry is a record of the SPN, FMI and OC for any fault that has occurred. There are eight setpoints associated with if and how the ECU will send diagnostic messages for each channel. For more details refer to the user manual.

General Specifications:

Microprocessor	STM32F405RG, 32-bit, 1MByte flash memory
Quiescent Current	39mA at 24V, 76mA at 12V
Isolation	Isolation of TC input channel and the CAN ports from the other inputs and power supply. 330 Vrms for the CAN port 445 Vrms for the TC input
CAN Interface	2 Isolated CAN ports (SAE J1939) (CANopen® model is AX189001) The software was designed to provide flexibility and provides the following. • Configurable ECU Instance in the NAME (for multiple ECU's on the network) • Configurable SPN for each channel • Configurable Diagnostic Messaging Parameters, as required • Diagnostic Log, maintained in non-volatile memory **Note: Configurable parameters are also called setpoints.**
Baud Rate	SAE J1939, 250kbit/s, 500kbit/s, 667kbit/s, 1Mbit/s. Automatic Baud Rate De
Protection for CAN port	CAN transceivers provide a 115 mA short circuit current limit
User Interface	Via The Axiomatic Electronic Assistant KIT, P/N: AX070502, or AX070506K The KIT includes the USB-CAN Converter, cables and EA Software. The Electronic Assistant is for *Windows* operating systems. It comes with a royalty-free license for use.
Reflashing Software over CAN	Reflash software over the CAN bus per the SAE J1939 standard using the Electronic Assistant.
Mating Plug Kit	Mates to PL-DTM06-12SA (1 DTM06-12SA, 1 WM-12S, 10 0462-201-20141, 2 0413-204-2005 Sealing Plug)
Operating Conditions	-40 to 70°C (-40 to 158°F)
Weight	0.15 lb. (0.068 kg)
Protection	IP67; Unit is conformal coated within the housing.
Vibration	MIL-STD-202G, Test 204D and 214A (Sine and Random) 10 g peak (Sine) 7.65 Grms peak (Random)
Shock	MIL-STD-202G, Test 213B 50 g
Mounting	Mounting holes are sized for #8 or M4 bolts. The bolt length will be determined by the end-user's mounting plate thickness. The mounting

	flange of the controller is 0.425 inches (10.8 mm) thick. If the module is mounted without an enclosure, it should be mounted vertically with connectors facing left or right to reduce likelihood of moisture entry. The CAN wiring is considered intrinsically safe. The power wires are not considered intrinsically safe and so in hazardous locations, they need to be located in conduit or conduit trays at all times. The module must be mounted in an enclosure in hazardous locations for this purpose. No wire or cable harness should exceed 30 meters in length. The power input wiring should be limited to 10 meters. All field wiring should be suitable for the operating temperature range. Install the unit with appropriate space available for servicing and for adequate wire harness access (6 inches or 15 cm) and strain relief (12 inches or 30 cm).
ISO 11898	120Ohm terminated twisted pair, baud rate up to 1Mbit/s. External 120Ohm termination is required.

Note: CANopen® is a registered community trademark of CAN in Automation e.V.

7. VERSION HISTORY

Version	Date	Author	Modifications
-	July 8th, 2021	Peter Sotirakos	Initial Draft
1.0	September 10th, 2021	Peter Sotirakos	Updated CAN network information
1.01	August 30th, 2023	Kiril Mojsov	Performed Legacy Updates

Global Electronic Solutions

OUR PRODUCTS

AC/DC Power Supplies

Actuator Controls/Interfaces

Automotive Ethernet Interfaces

Battery Chargers

CAN Controls, Routers, Repeaters

CAN/WiFi, CAN/Bluetooth, Routers

Current/Voltage/PWM Converters

DC/DC Power Converters

Engine Temperature Scanners

Ethernet/CAN Converters, Gateways, Switches

Fan Drive Controllers

Gateways, CAN/Modbus, RS-232

Gyroscopes, Inclinometers

Hydraulic Valve Controllers

Inclinometers, Triaxial

I/O Controls

LVDT Signal Converters

Machine Controls

Modbus, RS-422, RS-485 Controls

Motor Controls, Inverters

Power Supplies, DC/DC, AC/DC

PWM Signal Converters/Isolators

Resolver Signal Conditioners

Service Tools

Signal Conditioners, Converters

Strain Gauge CAN Controls

Surge Suppressors

OUR COMPANY

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

QUALITY DESIGN AND MANUFACTURING

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

WARRANTY, APPLICATION APPROVALS/LIMITATIONS

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

COMPLIANCE

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

SAFE USE

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

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

SERVICE

All products to be returned to Axiomatic require a Return Materials Authorization Number (RMA#) from 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.

CONTACTS

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salesfinland@axiomatic.com