USER MANUAL UMAX200000
Version V3A

4-CHANNEL
STRAIN GAUGE CONTROLLER
With SAEJ1939®

USER MANUAL

P/N: AX200000 (250kbps)
P/N: AX200000-01 (500kbps)
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ACCRONYMS

ACK	Positive Acknowledgement (from SAE J1939 standard)
SGIN	Strain Gauge Input
EA	Electronic Assistant ®, p/n AX070502 (A Service Tool for Axiomatic ECUs)
ECU	Electronic Control Unit (from SAE J1939 standard)
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
SPN	Suspect Parameter Number (from SAE J1939 standard)

TABLE OF CONTENTS

1. OVERVIEW OF CONTROLLER

1.1. Description of 4-Channel Strain Gauge Input Controller

This User Manual describes the architecture and functionality of the 4-Channel Strain Gauge input controller.

The 4-Channel Strain Gauge Input Controller (4CH-SG) is designed for versatile control of up to 4 input channels to measure strain gauge load cells independently, Digital input for Tare/Calibration operations, 1 Digital output and 1 Interlock/relay output. The sophisticated control algorithms allow the user to program the controller for a wide range of applications without the need for custom software.

There are 4 strain gauge input channels which can be configured to read any type of Load Cell with output ranges from +/-19mV to +/-2.5V to suit a wide variety of applications.

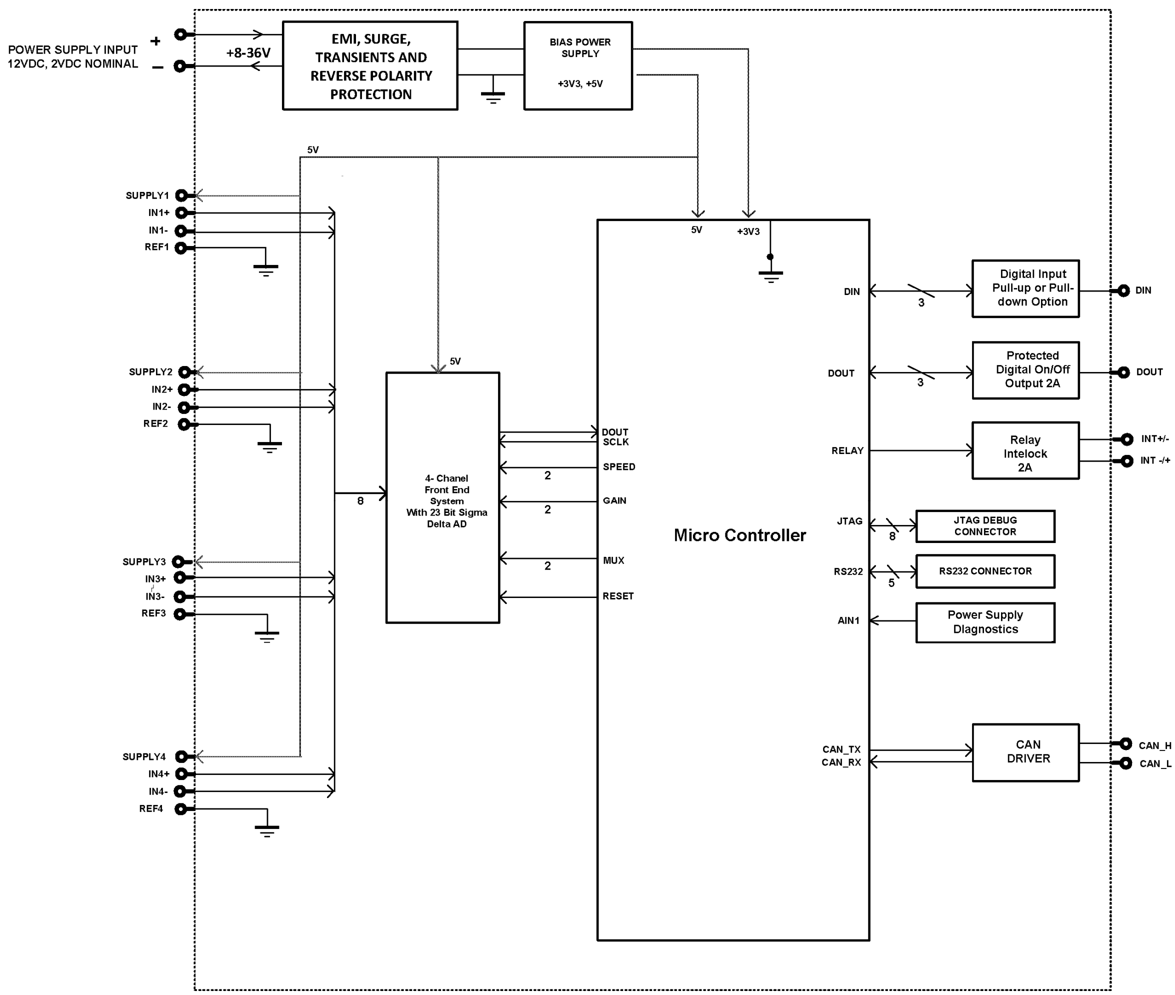


Figure 1 - Hardware Functional Block Diagram

The 4CH-SG is a highly configurable controller - allowing for custom configuration without the need of custom firmware. Its inputs, outputs, logical and mathematical function blocks allow the controller to support a wide variety of load cells to fit customer's various applications.

The 4CH-SG controller consists of a Digital Input which is used for Tare/Calibration operations that are highly configurable in order to accommodate various users' applications. In cases where the digital input is not desired to be used as a Tare, the controller also allows to Tare the inputs via CAN messages.

The controller also consists of an Interlock output and Digital output. These can be used for signaling through an LED/lamp, driving an On/Off valve and/or as an interlock mechanism.

All inputs 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. Figure 2 shows the hardware features of the 4CH-SG while Figure 1 shows the firmware features of the 4CH-SG.

The various function blocks supported by the 4CH-SG are outlined in the following sections. All setpoints are configurable using Axiomatic service tool, Electronic Assistant (EA).

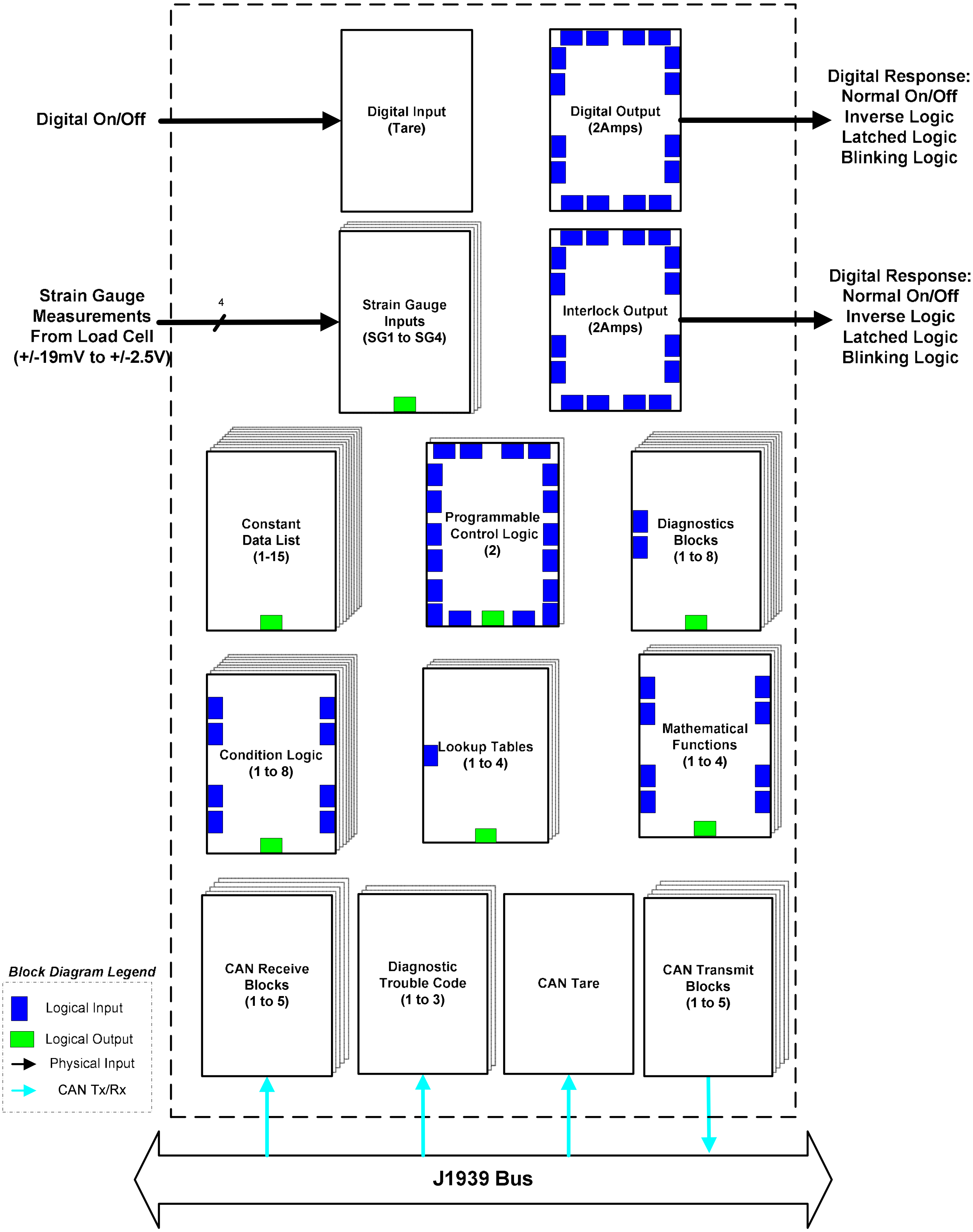


Figure 2 - Firmware Functional Block Diagram

1.2. Tare/Calibration Input Function Block

The Tare/Calibration input function block can be used to zero the platform and measure and store minimum and maximum weights of the 4-strain gauge system. Figure 2 shows the parameters in the Tare Input Function Block:

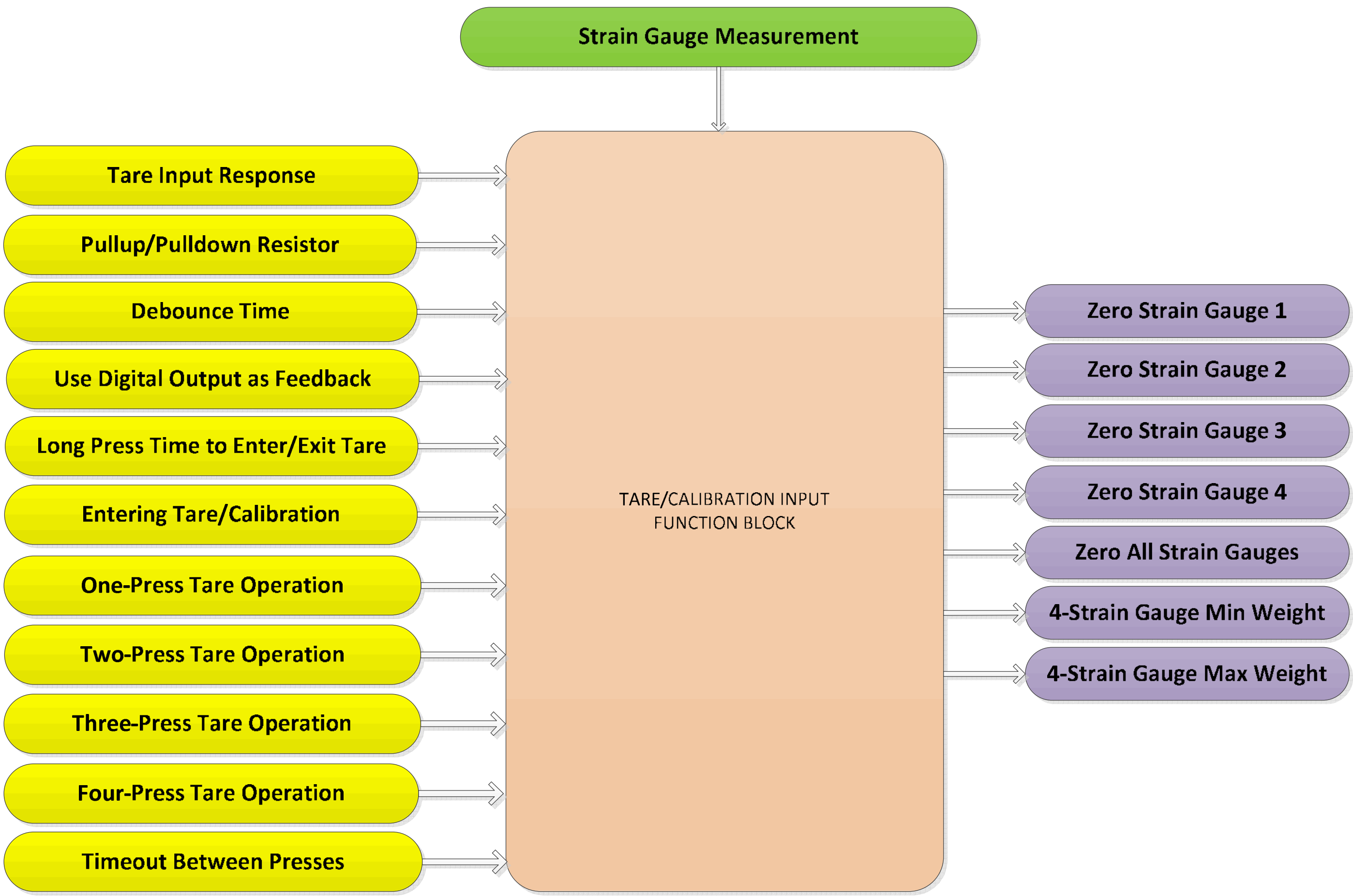


Figure 3 - Tare/Calibration Input Function Block Diagram

1.2.1. Digital Input Setpoints

Tare Input Response allows the user to select how the controller responds to the behaviour of the digital input. The signals going into the controller are interpreted as 0 or 1. The turn ON value (1) is reached at ~1V signal. Table 1 shows the different Tare Input Responses with the default response being highlighted.

Value	Meaning
0	***Normal On/Off***
1	*Inverse Logic*
2	*Latched Logic*

Table 1 - Tare Input Response

22kOhm pull-up and 22kOhm pull-down resistors can be enabled or both can be disabled using the setpoint **Pullup/Pulldown Resistor.** Table 2 lists the available pull-up/pull-down resistor options with the default option highlighter.

Value	Meaning
0	***Pullup/Pulldown Off***
1	*22kOhm pullup*
2	*22kOhm pulldown*

Table 2 - Pull-up/Pull-down Resistor Options

The Debounce Time parameter is a useful parameter in cases where the digital input signal coming in to the controller is noisy. Figure 4 how the Debounce Time helps detect a correct input signal

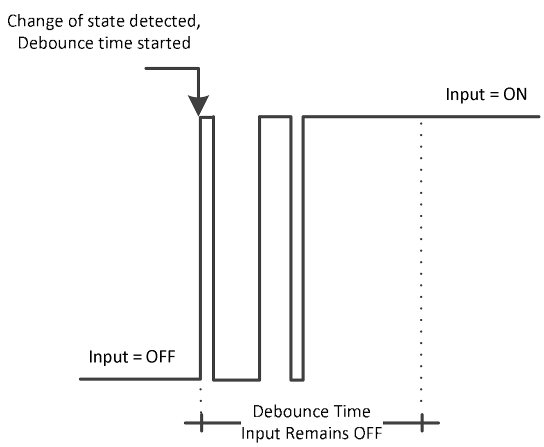


Figure 4 - Digital Input Debounce Time

1.2.2. Tare/Calibrate Functionality

When calibrating or zeroing the strain gauge inputs, the 4CH-SG offers a variety of options that can be performed with the use of a single Tare button. The **'Use Digital Output as Feedback'** setpoint gives the user the option of using one of the digital outputs as feedback to calibration steps. **Table 3** lists the different feedback types that can be selected when Tare/Calibrating.

Value	Meaning
0	*No Feedback Used*
1	***Digital Output***
2	*Interlock Output*

Table 3 - Use Digital Output as Feedback Options

When using the Digital Output or the Interlock Output as feedback when calibrating, the following scenarios will occur:

- Outputs will not be commanded by their respective control sources
- The selected output will engage for 750ms when Entering Calibration
- The selected output will engage for 250ms corresponding to the Tare Operation number
- The selected output will engage for 750ms when Exiting Calibration
- Outputs will be commanded by their respective control sources after exiting calibration

1.2.2.1. Entering/Exiting Calibration

In order to prevent ‘false calibration’ by pressing the Tare button by mistake, it is therefore necessary to enter calibration mode and exit calibration mode. ‘**Long Press Time to Enter/Exit Calibration**’ setpoint is used to accomplish this function. **Figure 5** explains the operation of entering and exiting calibration mode.

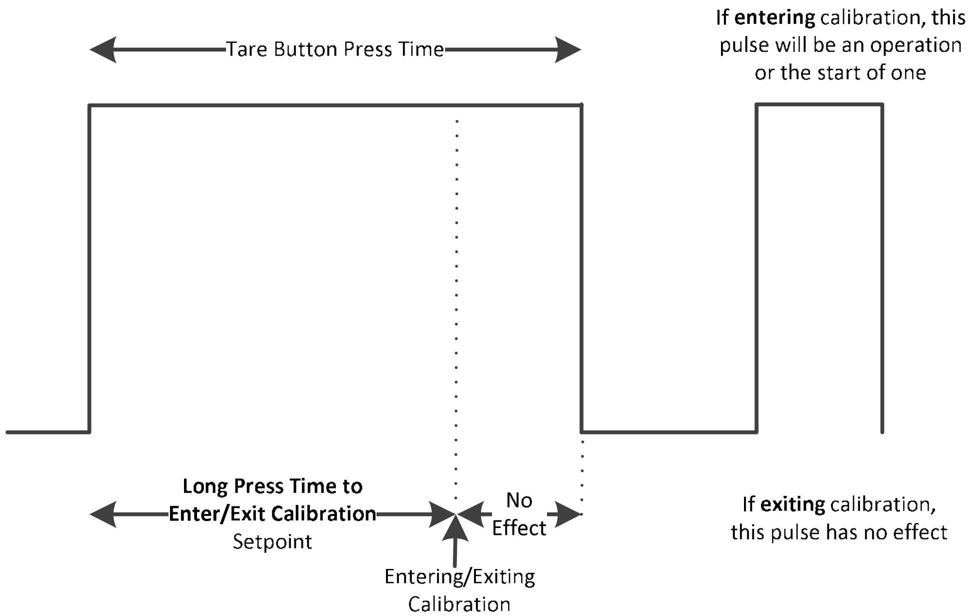


Figure 5 - Long Press to Enter/Exit Calibration Mode

As shown in **Figure 5**, the user can press the Tare button for much longer than the ‘**Long Press Time to Enter/Exit Calibration**’ setpoint as it will have no effect on the calibration. When entering calibration, any Tare button press which has been pressed for shorter period of time than ‘**Long Press Time to Enter/Exit Calibration**’ setpoint will be considered a Tare/Calibration operation. Refer to section 1.2.2.2 for more details. On the other hand, when exiting calibration, any Tare button press which has been pressed for shorter period of time than ‘**Long Press Time to Enter/Exit Calibration**’ will be ignored.

⚠	It is very important to exit calibration after the needed operations have been completed. Otherwise, the tare/calibration operations will not be saved.

1.2.2.2. Tare/Calibration Operations

After entering calibration mode the amount of consecutive presses will reflect the operation number. Consecutive presses are determined by parameter '**Timeout Between Presses**'. As long as the next Tare button press occurs before this parameter, the number of consecutive presses increases. Once the timeout occurs, the operation that will be executed will be determined by the count of consecutive presses before the timeout happened. **Figure 6** provides a graphical explanation.

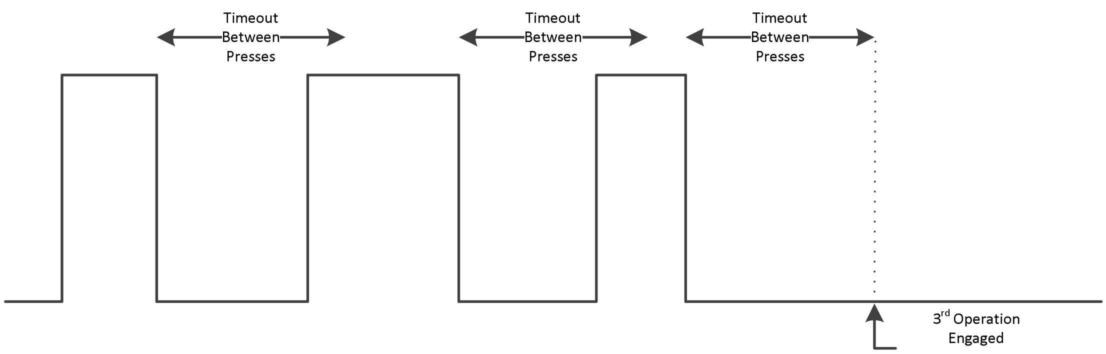


Figure 6 - Timeout Between Presses (Example)

The 4CH-SG allows up to 4 Tare/calibration operations that the user can perform. **Table 4** lists all the available operations.

Value	Tare Operation
0	*Operation Not Used*
1	*Zero Strain Gauge 1*
2	*Zero Strain Gauge 2*
3	*Zero Strain Gauge 3*
4	*Zero Strain Gauge 4*
5	*Zero All Strain Gauges*
6	*Set Overall Minimum Weight*
7	*Set Overall Maximum Weight*

Table 4 - Tare Operations

When Tare Options 6 and 7 are used ('*Set Overall Minimum Weight*' and '*Set Overall Maximum Weight*') as Tare/Calibration steps, their results - after exiting calibration mode - will be stored to Constant Data List 3 and Constant Data List 4, respectively. This allows the user to use those variables as inputs to other function blocks.

1.3. Strain Gauge Input Function Block

The Strain Gauge Input (SGIn) function block is the logic associated with measuring and managing strain gauge inputs. The SGIn function block provides configurable parameters

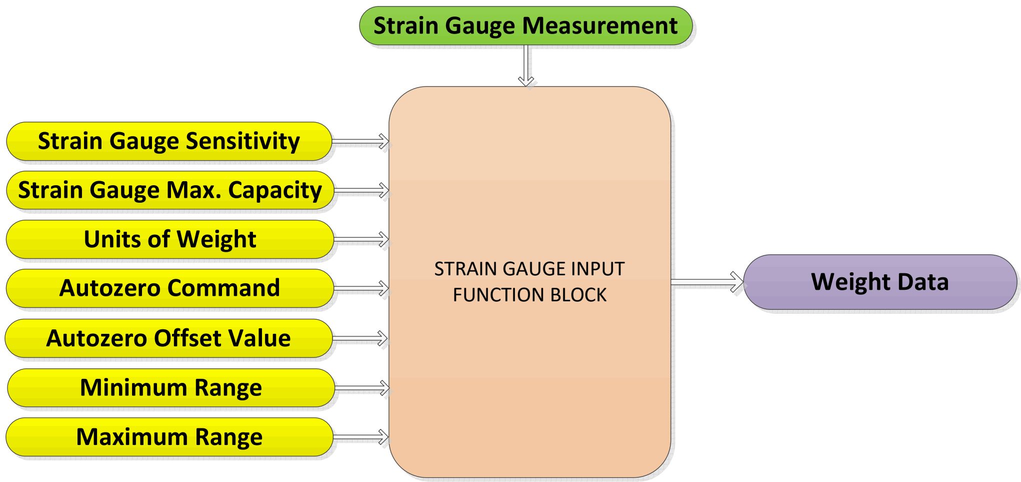


Figure 7 - Strain Gauge Input Function Block Diagram

The **Strain Gauge Sensitivity** parameter is the Strain Gauge Load Cell's output voltage (in mV/V). **The Strain Gauge Maximum Capacity** parameter is the maximum weight (in kilograms) the strain gauge can sense. With these two parameters, the 4CH-SG controller will modify its input measurements to determine the appropriate calculations based on the load cell's entire output range.

When the required or desired measurements of weight need to be other than kg, **Units of Weight** parameter can be used to convert the measured weight in kg (by default) into pounds (lbs). This conversion of weight can be used in other functional blocks to compare to different weights.

Value	Meaning
0	***Kilograms (kg)***
1	*Pounds (lbs)*

Table 5 - Weight Conversion Options

Strain gauge load cells typically have an offset when installing. There may be weight added to the load cells, i.e. a platform which exerts weight onto the strain gauges. These offsets or extra added weight may be desired to become to 'zero-weight' position of the system. The 4CH-SG controller is continuously reading input data from strain gauge load cells. Another alternative to using the Tare button as explained in section 1.2, when the **Autozero Command** parameter is set to TRUE, the current measured weight (in kg or lbs) by the 4CH-SG will be considered the 'zero-weight' position. By doing this, **Autozero Offset Value** parameter will be automatically updated to the current weight position. Alternatively, the **Autozero Offset Value** parameter can be changed at any time.

1.4. Internal Function Block Control Sources

The 4-Channel Strain Gauge controller allows for internal function block sources to be selected from the list of the logical function blocks supported by the controller. As a result, any output from one function block can be selected as the control source for another. Keep in mind that not all options make sense in all cases, but the complete list of control sources is shown in Table 6.

Value	Meaning
0	*Control Source Not Used (Ignored)*
1	*Strain Gauge Input Function Block*
2	*Digital Output Stage*
3	*CAN Receive Message*
4	*Conditional Logic Block*
5	*Lookup Table Function Block*
6	*Mathematical Function Block*
7	*Programmable Logic Function Block*
8	*Constant Data List Block*
9	*Diagnostic Trouble Code*
10	*Measured Power Supply*
11	*Measured Processor Temperature*
12	*Receive Message Timeout*

Table 6 - Control Source Options

In addition to a source, each control also has a number which corresponds to the sub-index of the function block in question. Table 7 outlines the ranges supported for the number objects, depending on the source that had been selected.

Control Source	Control Source Number
Control Source Not Used (Ignored)	[0]
Strain Gauge Input Function Block	[1…4]
Digital Output Stage Function Block	[1…4]
CAN Receive Message	[1…5]
Conditional Logic Block	[1….8]
Lookup Table Function Block	[1…4]
Mathematical Function Block	[1…4]
Programmable Logic Function Block	[1…2]
Constant Data List Block	[1…15]
Diagnostic Trouble Code	[1…3]
Measured Power Supply	[1]
Measured Processor Temperature	[1]
Receive Message Timeout	[1]

Table 7 - Control Source Number Options

1.5. Digital / Interlock Function Blocks

The 4CH-SG supports a Digital Output as well as an Interlock Output. These outputs can be used for signaling, driving on/off valves, and interlocking – whichever the application may be.

The structure of the output blocks for Digital and Interlock outputs are based on stages. The 4CH-SG provides the user with up to four different stages in order to provide more flexibility to the digital and digital output functionality.

Each of the four stages consists of its independent control source and digital response. However, only one stage can be used to control the output. For this reason, the 4-stage structure is based on priority in which the 4th stage has the highest priority and the 1st stage has the lowest priority. In other words: if all 4 stages are true, the digital response set for stage 4 will be used to drive the particular output.

The control sources that can be used to command each of the four stages are listed in section 1.4 **Table 7**.

The Digital Responses that are available for each stage in the 4CH-SG are listed in **Table 8** below

Value	Meaning
0	*Normal On/Off*
1	*Inverse Logic*
2	*Latched Logic*
3	*Blinking Logic*

Table 8 - Digital Response Options

Table 8 – Digital Response Options

In '*Normal On/Off*' response type, the output command state will follow the control input command: when the control input command is ON, the output will be turned ON and vice-versa.

In '*Inverse Logic*' response type, the output command state will be opposite of the control input command: when the control input command is ON, the output will be turned OFF and vice-versa.

In *'Latched Logic'* response type, the output command state will change every time the input command goes from OFF to ON.

In *'Blinking Logic'* response type, the output will toggle at a period of '**Digital Blink Rate**' for as long as the input command is ON.

The "**Control Source**" setpoint together with "**Control Number**" setpoint determine which signal is used to drive the output. For example setting "**Control Source**" to '*Strain Gauge Input Measured'* and "**Control Number**" to '*1*', connects signal measured from Strain Gauge Input 1 to the output in question. The input signal is scaled per input type range between 0 and 1 to form control signal. Outputs respond in a linear fashion to changes in control signal. If a non-digital signal is selected to drive digital output the command state will be 0 (OFF) at or below the "**Output At Minimum Command**", 1 (ON) at or above "**Output At Maximum Command**" and will not change in between those points.

In addition to the Control input, Proportional Outputs also support Enable and Override inputs.

*The “**Enable Source**” setpoint together with “**Enable Number**” setpoint determine the enable signal for the output in question. The “**Enable Response**” setpoint is used to select how output will respond to the selected Enable signal. “**Enable Response**” setpoint options are listed in Table 9 - Enable Response Options*

9. If a non-digital signal is selected as Enable signal the signal is interpreted as shown in Figure 8.

Value	Meaning
0	Enable When On
1	Enable When Off

Table 9 - Enable Response Options

Override input allows the output drive to be configured to go to a default value in the case of the override input being engaged/disengaged, depending on the logic selected in “**Override Response**”, presented on 0. When active, the output will be driven to the value in “**Output at Override Command**” regardless of the value of the Control input. The “**Override Source**” and “**Override Number**” together determine the Override input signal.

Value	Meaning
0	Override When On
1	Override When Off

Table 10 - Override Response Options

If a fault is detected in any of the active inputs (Control/Enable/Override) the output will respond per “**Control Fault Response**” setpoint as outlined in Table 11. Fault Value is defined by “**Output in Fault Mode**” setpoint value, which is interpreted in selected output units.

Value	Meaning
0	Shutoff Output
1	Apply Fault Value
2	Hold Last Value

Table 11 - Fault Response Options

Fault detection is available for current output types. A current feedback signal is measured and compared to desired output current value. Fault detection and associated setpoints are presented in section 1.66.

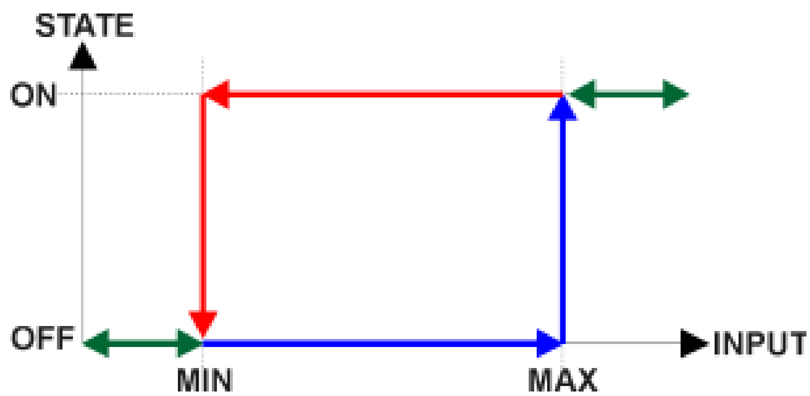


Figure 8 - Analog Source to Digital Input

Figure 1 - Analog source to Digital input

1.6. Diagnostic Function Blocks

The 4CH-SG supports diagnostic messaging. DM1 message is a message, containing Active Diagnostic Trouble Codes (DTC) that is sent to the J1939 network in case a fault has been detected. A Diagnostic Trouble Code is defined by the J1939 standard as a four byte value.

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

DM2	Previously Active Diagnostic Trouble Codes	Sent only on request

SPN	Suspect Parameter Number	(user defined)
FMI	Failure Mode Identifier	(see 0 and Table 151)
CM	Conversion Method	(always set to 0)
OC	Occurrence Count	(number of times the fault has happened)
DM3	Diagnostic Data Clear/Reset of Previously Active DTCs	Done only on request
DM11	Diagnostic Data Clear/Reset for Active DTCs	Done only on request

Fault detection and reaction is a standalone functionality that can be configured to monitor and report diagnostics of various controller parameters. The 4CH-SG supports 8 Diagnostics Definitions, each freely configurable by the user.

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

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

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

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

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

Double minimum and maximum error lets user to specify four thresholds, each with independent diagnostic parameters. The diagnostic status and threshold values is determined and expected as show in **Error! Reference source not found.**5 below.

By default, Diagnostic Block 8 gets automatically updated if it monitoring a Math Block Function Block after going through Calibration with the Tare Button. The updated parameters are the MIN Shutdown Set, MAX Shutdown Set with a 10% Hysteresis. The fault type by default in Diagnostic Block 8 is with **Minimum and maximum error.**

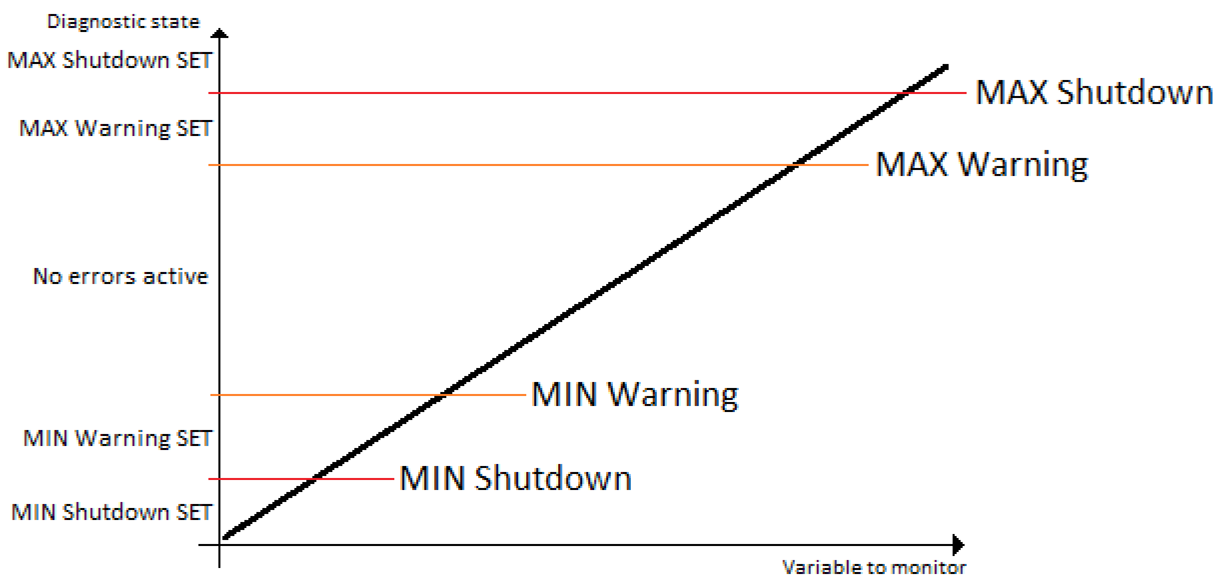


Table 12 - Double Minimum and Maximum Error Thresholds

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

While there are no active DTCs, the 4CH-SG will send "No Active Faults" message. If a previously inactive DTC becomes active, a DM1 will be sent immediately to reflect this. As soon as the last active DTC goes inactive, a DM1 indicating that there are no more active DTCs will be sent.

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

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

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

As defined by J1939 Standard the first byte of the DM1 message reflects the Lamp status. "**Lamp Set by Event**" setpoint determines the lamp type set in this byte of DTC. "**Lamp Set by Event"** setpoint options are listed in Table 13. By default, the '*Amber, Warning'* lamp is typically the one set be any active fault.

Value	Meaning
0	Protect
1	Amber Warning
2	Red Stop
3	Malfunction

Table 13 - Lamp Set by Even in DM1 Options

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

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

17	*Data Valid But Below Normal Operating Range – Least Severe Level*
18	*Data Valid But Below Normal Operating Range – Moderately Severe Level*
19	*Network Error*
20	*Data Drifted High*
21	*Data Drifted Low*
31	*Condition Exists*

Table 14 – FMI for Event Options

Every fault has associated a default FMI with them. The used FMI can be configured with "**FMI for Event**" setpoint, presented in Table 14. When an FMI is selected from Low Fault FMIs in Table 15 for a fault that can be flagged either high or low occurrence, it is recommended that the user would select the high occurrence FMI from the right column of Table 15. There is no automatic setting of High and Low FMIs in the firmware, the user can configure these freely.

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

Table 15 – Low Fault FMIs and corresponding High Fault FMIs

1.7. Simple Conditional Logic Function Blocks

The Simple Conditional Logic Blocks provide a way of connecting different blocks and comparing them to one another. The output of the Conditional Logic Blocks is either 0 (FALSE) or 1 (TRUE).

There are three operations that take place in the Conditional Logic Blocks which allows the user to make more elaborate comparisons. The first two operations, ‘**Operator 1 (Input 1, Input 2)**’ and ‘**Operator 2 (Input 3, Input4)**’ compare two separate values from different selectable control sources. The operations for these two operators are listen in **Table 16**.

Value	Operation	Meaning
0	*Not Used*	*Result = False*
1	=	*True when InA Equals InB*
2	!=	*True when InA Not Equal InB*
3	>	*True when InA Greater Than InB*
4	>=	*True when InA Greater Than or Equal InB*
5	<	*True when InA Less Than InB*
6	<=	*True when InA Less Than or Equal InB*
7	*OR*	*True when InA or InB is True*
8	*AND*	*True when InA and InB are True*
9	*XOR*	*True when InA/InB is True, but not both*

Table 16 - Available Operation for Operator 1 and Operator 2

The last operation is used between the results of both Operator 1 and Operator 2 using logic gates operations. The list of available operations for ‘**Operator 3 (Operator 1, Operator 2)**’ are listed in **Table 17**.

Value	Operation	Meaning
0	*Not Used*	*Result = False*
1	*OR*	*True when Op1 or Op2 is True*
2	*AND*	*True when Op1 and Op2 are True*
3	*XOR*	*True when Op1/Op2 is True, but not both*

Table 17 - Available Operations for Operator 3

When configuring a Conditional Block and only one comparison is needed, it is necessary that operation selected for **‘Operator 3 (Operator 1, Operator 2)’** is set to *1* (‘*OR, True When Op1 or Op2 is True*’)

1.8. Lookup Table Function Block

Lookup Tables are used to give an output response of up to 10 slopes per input. The array size of the Response [ ], Point X [ ] and Point Y [ ] setpoints shown in the block diagram above is therefore 6.

Note: 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 is described in Section 1.5.

There are two key setpoints that will affect this function block. The first is the "**X-Axis Source**" and **"X-Axis Number"** which together define the Control Source for the function block. When it is changed, the table is automatically updated with new defaults based on the X-Axis source selected if "**Auto update when control changes"** in the Miscellaneous block is *TRUE.*

As stated earlier if **"Auto update when control changes"** is *TRUE,* should the selected Control Source change (i.e. the Min or Max values of the function block are updated), the associated table will also be automatically updated with default settings, based on the new X-Axis limits.

> Initialize the Control Source of a Lookup Table BEFORE changing the table values, as the new settings WILL get erased when the control is updated if the **"Auto update when control changes"** in the Miscellaneous function block is set to *TRUE*.

The second setpoint that will affect the function block (i.e. reset to defaults), is the "**X-Axis Type**". By default, the tables have a *'Data Response'* output. Alternatively, it can be selected as a *'Time Response'.*

1.8.1. X-Axis, Input Data Response

In the case where the **X-Axis Type**" = *'Data Response',* the points on the X-Axis represents the data of the control source. These values must be selected within the range of the control source.

When selecting X-Axis data values, there are no constraints on the value that can be entered into any of the X-Axis points. The user should enter values in increasing order to be able to utilize the entire table. Therefore, when adjusting the X-Axis data, it is recommended that X_{10} is changed first, then lower indexes in descending order as to maintain the below:

$$MinInputRange <= X_0 <= X_1 <= X_2 <= X_3 <= X_4 <= X_5 <= X_6 <= X_7 <= X_8 <= X_9 <= X_{10}\ MaxInputRange$$

As stated earlier, MinInputRange and MaxInputRange will be determined by the X-Axis Source that has been selected.

If some of the data points are *'Ignored'* as described in Section 1.8.4, they will not be used in the X-Axis calculation shown above. For example, if points X_4 and higher are ignored, the formula becomes MinInputRange <= X_0 <= X_1 <= X_2<= X_3<= MaxInputRange instead.

1.8.2. Y-Axis, Lookup Table Output

The Y-Axis has no constraints on the data that it represents. This means that inverse, or increasing/decreasing or other responses can be easily established.

In all cases, the controller looks at the **entire range** of the data in the Y-Axis setpoints, and selects the lowest value as the MinOutRange and the highest value as the MaxOutRange. They are passed directly to other function blocks as the limits on the Lookup Table output. (i.e used as Xmin and Xmax values in linear calculations.)

However, if some of the data points are *'Ignored'* as described in Section 1.8.4, they will not be used in the Y-Axis range determination. Only the Y-Axis values shown on EA will be considered when establishing the limits of the table when it is used to drive another function block, such as a Math Function Block.

1.8.3. Default Configuration, Data Response

By default, all Lookup Tables in the ECU are disabled (**"X-Axis Source"** equals *'Control Source Not Used').* Lookup Tables can be used to create the desired response profiles. If a Strain Gauge input is used as the X-Axis, the output of the Lookup Table will be what the user enters in Y-Axis[] setpoints.

Recall, any controlled function block which uses the Lookup Table as an input source will also apply a linearization to the data. **Therefore, for a 1:1 control response, ensure that the minimum and maximum values of the output correspond to the minimum and maximum values of the table's Y-Axis.**

All tables (1 to 4) are disabled by default (no control source selected). However, should an **"X-Axis Source"** be selected, the Y-Axis defaults will be in the range of 0 to 100% as described in the "Y-Axis, Lookup Table Output" section above. X-Axis minimum and maximum defaults will be set as described in the "X-Axis, Data Response" section above.

By default, the X and Y axes data is setup for an equal value between each point from the minimum to maximum in each case.

1.8.4. Point To Point Response

By default, the X and Y axes are setup for a linear response from point (0,0) to (10,10), where the output will use linearization between each point, as shown in Figure 6. To get the linearization, each "**Point N – Response**", where N = 1 to 10, is setup for a *'Ramp To'* output response.

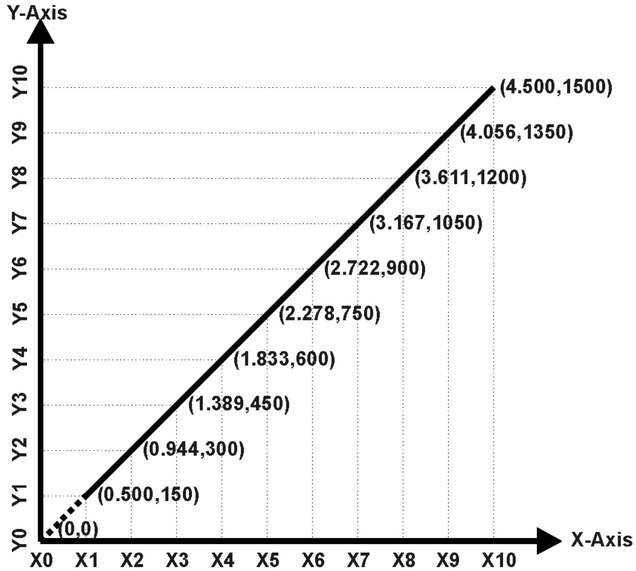


Figure 9 - Lookup Table with "Ramp To" Data Response

Alternatively, the user could select a *'Jump To'* response for "**Point N – Response**", where N = 1 to 10. In this case, any input value between X_{N-1} to X_N will result in an output from the Lookup Table function block of Y_N.

An example of a Math function block (0 to 100) used to control a default table (0 to 100) but with a *'Jump To'* response instead of the default *'Ramp To'* is shown in Figure 10.

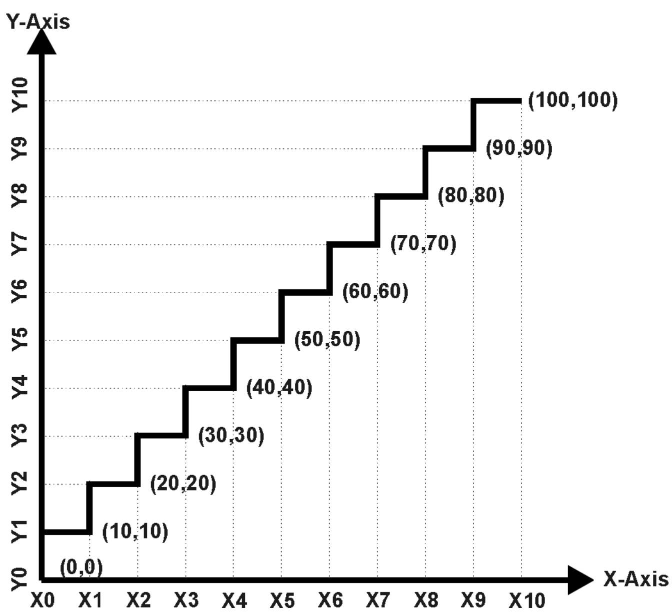


Figure 10 - Lookup Table with "Jump To" Data Response

Lastly, any point except (0,0) can be selected for an *'Ignore'* response. If "**Point N – Response**" is set to ignore, then all points from (X_N, Y_N) to (X_5, Y_5) will also be ignored. For all data greater than X_{N-1}, the output from the Lookup Table function block will be Y_{N-1}.

A combination of *'Ramp To'*, *'Jump To'* and *'Ignore'* responses can be used to create an application specific output profile.

1.8.5. X-Axis, Time Response

As mentioned in Section 1.8, a Lookup Table can also be used to get a custom output response where the "**X-Axis Type**" is a *'Time Response.'* When this is selected, the X-Axis now represents time, in units of milliseconds, while the Y-Axis still represents the output of the function block.

In this case, the **"X-Axis Source"** is treated as a digital input. If the signal is actually an analog input, it is interpreted like a digital input per Figure 8. When the control input is ON, the output will be changed over a period of time based on the profile in the Lookup Table. Once the profile has finished (i.e. index 10, or *'Ignored'* response), the output will remain at the last output at the end of the profile until the control input turns OFF.

When the control input is OFF, the output is always at zero. When the input comes ON, the profile ALWAYS starts at position (X_0, Y_0) which is 0 output for 0ms.

In a time response, the interval time between each point on the X-axis can be set anywhere from 1ms to 24 hours. [86,400,000 ms]

1.9. Programmable Logic Function Block

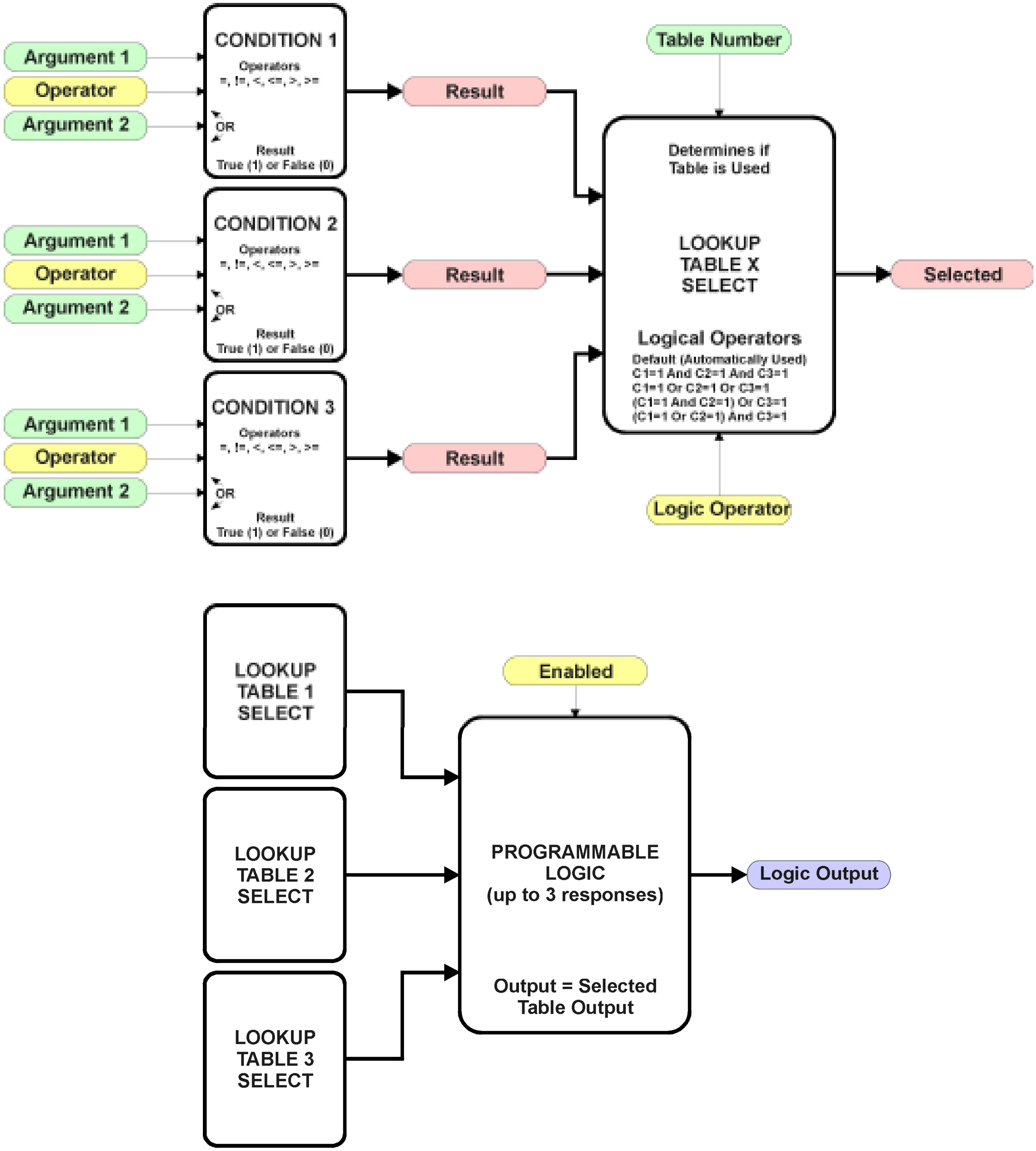


Figure 11 - Programmable Logic Function Block

This function block is obviously the most complicated of them all, but very powerful. The Programmable Logic can be linked to up to three tables, any one of which would be selected only under given conditions. Any three tables (of the available 8) can be associated with the logic, and which ones are used is fully configurable.

Should the conditions be such that a particular table (1, 2 or 3) has been selected as described in Section 1.9.2, then the output from the selected table, at any given time, will be passed directly to the Logic Output.

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, such as an Output X Drive. To do this, the "**Control Source**" for the reactive block would be selected to be the *'Programmable Logic Function Block.'*

In order to enable any one of Programmable Logic blocks, the "**Programmable Logic Block Enabled**" setpoint must be set to True. They are all disabled by default.

Logic is evaluated in the order shown in Figure 12. Only if a lower number table has not been selected will the conditions for the next table be looked at. **The default table is always selected as soon as it is evaluated. It is therefore required that the default table always be the highest number in any configuration.**

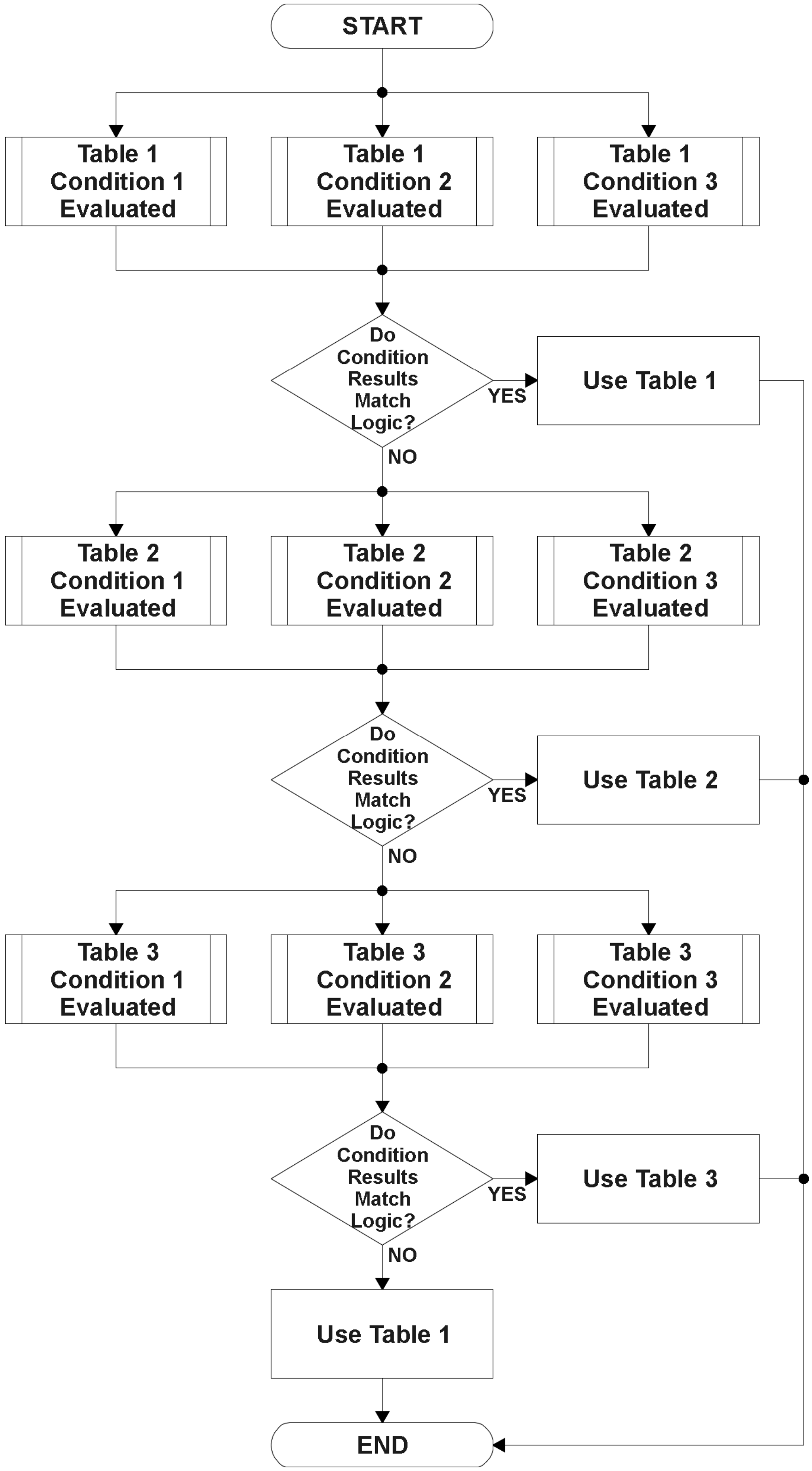


Figure 12 - Programmable Logic Flowchart

1.9.1. Conditions Evaluation

The first step in determining which table will be selected as the active table is to first evaluate the conditions associated with a given table. Each table has associated with it up to three conditions that can be evaluated.

Argument 1 is always a logical output from another function block, as listed in Section 1.3. As always, the source is a combination of the functional block type and number, setpoints **"Table X, Condition Y, Argument 1 Source"** and **"Table X, Condition Y, Argument 1 Number"**, where both X = 1 to 3 and Y = 1 to 3.

Argument 2 on the other hand, could either be another logical output such as with Argument 1, OR a constant value set by the user. To use a constant as the second argument in the operation, set **"Table X, Condition Y, Argument 2 Source"** to *'Control Constant Data.'* Note that the constant value has no unit associated with it in EA, so the user must set it as needed for the application.

The condition is evaluated based on the **"Table X, Condition Y Operator"** selected by the user. It is always *'=, Equal'* by default. The only way to change this is to have two valid arguments selected for any given condition. Options for the operator are listed in Table 18.

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

Table 18 - Condition Operator Options

For example, a condition for a weight going over a certain range could be that the Strain Gauge Input Measured 1 be greater than a certain value to flag a different output. In this case, **"…Argument 1 Source"** would be set to *'Strain Gauge Input Measured 1,* **"…Argument 2 Source"** to *'Control Constant Data'*, and the **"…Operator"** to *'>, Greater Than.'* The **"Constant Value X"** in the Constant Data List would be set to whatever warning weight the application required.

By default, both arguments are set to *'Control Source Not Used'* which disables the condition, and automatically results in a value of N/A as the result. Although Figure 12 shows only True or False as a result of a condition evaluation, the reality is that there could be four possible results, as described in Table 19.

Value	Meaning	Reason
0	False	(Argument 1) Operator (Argument 2) = False
1	True	(Argument 1) Operator (Argument 2) = True
2	Error	Argument 1 or 2 output was reported as being in an error state
3	Not Applicable	Argument 1 or 2 is not available (i.e. set to *'Control Source Not Used'*)

Table 19 - Condition Evaluation Results

1.9.2. Table Selection

In order to determine if a particular table will be selected, logical operations are performed on the results of the conditions as determined by the logic in Section 1.9.1. There are several logical combinations that can be selected, as listed in Table 20.

0	*Default Table*
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 20 - Conditions Logical Operator Options

Not every evaluation is going to need all three conditions. The case given in the earlier section, for example, only has one condition listed, i.e. that the Engine RPM be below a certain value. Therefore, it is important to understand how the logical operators would evaluate an Error or N/A result for a condition.

Logical Operator	**Select Conditions Criteria**
Default Table	Associated table is automatically selected as soon as it is evaluated.
Cnd1 And Cnd2 And Cnd3	**Should be used when two or three conditions are relevant, and all must be true to select the table.** If any condition equals False or Error, the table is not selected. An N/A is treated like a True. If all three conditions are True (or N/A), the table is selected. If((Cnd1==True) &&(Cnd2==True)&&(Cnd3==True)) Then Use Table
Cnd1 Or Cnd2 Or Cnd3	**Should be used when only one condition is relevant. Can also be used with two or three relevant conditions.** If any condition is evaluated as True, the table is selected. Error or N/A results are treated as False If((Cnd1==True) || (Cnd2==True) || (Cnd3==True)) Then Use Table
(Cnd1 And Cnd2) Or Cnd3	**To be used only when all three conditions are relevant.** If both Condition 1 and Condition 2 are True, OR Condition 3 is True, the table is selected. Error or N/A results are treated as False If(((Cnd1==True)&&(Cnd2==True)) || (Cnd3==True)) Then Use Table
(Cnd1 Or Cnd2) And Cnd3	**To be used only when all three conditions are relevant.** If Condition 1 And Condition 3 are True, OR Condition 2 And Condition 3 are True, the table is selected. Error or N/A results are treated as False If(((Cnd1==True)||(Cnd2==True)) && (Cnd3==True)) Then Use Table

Table 21 - Conditions Evaluation Based on Selected Logical Operator

The default **"Table X, Conditions Logical Operator"** for Table 1 and Table 2 is *'Cnd1 And Cnd2 And Cnd3,'* while Table 3 is set to be the *'Default Table.'*

1.9.3. Logic Block Output

Recall that Table X, where X = 1 to 3 in the Programmable Logic function block does NOT mean Lookup Table 1 to 3. Each table has a setpoint **"Table X – Lookup Table Block Number"** which allows the user to select which Lookup Tables they want associated with a particular Programmable Logic Block. The default tables associated with each logic block are listed in Table 22

Programmable Logic Block Number	Table 1 – Lookup Table Block Number	Table 2 – Lookup Table Block Number	Table 3 – Lookup Table Block Number
1	1	2	3

Table 22 - Programmable Logic Block Default Lookup Table

If the associated Lookup Table does not have an **"X-Axis Source"** selected, then the output of the Programmable Logic block will always be "Not Available" so long as that table is selected. However, should the Lookup Table be configured for a valid response to an input, be it Data or Time, the output of the Lookup Table function block (i.e. the Y-Axis data that has been selected based on the X-Axis value) will become the output of the Programmable Logic function block so long as that table is selected.

Unlike all other function blocks, the Programmable Logic does NOT perform any linearization calculations between the input and the output data. Instead, it mirrors exactly the input (Lookup Table) data. Therefore, when using the Programmable Logic as a control source for another function block, it is HIGHLY recommended that all the associated Lookup Table Y-Axes either be (a) Set between the 0 to 100% output range or (b) all set to the same scale.

1.10. 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 four input signals. Each input is then scaled according to the associated limit and scaling setpoints.

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

A mathematical function block includes three selectable functions, which each implements equation $\mathrm{A\ operator\ B}$, where A and B are function inputs and operator is function selected with setpoint "**Math function X Operator**". Setpoint options are presented in Table 23. The functions are connected together, so that result of the preceding function goes into Input A of the next function. Thus Function 1 has both Input A and Input B selectable with setpoints, where Functions 2 to 4 have only Input B selectable. Input is selected by setting "**Function X Input Y Source**" and "**Function X Input Y Number**". If "**Function X Input B Source**" is set to 0 '*Control not used'* signal goes through function unchanged.

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

0	=, True when InA equals InB
1	!=, True when InA not equal InB
2	>, True when InA greater than InB
3	>=, True when InA greater than or equal InB
4	<, True when InA less than InB
5	<=, True when InA less than or equal InB
6	OR, True when InA or InB is True
7	AND, True when InA and InB are True
8	XOR, True when either InA or InB is True, but not both
9	+, Result = InA plus InB
10	-, Result = InA minus InB
11	x, Result = InA times InB
12	/, Result = InA divided by InB
13	MIN, Result = Smallest of InA and InB
14	MAX, Result = Largest of InA and InB
15	MAX-MIN, Result = Absolute value of (InA – InB)

Table 23 - Math Function Operators

User should make sure the inputs are compatible with each other when using some of the Mathematical Operations. For instance, if Strain Gauge Input 1 is to be measured in [kg], while Strain Gauge Input 2 is to be measured in [lbs] and Math Function Operator 9 (+), the result will not be the true weight of the system.

For a valid result, the control source for an input must be a non-zero value, i.e. something other than *'Control Source Not Used.'*

When dividing, a zero InB value will always result is a zero output value for the associated function. When subtracting, a negative result will always be treated as a zero, unless the function is multiplied by a negative one, or the inputs are scaled with a negative coefficient first.

1.11. CAN Transmit Function Block

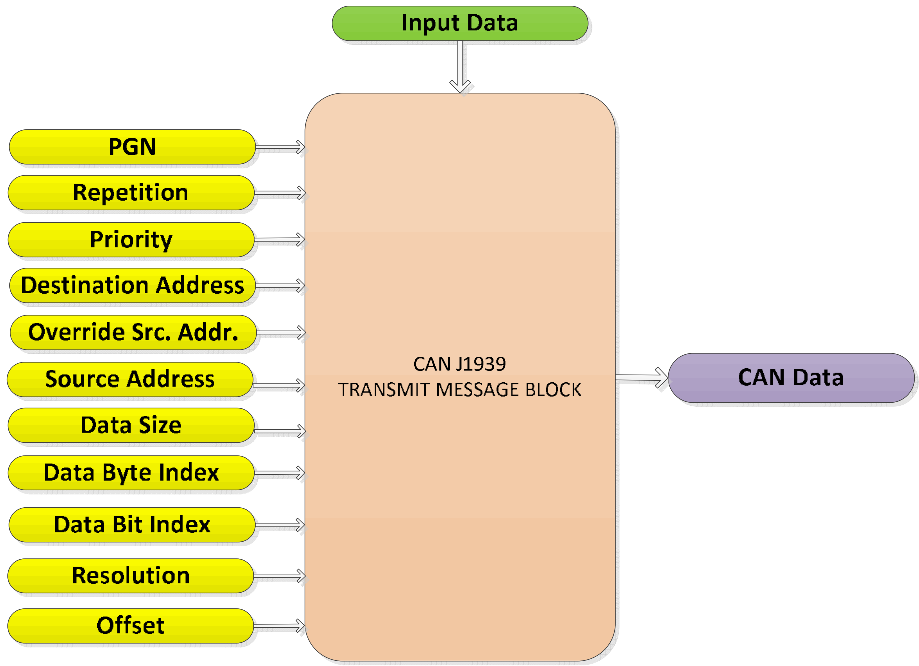


Figure 13 - CAN Transmit Function Block

The CAN Transmit function block is used to send any output from another function block (i.e. input, status or feedback signals) to the J1939 network.

Normally, to disable a transmit message, the **"Transmit Repetition Rate"** is set to zero. However, should message share its Parameter Group Number (PGN) with another message, this is not necessarily true. In the case where multiple messages share the same **"Transmit PGN"**, the repetition rate selected in the message with the LOWEST number will be used for ALL the messages that use that PGN.

By default, all messages are sent on Proprietary B PGNs as broadcast messages. If all of the data is not necessary, disable the entire message by setting the lowest channel using that PGN to zero. If some of the data is not necessary, simply change the PGN of the superfluous channel(s) to an unused value in the Proprietary B range.

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.

Since the defaults are PropB messages, the **"Transmit Message Priority"** is always initialized to 6 (low priority) and the **"Destination Address (for PDU1)"** setpoint is not used. This setpoint is only valid when a PDU1 PGN has been select, and it can be set either to the Global Address (0xFF) for broadcasts, or sent to a specific address as setup by the user.

The 4CH-SG allows to transmit CAN messages with a masked source address. The associated setpoints for this configuration are "**Override Source Address"** and **"Source Address".** When

“Override Source Address” setpoint is set to *FALSE* the CAN Transmit will transmit with the address the 4CH-SG has claimed. However, when this is set to *TRUE,* the user can configure a source address to be used for that CAN Transmit, from 0…255. Each CAN Transmit setpoint group has the ability to have its own source address configured.

The **“Transmit Data Size”**, **“Transmit Data Index in Array (LSB)”**, **“Transmit Bit Index in Byte (LSB)”**, **“Transmit Resolution”** and **“Transmit Offset”** can all be use to map the data to any SPN supported by the J1939 standard. The defaults used by the 4CH-SG are all for proprietary SPNs, and are defined in detail in Section 3.3.

Note: CAN Data = (Input Data – Offset)/Resolution

The 4CH-SG supports up to 5 unique CAN Transmit Messages, all of which can be programmed to send any available data to the CAN network. By default, the first CAN Transmit block is pre-configured to send all Strain Gauge Input measurements. The details are outlined in Section 3.3, and the default list is shown in Table 24 below.

Block#, Signal #	Default Transmit Data	(PGN)
1, 1	Strain Gauge Input 1	(0xFF00)
1, 2	Strain Gauge Input 2	(0xFF00)
1, 3	Strain Gauge Input 3	(0xFF00)
1, 4	Strain Gauge Input 4	(0xFF00)
2, 1	Control Source Not Used	(0xFF01)
2, 2	Control Source Not Used	(0xFF01)
2, 3	Control Source Not Used	(0xFF01)
2, 4	Control Source Not Used	(0xFF01)
3, 1	Control Source Not Used	(0xFF01)
3, 2	Control Source Not Used	(0xFF01)
3, 3	Control Source Not Used	(0xFF01)
3, 4	Control Source Not Used	(0xFF01)
4, 1	Control Source Not Used	(0xFF01)
4, 2	Control Source Not Used	(0xFF01)
4, 3	Control Source Not Used	(0xFF01)
4, 4	Control Source Not Used	(0xFF01)
5, 1	Control Source Not Used	(0xFF01)
5, 2	Control Source Not Used	(0xFF01)
5, 3	Control Source Not Used	(0xFF01)
5, 4	Control Source Not Used	(0xFF01)

Table 24 - Default CAN Transmit Messages

1.12. Diagnostic Trouble Code (DTC) React

The DTC React function block will allow a received DTC sent from another ECU on a DM1 message to be used as an input to any other function block in order to disable an output, for example. Up to three SPN/FMI combinations can be selected.

Should a DM1 message be received with the SPN/FMI combination defined, the corresponding DTC State will be set to ON. Once ON, if the same SPN/FMI combination has not been received again after 3 seconds, the DTC State will be reset to OFF.

The DTC could be used as a digital input for any function block as appropriate.

1.13. CAN Receive Function Block

The CAN Receive function block is designed to take any SPN from the J1939 network, and use it as an input to another function block.

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. This could trigger a Lost Communication event as described in section 1.66. 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 timeout and will never trigger a Lost Communication fault.

By default, all control messages are expected to be sent to the 4CH-SG Controller on Proprietary B PGNs. However, should a PDU1 message be selected, the 4CH-SG Controller can be setup to receive it from any ECU by setting the **Specific Address that sends the PGN** to the Global Address (0xFF). If a specific address is selected instead, then any other ECU data on the PGN will be ignored.

The **Receive Data Size**, **Receive Data Index in Array (LSB)**, **Receive Bit Index in Byte (LSB)**, **Receive Resolution** and **Receive Offset** can all be used to map any SPN supported by the J1939 standard to the output data of the Received function block.

As mentioned earlier, a CAN receive function block can be selected as the source of the control input for the output function blocks. When this is the case, the **Received Data Min** (Off Threshold) and **Received Data Max** (On Threshold) setpoints determine the minimum and maximum values of the control signal. As the names imply, they are also used as the On/Off thresholds for digital output types. These values are in whatever units the data is AFTER the resolution and offset is applied to CAN receive signal. The 4CH-SG Controller supports up to five unique CAN Receive Messages.

1.14. CAN Tare Function Block

The CAN Tare function block is a means to zero/tare the input via CAN messages. If desired to tare the inputs via this function block, the user must send the specific CAN message frames the 4CH-SG expects. By default, the **"Receive PGN"** is set to 0xFFA5 but can be configured to a different PGN.

The message to be sent is a 2-byte message with the first byte being the command while the second byte determines the operation. See the below tables for the list of commands and operations.

Command	First Byte Data
Enter Calibration	0xAB
Exit Calibration and Save	0xBA

Table 25 - CAN Tare Command Byte

Options	Bits on Second Byte Data
Tare Strain Gauge Input 1	1st bit location
Tare Strain Gauge Input 2	2nd bit location
Tare Strain Gauge Input 3	3rd bit location
Tare Strain Gauge Input 4	4th bit location
Minimum Sum of all Strain Gauge Inputs is saved as a Constant in Constant Data List	5th bit location
Maximum Sum of all Strain Gauge Inputs is saved as a Constant in Constant Data List	6th bit location

Table 26 - CAN Tare Option Byte

For example, if Strain Gauge Inputs 1 & 3 need to be Tared, the following command would be sent to the 4CH-SG unit (with the default settings)

PGN	Length	D0	D1
0xFFA5	2	0xAB	0x05 (00000101b)

Then to save the calibration settings to the flash, the following command needs to be sent:

PGN	Length	D0	D1
0xFFA5	2	0xBA	0xnn

D1: 0xnn (this byte is ignored when 0xBA is sent)

2. Installation Instructions

2.1. Dimensions and Pinout

The 4-Channel Strain Gauge Input Controller is packaged in a plastic housing from Deutsch IPD. The assembly carries an IP67 rating.

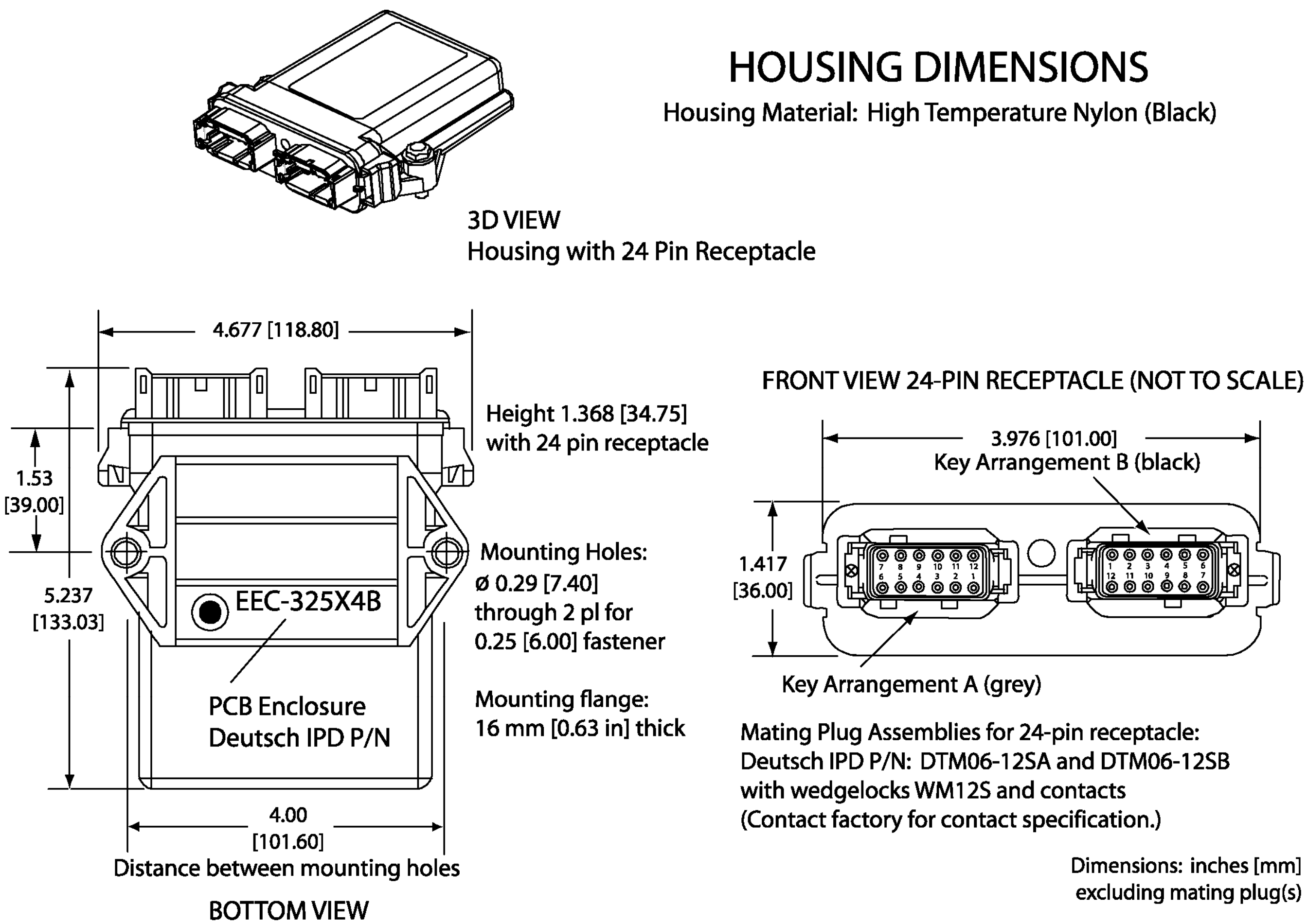


Figure 14 - Housing Dimensions

Grey Connector		Black Connector	
Pin #	**Function**	**Pin #**	**Function**
1	+5V Excitation 1	1	GND 3
2	IN 1+	2	IN 3-
3	+5V Excitation 2	3	GND 4
4	IN 2+	4	IN 4-
5	Tare Button	5	Interlock +/-
6	BATT-	6	CAN_H
7	BATT+	7	CAN_L
8	Digital Out	8	Interlock +/-
9	IN 2-	9	IN 4+
10	GND 2	10	+5V Excitation 4
11	IN 1-	11	IN 3+
12	GND 1	12	+5V Excitation 3

Table 27 - Connector Pinout

2.2. Mounting Instructions

NOTES & WARNINGS

- Do not install near high-voltage or high-current devices.
- Note the operating temperature range. All field wiring must be suitable for that temperature range.
- Install the unit with appropriate space available for servicing and for adequate wire harness access (15 cm) and strain relief (30 cm).
- Do not connect or disconnect the unit while the circuit is live, unless the area is known to be non-hazardous.

MOUNTING

The module is designed for mounting on the valve block. If it is mounted without an enclosure, the controller should be mounted horizontally with connectors facing left or right, or with the connectors facing down, to reduce likelihood of moisture entry.

Mask all labels if the unit is to be repainted, so label information remains visible.

Mounting legs include holes sized for ¼" bolts. The bolt length will be determined by the end-user's mounting plate thickness. Typically 20 mm (3/4 inch) is adequate.

If the module is mounted away from the valve block, no wire or cable in the harness should exceed 30 meters in length. The power input wiring should be limited to 10 meters.

CONNECTIONS

Use the following Deutsch IPD mating plugs to connect to the integral receptacles. Wiring to these mating plugs must be in accordance with all applicable local codes. Suitable field wiring for the rated voltage and current must be used. The rating of the connecting cables must be at least 85°C. For ambient temperatures below –10°C and above +70°C, use field wiring suitable for both minimum and maximum ambient temperature.

Refer to the respective Deutsch IPD datasheets for usable insulation diameter ranges and other instructions.

Receptacle Contacts	Mating Sockets as appropriate (Refer to www.laddinc.com for more information on the contacts available for this mating plug.)
Mating Connector	DTM06-12SA, DTM06-12SB, 2 wedges WM12S, 24 contacts (0462-201-20141)

3. 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

3.1. 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 Measured Inputs Feedback Message 65280 ($00FF00)
- PropB Transmit, Default Proportional Outputs Target Message 65296 ($00FF10)
- PropB Transmit, Default Proportional Outputs Feedback Message 65312 ($00FF20)
- PropB Transmit, Default Digital I/O State Feedback Message 65328 ($00FF30)
- PropB Receive, Default Output Control Data Message 65408 ($00FF80)
- PropB Receive, Default Output Enable Data Message 65424 ($00FF90)
- PropB Receive, Default Output Override Data Message 65440 ($00FFA0)
- PropB Receive, Default PID Feedback Data Message 65456 ($00FFB0)

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 of the 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 Electronic Assistant ® (EA) allows for quick and easy configuration of the unit over the CAN network.

3.2. NAME, Address and Software ID

J1939 NAME

The 4CH-SG 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	230, Body-to-Vehicle Interface Control
Function Instance	00, Axiomatic AX200000, 4 Channel Strain Gauge
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 Electronic Assistant ®) when they are all connected on the same network.

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 EA will allow 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 4CH-SG will continue select the next highest address until it find one that it can claim. See J1939/81 for more details about address claiming.

Software Identifier

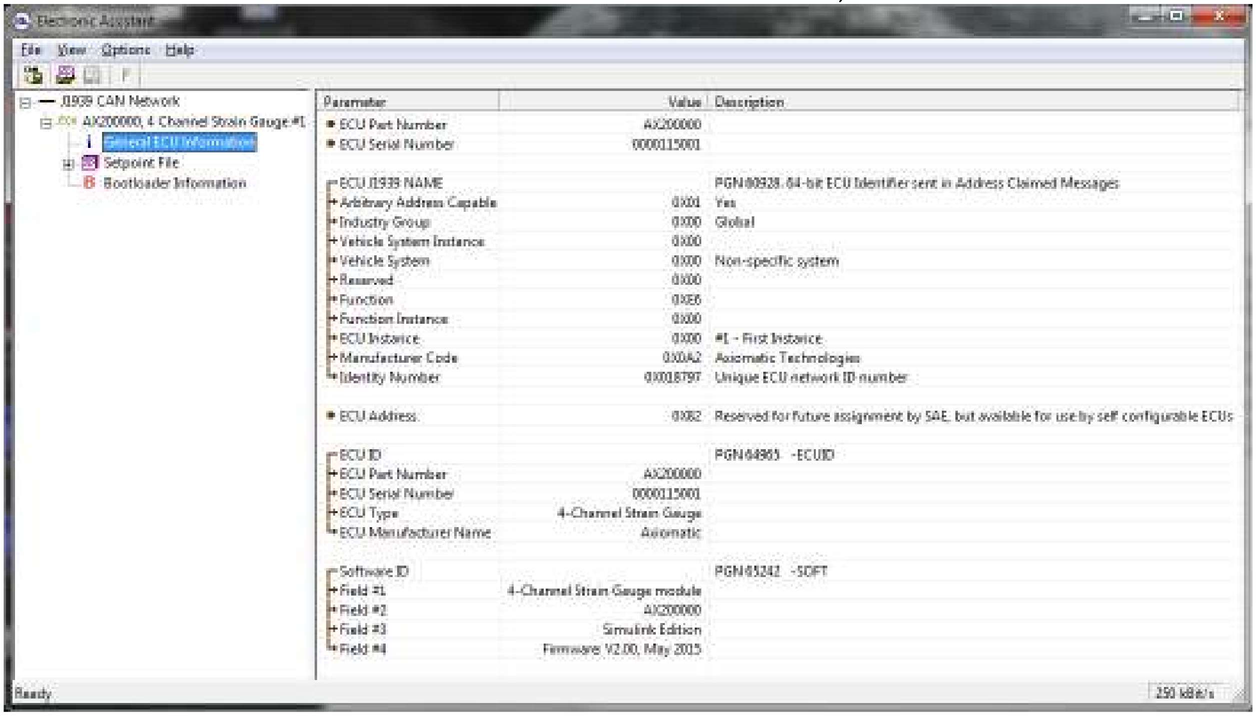
PGN 65242 Software Identification - SOFT
Transmission Repetition Rate: On request
Data Length: Variable
Extended Data Page: 0
Data Page: 0
PDU Format: 254
PDU Specific: 218 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65242 (0xFEDA)

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

For the 4CH-SG ECU, Byte 1 is set to 5, and the identification fields are as follows

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

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.

3.3. CAN Transmit Message Defaults

This section outlines the **default** settings of the 4CH-SG CAN transmissions. Recall, however, that this is a fully programmable unit, such that all these SPNs can be sent on different PGNs if so desired.

In all the messages shown below, not all the transmitted values have an SPN assigned to them, as this ECU only uses the SPNs for diagnostic trouble codes. If the SPN is shown as N/A, this means that the associated value cannot be used to generate DTCs.

The “Strain Gauge Inputs Message” has the following default configuration.

PGN 65280 Strain Gauge Input Measured

Transmission Repetition:	1000ms (1 second transmit rate)
Data Length:	8
Data Page:	0
PDU Format:	254
PDU Specific:	GE PGN Supporting Information:
Default Priority:	6
Parameter Group Number:	65280 (0xFF00)

Start Position	Length	Parameter Name	SPN
1-2	2 byte	Strain Gauge Input Measured 1	520448
3-4	2 byte	Strain Gauge Input Measured 2	520449
5-6	2 byte	Strain Gauge Input Measured 3	520450
7-8	2 byte	Strain Gauge Input Measured 4	520451

Strain Gauge Input Measured X, where X = 1 to 4

This value reflects the measured strain gauge load cell. By default, this value will be in terms of g/bit (grams per bit).

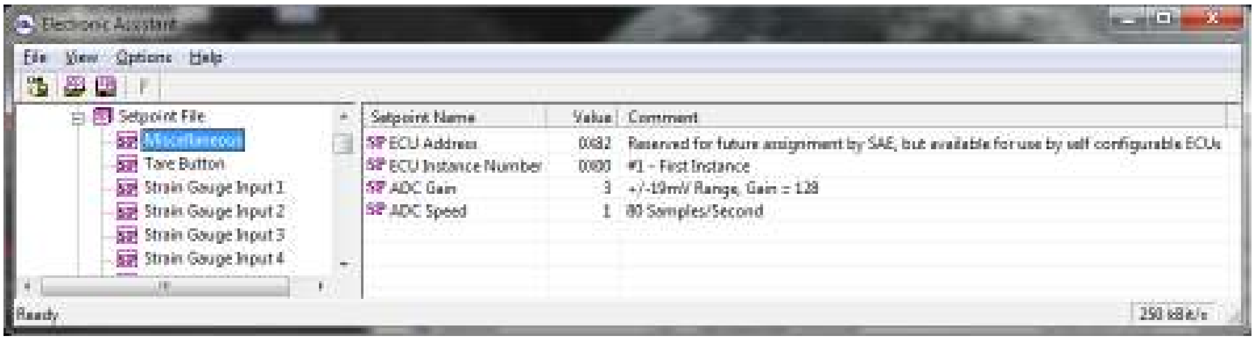
Data Length:	2 byte
Resolution:	1kg/bit, 0 offset
Data Range:	0 to 64255 g
Type:	Measured
Suspect Parameter Number:	520448 to 520451 (0x7F100 to 0x7F103, proprietary SPNs)
Parameter Group Number:	65280

4. ECU SETPOINTS ACCESSED WITH ELECTRONIC ASSISTANT

Many setpoints have been reference throughout this manual. This section describes in detail each setpoint, and their defaults and ranges. For more information on how each setpoint is used by the 4CH-SG, refer to the relevant section of the User Manual.

4.1. Miscellaneous Setpoints

The Miscellaneous setpoints primarily deal with the CAN Network. Refer to the notes for more information about each setpoint.



Screen Capture of Default Miscellaneous Setpoints

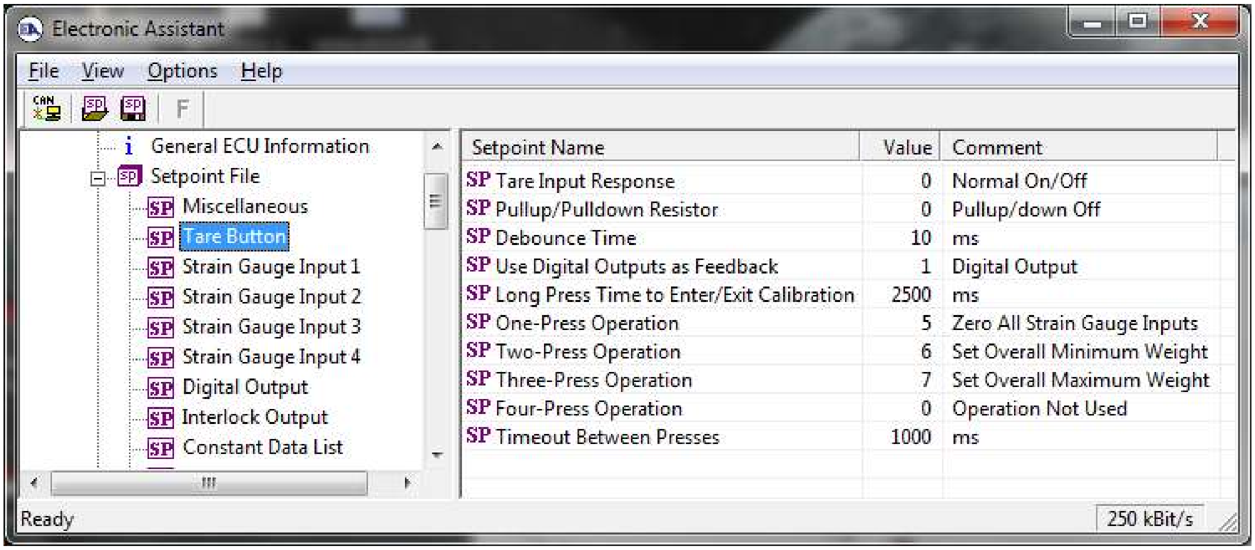
Name	Range	Default	Notes
ECU Instance Number	Drop List	0, #1 – First Instance	Per J1939-81
ECU Address	0 to 253	130 (0x82)	Preferred address for a self-configurable ECU
ADC Gain	0 to 3	3	+/-19mV (Gain 128)
ADC Speed	0 to 1	1	80 Samples per Second

If non-default values for the **"ECU Instance Number"** or **"ECU Address"** are used, they will not be updated during a setpoint file flash. These parameters need to be changed manually in order to prevent other units on the network to be affected. When they are changed, the controller will claim its new address on the network. It is recommended to close and re-open the CAN connection on EA after the file is loaded so that only the new NAME and address are showing in the J1939 CAN Network ECU list.

ADC Gain allows for determining the input differential range into the 4CH-SG controller. This parameter should be changed to optimize the highest resolution.

4.2. Tare Button Setpoints

The Tare/Calibration Input function block is defined in Section 1.2. Please refer to that section for detailed information on how these setpoints are used.

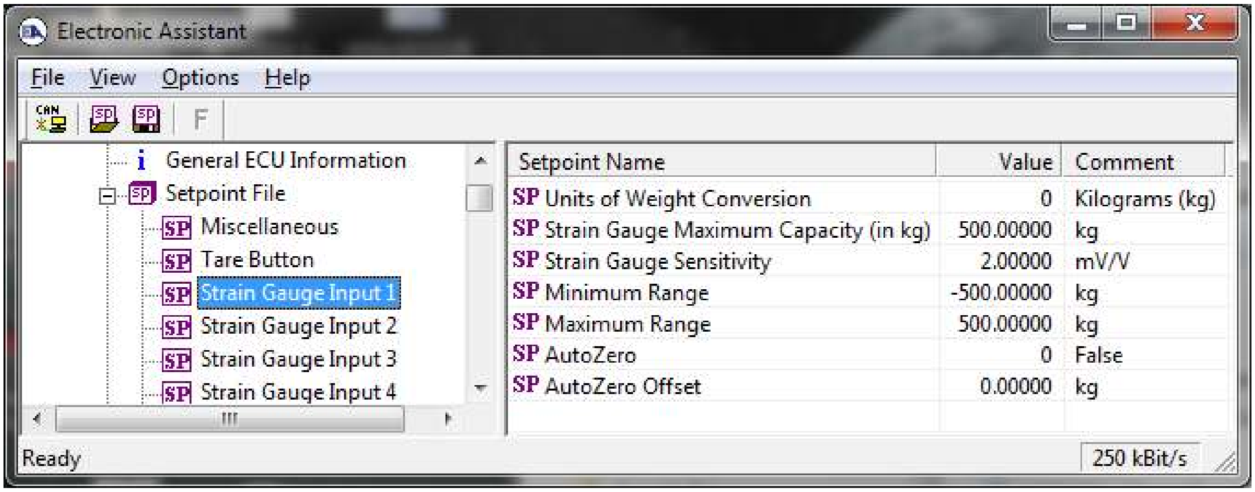


Screen Capture of Default Tare Button Setpoints

Name	Range	Default	Notes
Tare Input Response	Drop List	0 – Normal On/Off	Refer to Table 1
Pullup/Pulldown Resistor	Drop List	0 – Pullup/down Off	Refer to Table 2
Debounce Time	0 to 60000	10ms	Refer to Figure 3
Use Digital Outputs as Feedback	Drop List	1 – Digital Output	Refer to Table 3
Long Press Time to Enter/Exit Calibration	0 to 0xFFFFFFFF	2500ms	Time required to have the Tare button engaged to Enter and Exit Calibration. Refer to Figure 4
One-Press Operation	Drop List	5 – Zero All Strain Gauge Input	Refer to Table 4
Two-Press Operation	Drop List	6 – Set Overall Minimum Weight	Sets the overall minimum weight of all 4 strain gauge inputs for the application. Refer to Table 4
Three-Press Operation	Drop List	7 – Set Overall Maximum Weight	Sets the overall maximum weight of all 4 strain gauge inputs for the application. Refer to Table 4
Four-Press Operation	Drop List	0 – Operation Not Used	Refer to Table 4
Timeout Between Presses	0 to 0xFFFFFFFF	1000ms	Refer to Figure 5

4.3. Strain Gauge Input Setpoints

The Strain Gauge Input function block is defined in Section 1.3. Please refer there for detailed information about how all these setpoints are used.

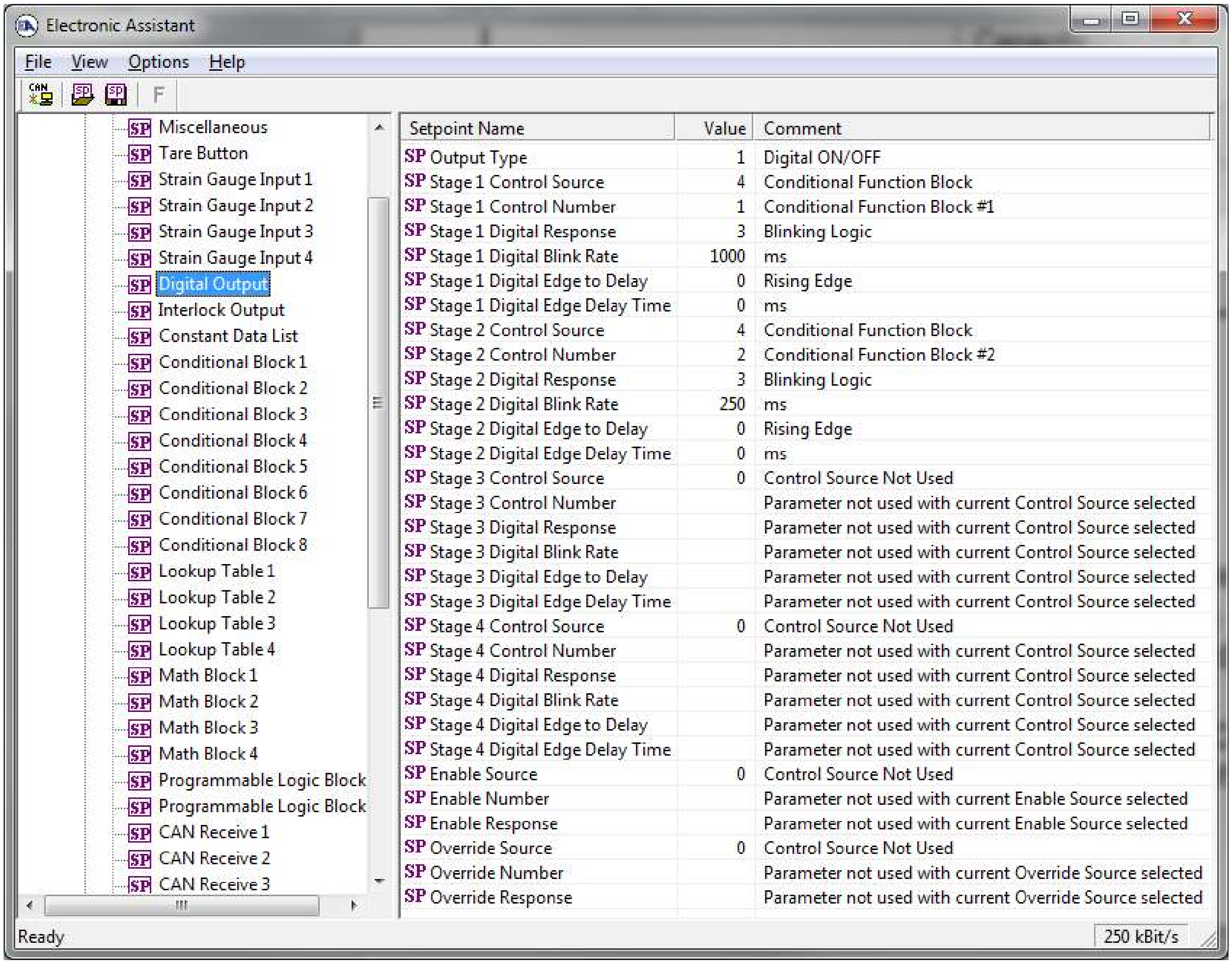


Screen Capture of Default Strain Gauge Input 1 Setpoints

Name	**Range**	**Default**	**Notes**
Units of Weight Conversion	Drop List	0 – Kilograms (kgs)	Units of conversion that will be used internally to measure weight
Strain Gauge Maximum Capacity	0 to 50000	500 kg	Capacity of Strain Gauge Load Cell is in kgs
Strain Gauge Sensitivity	0 to 50	2.00 mV/V	
Minimum Range	-Maximum Capacity to Maximum Range	-500 kg	This setpoint is automatically updated when Strain Gauge Maximum Capacity is changed. This range along with Maximum Range should be adjusted if intended to use a Strain Gauge Input as a Control Source to an Output Function Block
Maximum Range	Minimum Range to Maximum Capacity	500 kg	This setpoint is automatically updated when Strain Gauge Maximum Capacity is changed. This range along with Minimum Range should be adjusted if intended to use a Strain Gauge Input as a Control Source to an Output Function Block
AutoZero	Drop List	0 – False	When set to TRUE, the AutoZero command will auto null the current weight measured by the controller
AutoZero Offset	0 to 60000	0 (kg/lbs)	Updated when AutoZero command is used. However, it can be updated at anytime.

4.4. Digital Output Setpoints

The digital output by default is configured to respond to Conditional Function Block #1 and Conditional Function Block #2. Refer to section 1.5 for a more detailed description on this function block



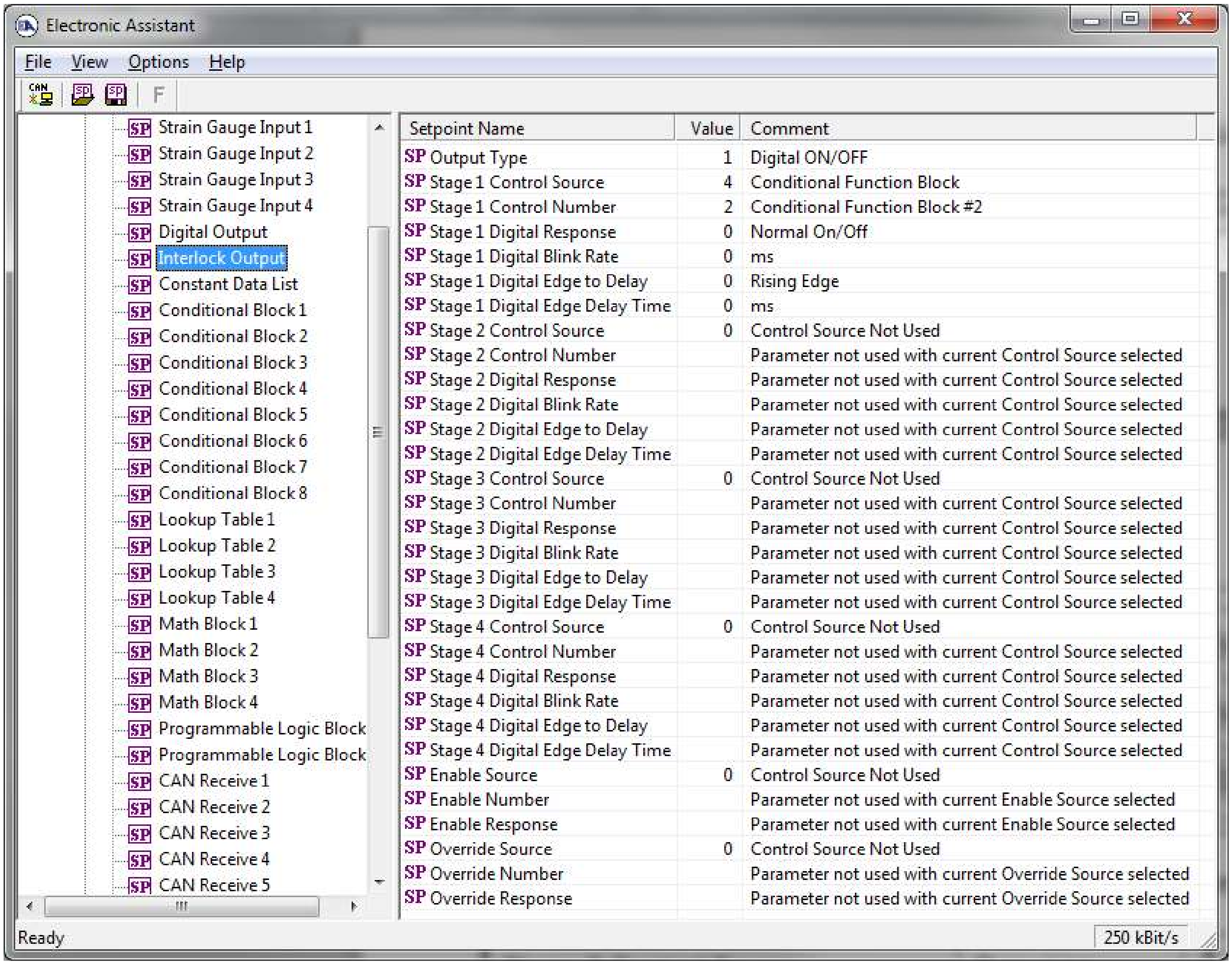
Screen Capture of Default Digital Output Setpoints

Name	Range	Default	Notes
Output Type	Drop List	1 – Digital ON/OFF	If value is set to 0, Output is disabled
Stage 1 Control Source	Drop List	4 – Conditional Function Block	Refer to Table 6
Stage 1 Control Number	Depends on Source	1 – Conditional Function Block #1	Refer to Table 7
Stage 1 Digital Response	Drop List	3 – Blinking Logic	Refer to Table 8
Stage 1 Digital Blink Rate	0 to 60000	1000ms	
Stage 1 Digital Edge to Delay	Drop List	0 – Rising Edge	
Stage 1 Digital Edge Delay Time	0 to 60000	0ms	
Stage 2 Control Source	Drop List	4 – Conditional Function Block	Refer to Table 6
Stage 2 Control Number	Depends on Source	2 – Conditional Function Block #2	Refer to Table 7

Stage 2 Digital Response	Drop List	3 – Blinking Logic	Refer to Table 8
Stage 2 Digital Blink Rate	0 to 60000	250ms	
Stage 2 Digital Edge to Delay	Drop List	0 – Rising Edge	
Stage 2 Digital Edge Delay Time	0 to 60000	0ms	
Stage 3 Control Source	Drop List	0 – Control Source Not Used	Refer to Table 6
Stage 3 Control Number	Depends on Source	1	Refer to Table 7
Stage 3 Digital Response	Drop List	0 – Normal On/Off	Refer to Table 8
Stage 3 Digital Blink Rate	0 to 60000	0	
Stage 3 Digital Edge to Delay	Drop List	0 – Rising Edge	
Stage 3 Digital Edge Delay Time	0 to 60000	0ms	
Stage 4 Control Source	Drop List	0 – Control Source Not Used	Refer to Table 6
Stage 4 Control Number	Depends on Source	1	Refer to Table 7
Stage 4 Digital Response	Drop List	0 – Normal On/Off	Refer to Table 8
Stage 4 Digital Blink Rate	0 to 60000	0	
Stage 4 Digital Edge to Delay	Drop List	0 – Rising Edge	
Stage 4 Digital Edge Delay Time	0 to 60000	0ms	
Enable Source	Drop List	0 – Control Source Not Used	Refer to Table 6
Enable Number	Depends on Source	1	Refer to Table 7
Enable Response	Drop List	0 – Enable When On	Refer to Table 9
Override Source	Drop List	0 – Control Source Not Used	Refer to Table 6
Override Number	Depends on Source	1	Refer to Table 7
Override Response	Drop List	0 – Override When On	Refer to Table 10

4.5. Interlock Output Setpoints

The interlock output by default is configured to respond to Conditional Function Block #2. Refer to section 1.5 for a more detailed description on this function block



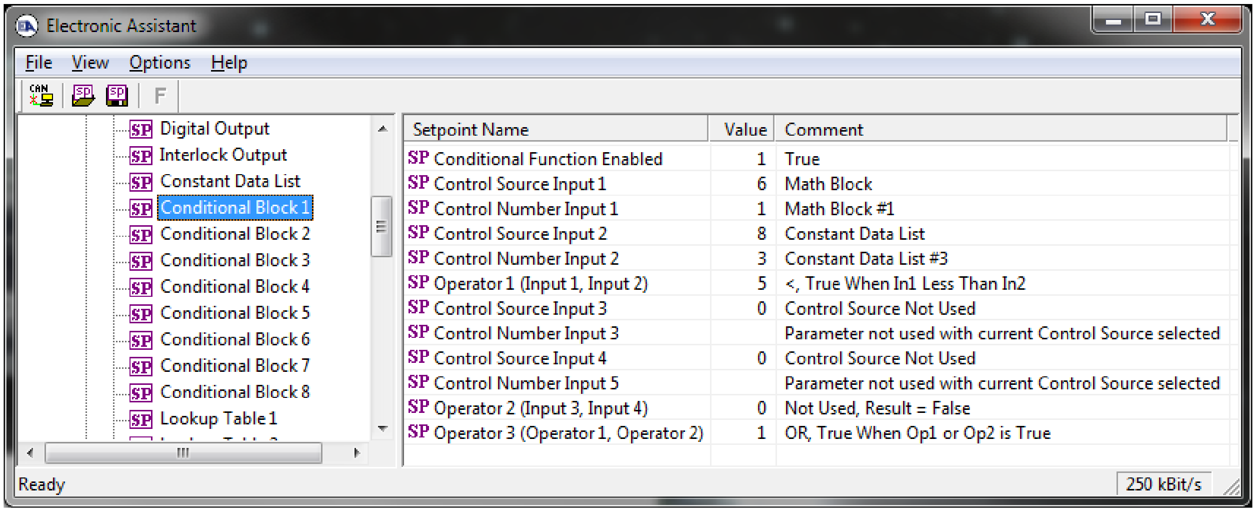
Screen Capture of Default Interlock Output Setpoints

Name	Range	Default	Notes
Output Type	Drop List	1 – Digital ON/OFF	If value is set to 0, Output is disabled
Stage 1 Control Source	Drop List	4 – Conditional Function Block	Refer to Table 6
Stage 1 Control Number	Depends on Source	2 – Conditional Function Block #2	Refer to Table 7
Stage 1 Digital Response	Drop List	0 – Normal On/Off	Refer to Table 8
Stage 1 Digital Blink Rate	0 to 60000	0ms	
Stage 1 Digital Edge to Delay	Drop List	0 – Rising Edge	
Stage 1 Digital Edge Delay Time	0 to 60000	0ms	
Stage 2 Control Source	Drop List	0 – Control Source Not Used	Refer to Table 6
Stage 2 Control Number	Depends on Source	1	Refer to Table 7
Stage 2 Digital Response	Drop List	0 – Normal On/Off	Refer to Table 8
Stage 2 Digital Blink Rate	0 to 60000	0ms	

Stage 2 Digital Edge to Delay	Drop List	0 – Rising Edge	
Stage 2 Digital Edge Delay Time	0 to 60000	0ms	
Stage 3 Control Source	Drop List	0 – Control Source Not Used	Refer to Table 6
Stage 3 Control Number	Depends on Source	1	Refer to Table 7
Stage 3 Digital Response	Drop List	0 – Normal On/Off	Refer to Table 8
Stage 3 Digital Blink Rate	0 to 60000	0	
Stage 3 Digital Edge to Delay	Drop List	0 – Rising Edge	
Stage 3 Digital Edge Delay Time	0 to 60000	0ms	
Stage 4 Control Source	Drop List	0 – Control Source Not Used	Refer to Table 6
Stage 4 Control Number	Depends on Source	1	Refer to Table 7
Stage 4 Digital Response	Drop List	0 – Normal On/Off	Refer to Table 8
Stage 4 Digital Blink Rate	0 to 60000	0	
Stage 4 Digital Edge to Delay	Drop List	0 – Rising Edge	
Stage 4 Digital Edge Delay Time	0 to 60000	0ms	
Enable Source	Drop List	0 – Control Source Not Used	Refer to Table 6
Enable Number	Depends on Source	1	Refer to Table 7
Enable Response	Drop List	0 – Enable When On	Refer to Table 9
Override Source	Drop List	0 – Control Source Not Used	Refer to Table 6
Override Number	Depends on Source	1	Refer to Table 7
Override Response	Drop List	0 – Override When On	Refer to Table 10

4.6. Conditional Function Block Setpoints

The Conditional Logic function blocks are defined in section 1.7. Please refer to that section for more details on the functionality of these blocks. The user can make up to two comparisons per block. The output of this function block is only 1 (TRUE) or 0 (FALSE).



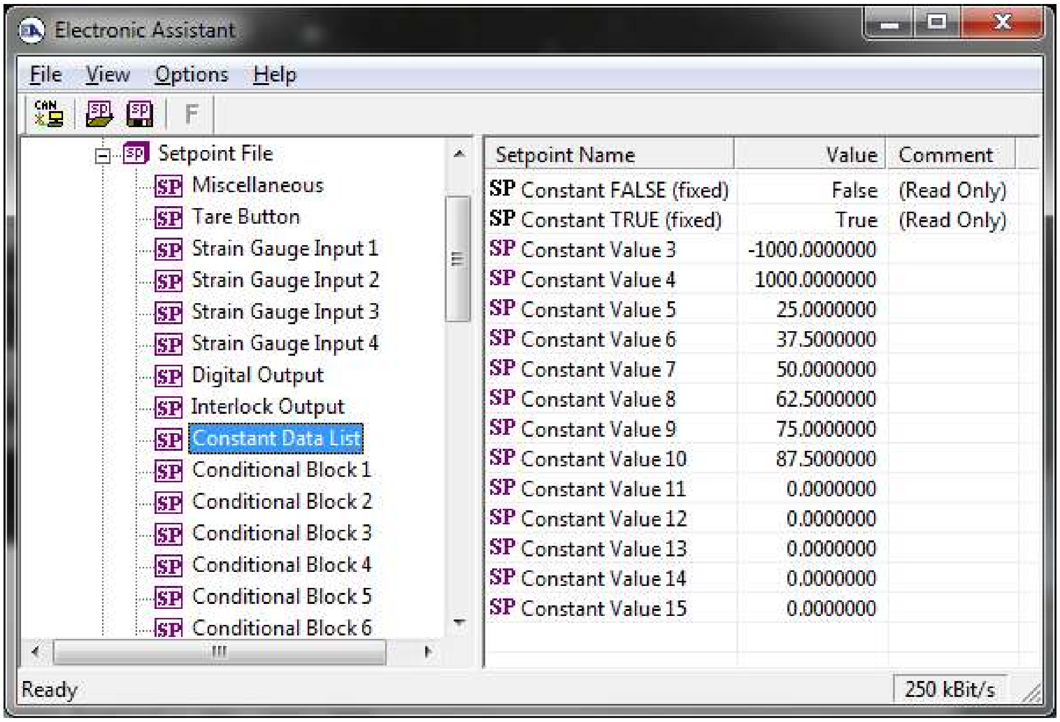
Screen Capture of Default Conditional Block Setpoints

4.7. 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. Throughout this manual, various references have been made to constants, as summarized in the examples listed below.

a) Programmable Logic: Constant **"Table X = Condition Y, Argument 2"**, where X and Y = 1 to 3
b) Math Function: Constant **"Math Input X"**, where X = 1 to 4

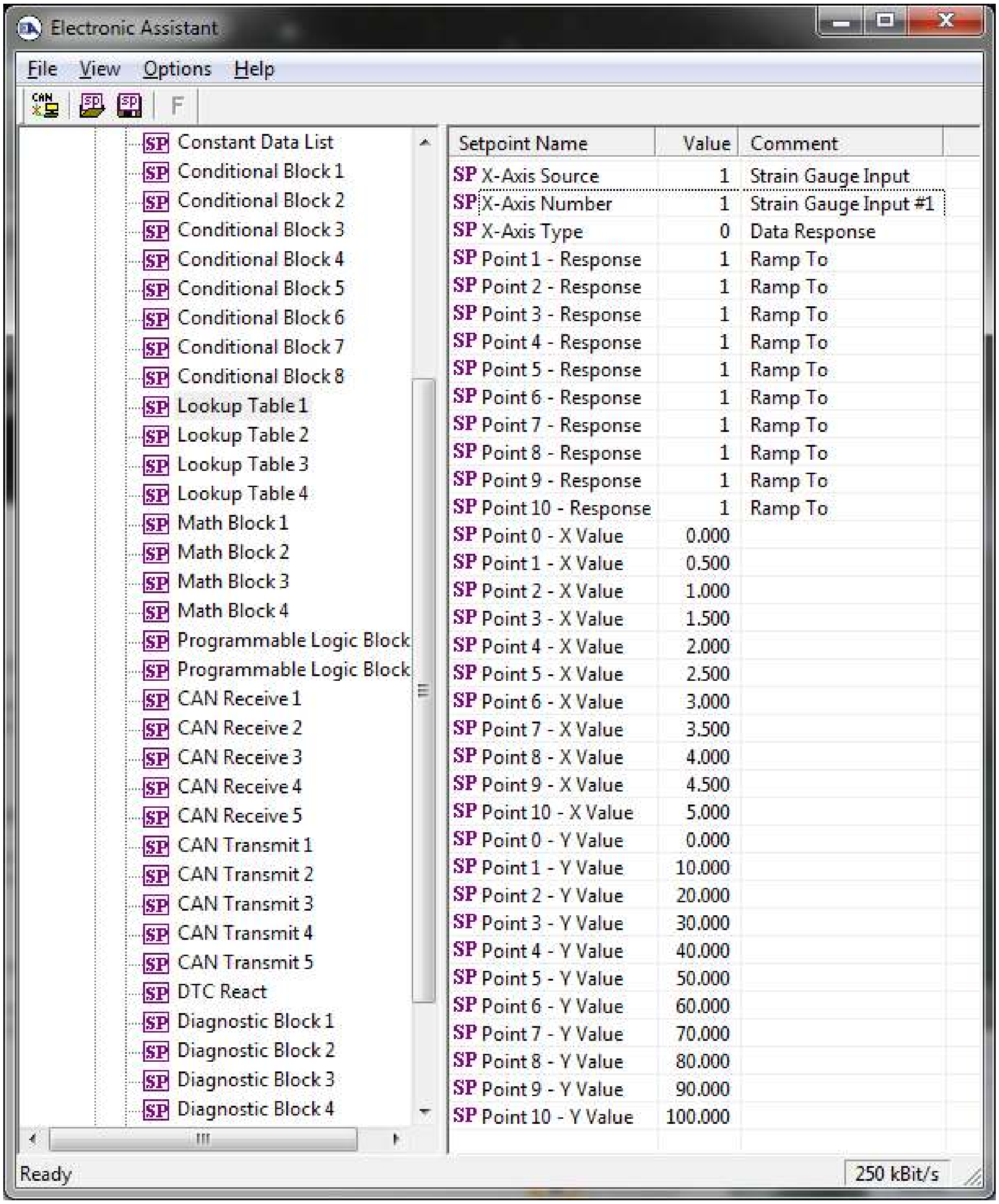
The first two constants are fixed values of 0 (False) and 1 (True) for use in binary logic. The remaining 13 constants are fully user configurable to any value between +/- 1,000,000. The default values (shown below) are arbitrary and should be configured by the user as appropriate for their application. Constant Value 3 will be updated if Tare Option 6 *'Set Overall Minimum Weight'* is selected during zeroing/calibration. Similarly, Constant Value 4 will be updated if Tare Option 7 *'Set Overall Maximum Weight'* is selected during zeroing/calibration.



Screen Capture of Default Constant Data List Setpoints

4.8. Lookup Table Setpoints

The Lookup Table function block is defined in Section 1.8. Please refer there for detailed information about how all these setpoints are used. As this function block's X-Axis defaults are defined by the **"X-Axis Source"** selected from Table 6, there is nothing further to define in terms of defaults and ranges beyond that which is described in Section 1.8. Recall, the X-Axis values will be automatically updated if the min/max range of the selected source is changed.



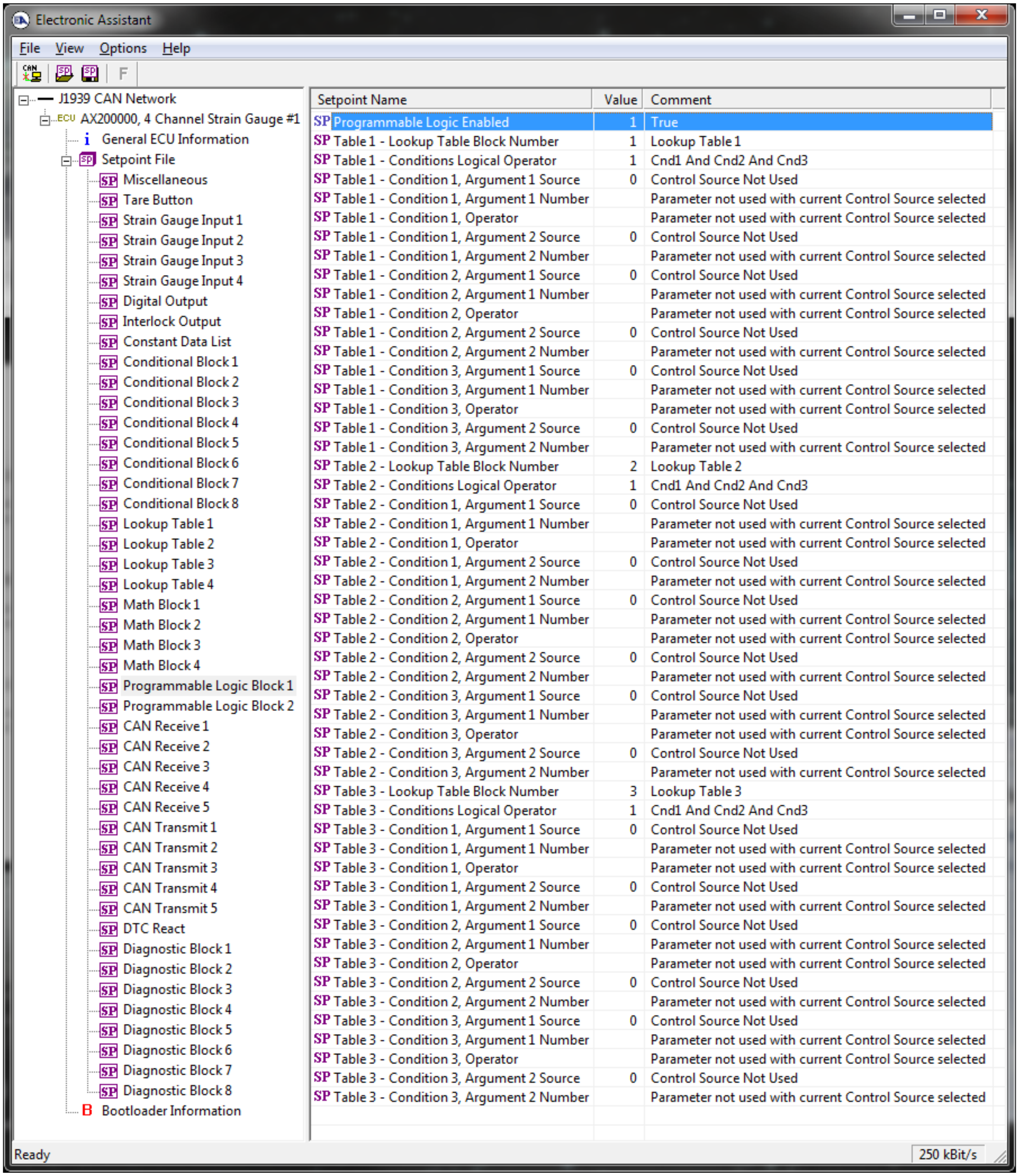
Screen Capture of Example Lookup Table 1 Setpoints

Note: In the screen capture shown above, the “X-Axis Source” has been changed from its default value in order to enable the function block.

4.9. Programmable Logic Setpoints

The Programmable Logic function block is defined in Section 1.9. Please refer there for detailed information about how all these setpoints are used.

As this function block is disabled by default, there is nothing further to define in terms of defaults and ranges beyond that which is described in Section 1.9. The screen capture below shows how the setpoints referenced in that section appear on EA.



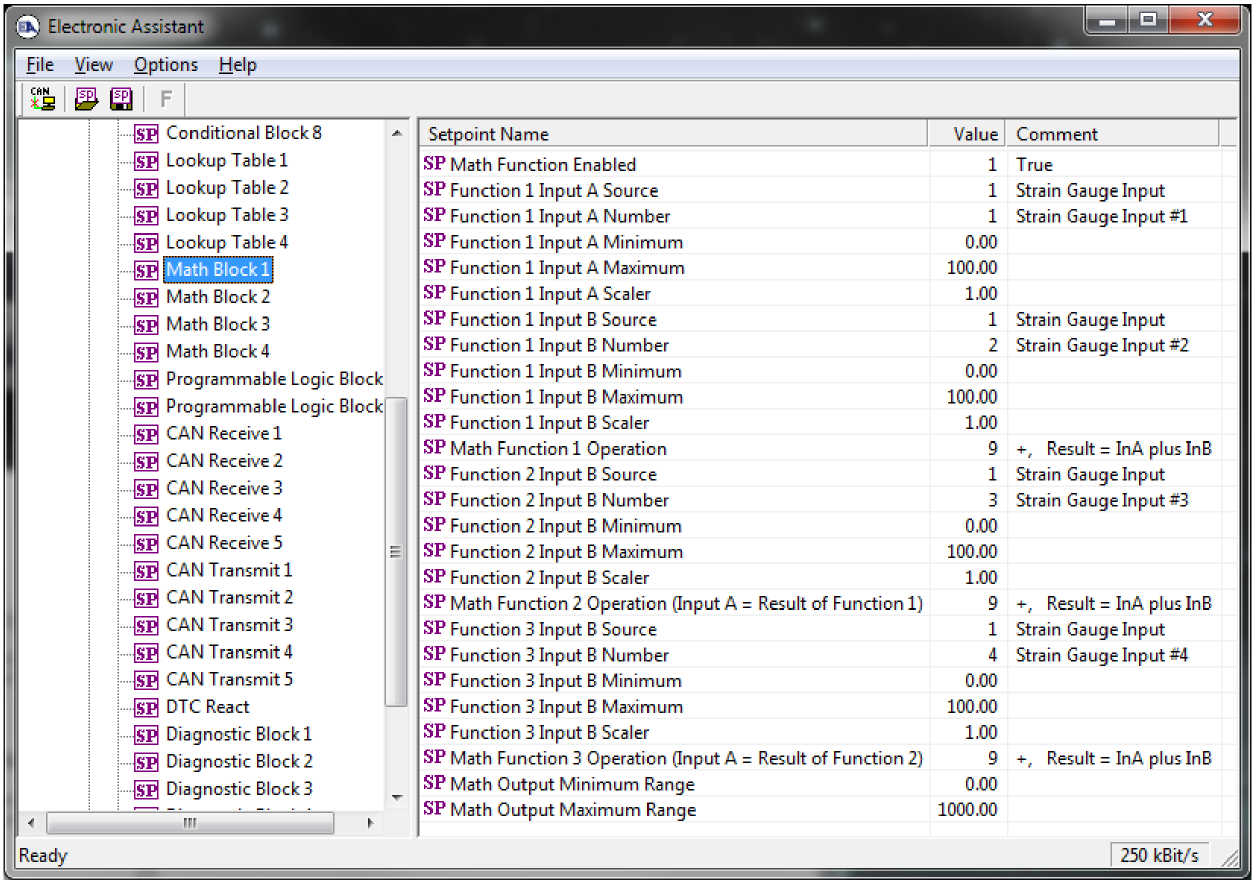
Screen Capture of Default Programmable Logic 1 Setpoints

Note: In the screen capture shown above, the “Programmable Logic Block Enabled” has been changed from its default value in order to enable the function block.

Note: The default values for the Argument1, Argument 2 and Operator are all the same across all the Programmable Logic function blocks, and must therefore be changed by the user as appropriate before this can be used.

4.10. Math Function Setpoints

The Math Function block is defined in Section 1.10. Please refer there for detailed information about how all these setpoints are used.



Screen Capture of Example Math Function 1 Setpoints

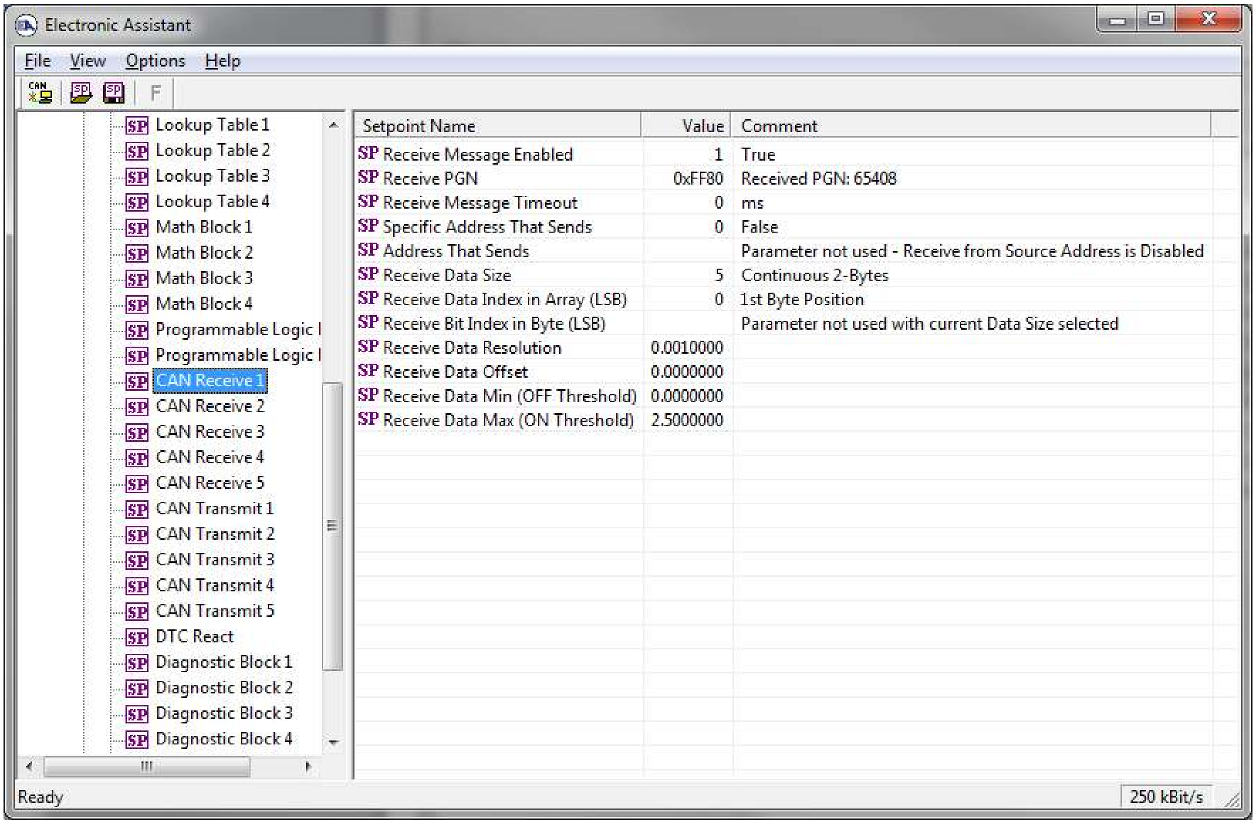
Note: In the screen capture shown above, the "Math Function Enabled" has been changed from its default value in order to enable the function block. Other setpoints have also been changed from default values in order to illustrate how the block might look when functional, as per the example outlined in Section 1.10.

Name	Range	Default	Notes
Math Function Enabled	Drop List	False	
Function 1 Input A Source	Drop List	Control not used	See **Error! Reference source not found.**6
Function 1 Input A Number	Depends on control source	1	See **Error! Reference source not found.**7
Function 1 Input A Minimum	-10^6 to 10^6	0.0	
Function 1 Input A Maximum	-10^6 to 10^6	100.0	
Function 1 Input A Scaler	-1.00 to 1.00	1.00	
Function 1 Input B Source	Drop List	Control not used	See **Error! Reference source not found.**6
Function 1 Input B Number	Depends on control source	1	See **Error! Reference source not found.**7

Function 1 Input B Minimum	-10^6 to 10^6	0.0	
Function 1 Input B Maximum	-10^6 to 10^6	100.0	
Function 1 Input B Scaler	-1.00 to 1.00	1.00	
Math Function 1 Operation	Drop List	=, True when InA Equals InB	See **Error! Reference source not found.**18
Function 2 Input B Source	Drop List	Control not used	See **Error! Reference source not found.**6
Function 2 Input B Number	Depends on control source	1	See Table **Error! Reference source not found.**7
Function 2 Input B Minimum	-10^6 to 10^6	0.0	
Function 2 Input B Maximum	-10^6 to 10^6	100.0	
Function 2 Input B Scaler	-1.00 to 1.00	1.00	
Math Function 3 Operation	Drop List	=, True when InA Equals InB	See **Error! Reference source not found.**18
Function 3 Input B Source	Drop List	Control not used	See **Error! Reference source not found.**6
Function 3 Input B Number	Depends on control source	1	See Table 7
Function 3 Input B Minimum	-10^6 to 10^6	0.0	
Function 3 Input B Maximum	-10^6 to 10^6	100.0	
Function 3 Input B Scaler	-1.00 to 1.00	1.00	
Math Function 3 Operation	Drop List	=, True when InA Equals InB	See **Error! Reference source not found.**18
Math Output Minimum Range	-10^6 to 10^6	0.0	
Math Outptu Maximum Range	-10^6 to 10^6	100.0	

4.11. CAN Receive Setpoints

The CAN Receive function block is defined in Section 1.13. Please refer there for detailed information about how all these setpoints are used.

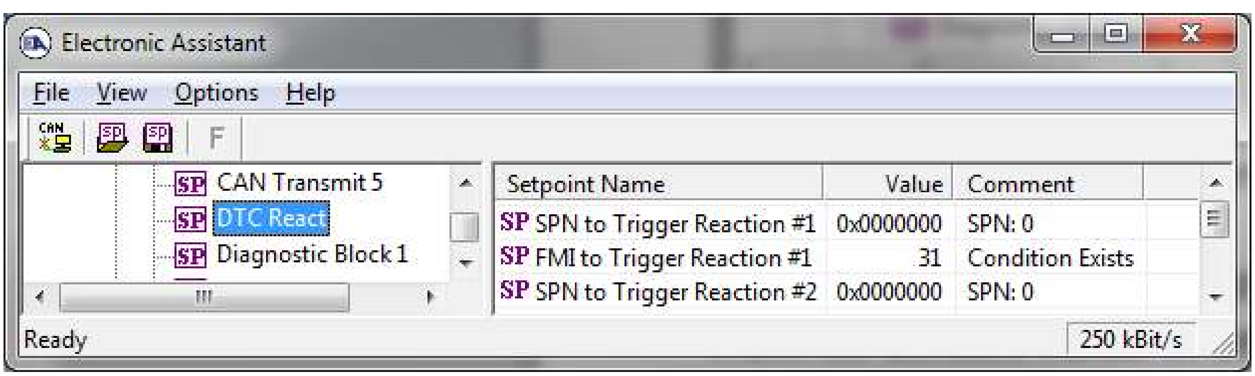


Screen Capture of Default CAN Receive 1 Setpoints

Note: In the screen capture shown above, the "Receive Message Enabled" has been changed from its default value in order to enable the function block

4.12. DTC React

The DTC React Function Block is defined in Section 1.1212. Please refer there for detailed information about how these setpoints are used.

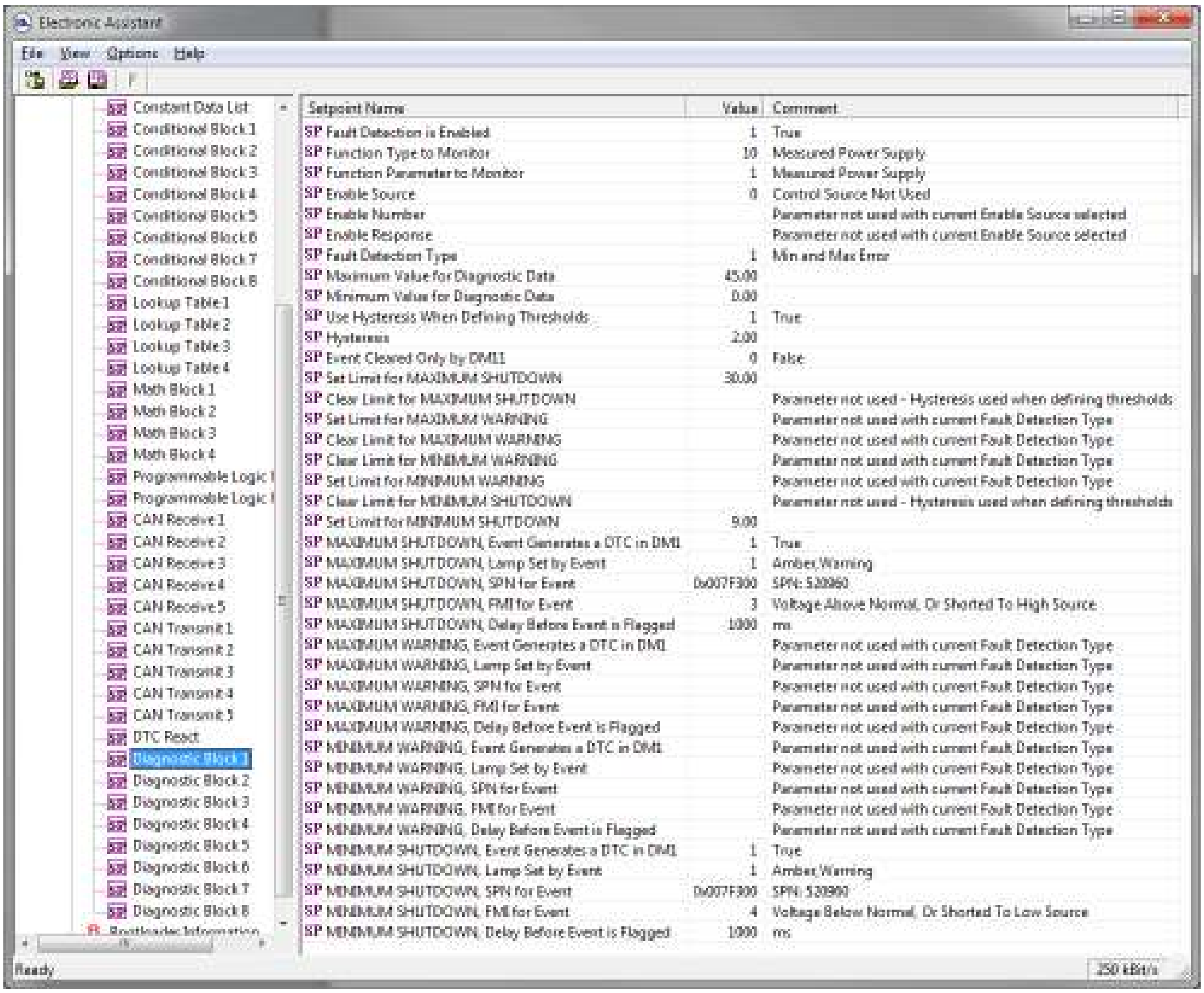


Screen Capture of DTC Setpoints

Name	Range	Default	Notes
SPN to Trigger Reaction #1	0 to 524287	0	0 is an illegal value, and disables the DTC
FMI to Trigger Reaction #X	Drop List	31, Condition Exists	Supports all FMIs in the J1939 standard

4.13. Diagnostics Blocks

There are 8 Diagnostics blocks that can be configured to monitor various parameters of the Controller. The Diagnostic Function Block is defined in section 1.66. Please refer there for detailed information how these setpoints are used.



Screen Capture of Default Diagnostic Block 1 Setpoints

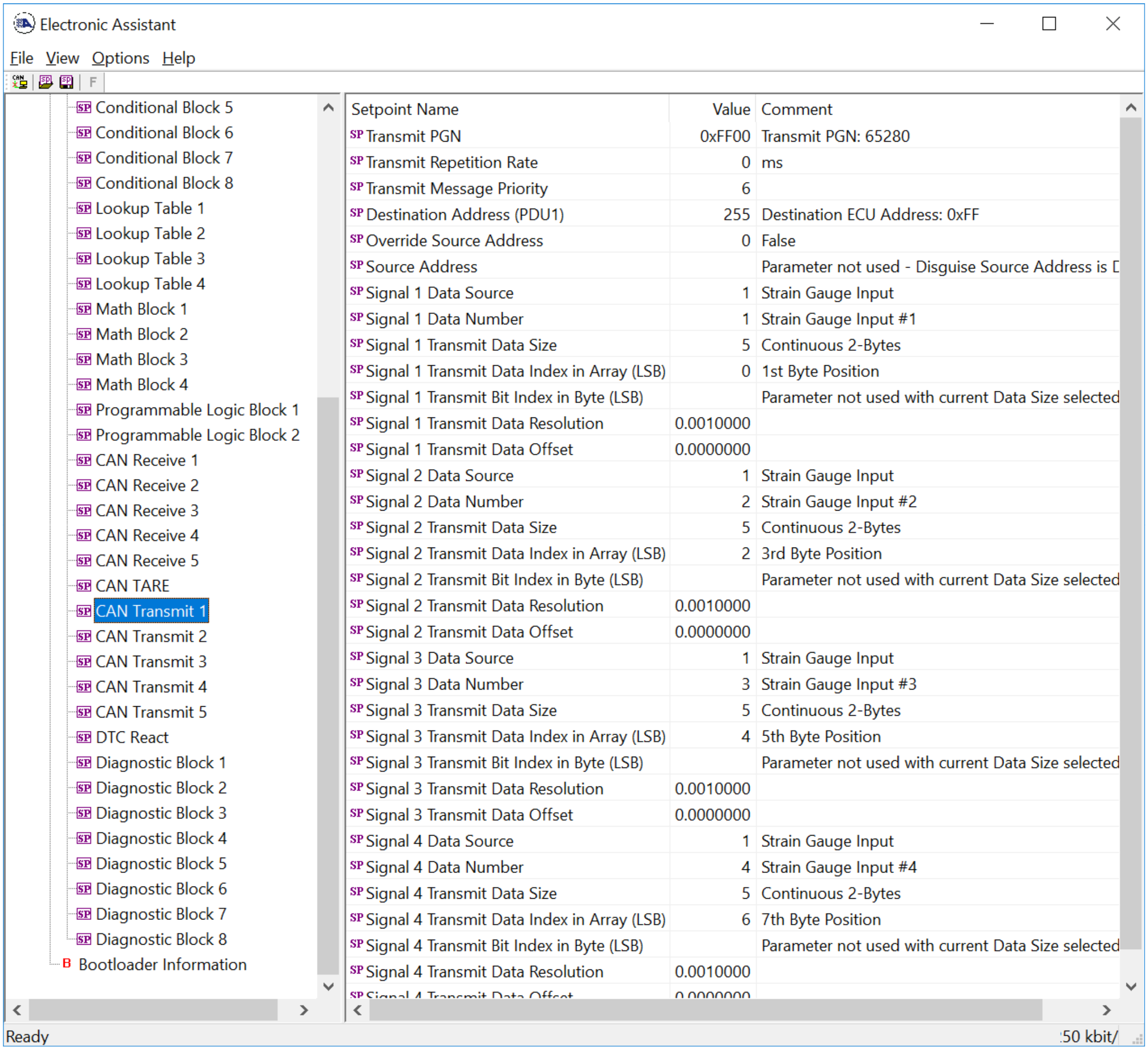
Name	Range	Default	Notes
Fault Detection is Enabled	Drop List	False	
Function Type to Monitor	Drop List	0 – Control not used	
Function parameter to Monitor	Drop List	0 – No selection	
Fault Detection Type	Drop List	1 – Min and Max Error	See section 1.6
Maximum Value for Diagnostic Data	Minimum Value for Diagnostic Data … 4.28e9	5.0	
Minimum Value for Diagnostic Data	0.0 … Maximum Value for Diagnostic Data	0.0	

Use Hysteresis When Defining Thresholds	Drop List	False	
Hysteresis	0.0 … Maximum Value for Diagnostic Data	0.0	
Event Cleared only by DM11	Drop List	False	
Set Limit for MAXIMUM SHUTDOWN	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	4.8	
Clear Limit for MAXIMUM SHUTDOWN	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	4.6	
Set Limit for MAXIMUM WARNING	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.0	
Clear Limit for MAXIMUM WARNING	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.0	
Clear Limit for MINIMUM WARNING	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.0	
Set Limit for MINIMUM WARNING	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.0	
Clear Limit for MINIMUM SHUTDOWN	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.4	
Set Limit for MINIMUM SHUTDOWN	Minimum Value for Diagnostic Data … Maximum Value for Diagnostics Data	0.2	
MAXIMUM SHUTDOWN, Event Generates a DTC in DM1	Drop List	True	
MAXIMUM SHUTDOWN, Lamp Set by Event	Drop List	0 – Protect	**1.1.** See Table **13 - Lamp Set by Even in DM1 Options**
MAXIMUM SHUTDOWN, SPN for Event	0...524287	520448 ($7F100)	It is the user's responsibility to select an SPN that will not violate the J1939 standard.
MAXIMUM SHUTDOWN, FMI for Event	Drop List	3, Voltage Above Normal	See Table 14
MAXIMUM SHUTDOWN, Delay Before Event is Flagged	0...60000 ms	1000	

MAXIMUM WARNING, Event Generates a DTC in DM1	Drop List	True	
MAXIMUM WARNING, Lamp Set by Event	Drop List	0 – Protect	**1.2.** See Table **13 - Lamp Set by Even in DM1 Options**
MAXIMUM WARNING, SPN for Event	0...524287	520704 ($7F200)	It is the user's responsibility to select an SPN that will not violate the J1939 standard.
MAXIMUM WARNING, FMI for Event	Drop List	3, Voltage Above Normal	See Table 14
MAXIMUM WARNING, Delay Before Event is Flagged	0...60000 ms	1000	
MINIMUM WARNING, Event Generates a DTC in DM1	Drop List	True	
MINIMUM WARNING, Lamp Set by Event	Drop List	0 – Protect	**1.3.** See Table **13 - Lamp Set by Even in DM1 Options**
MAXIMUM WARNING, SPN for Event	0...524287	520960 ($7F300)	It is the user's responsibility to select an SPN that will not violate the J1939 standard.
MINIMUM WARNING, FMI for Event	Drop List	4, Voltage Below Normal	See Table 14
MINIMUM WARNING, Delay Before Event is Flagged	0...60000 ms	1000	
MINIMUM SHUTDOWN, Event Generates a DTC in DM1	Drop List	True	
MINIMUM SHUTDOWN, Lamp Set by Event	Drop List	Amber Warning	**1.4.** See Table **13 - Lamp Set by Even in DM1 Options**
MINIMUM SHUTDOWN, SPN for Event	0...524287	521216 ($7F400)	It is the user's responsibility to select an SPN that will not violate the J1939 standard.
MINIMUM SHUTDOWN, FMI for Event	Drop List	4, Voltage Below Normal	See Table 14
MINIMUM SHUTDOWN, Delay Before Event is Flagged	0...60000 ms	1000	

4.14. CAN Transmit Setpoints

The CAN Transmit function block is defined in Section 1.11, with addition information in Section 3.3. Please refer there for detailed information about how all these setpoints are used.



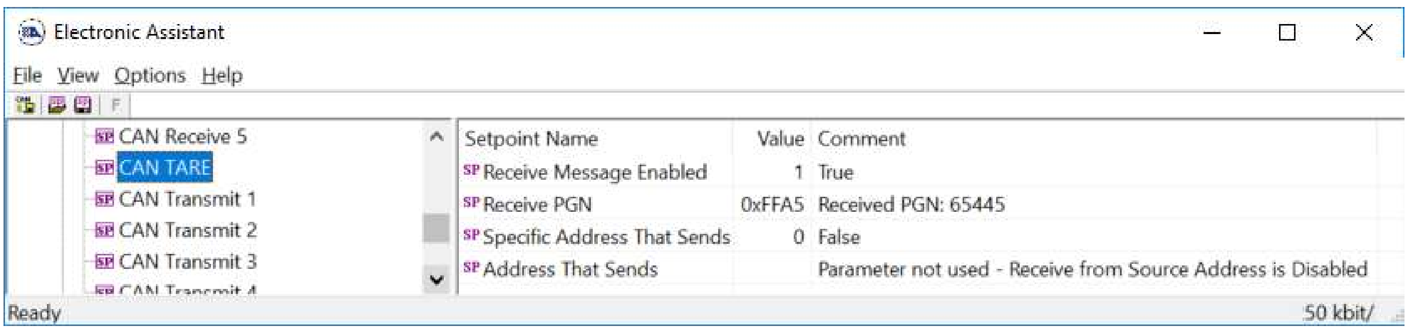
Screen Capture of Default CAN Transmit 1 Setpoints

Name	Range	Default	Notes
Transmit PGN	0 to 65535	65280 ($FF00) Txd1 to 2	See Section 3.3 for defaults
Transmit Repetition Rate	0 to 60,000 ms	0	0ms disables transmit
Transmit Message Priority	0 to 7	6	Proprietary B Priority
Destination Address (for PDU1)	0 to 255	254 (0xFE, Null Address)	Not used by default
Override Source Address	Drop List	No	
Source Address	0 to 255	130 (0x82)	Source Address to Mask
Transmit Data Source	Drop List	Different for each	See Table 18 for defaults
Transmit Data Number	Per Source	Different for each	See Table 18 for defaults
Transmit Data Size	Drop List	Continuous 2-Bytes	0 = Not Used (disabled) 1 = 1-Bit 2 = 2-Bits

			3 = 4-Bits 4 = 1-Byte 5 = 2-Bytes 6 = 4-Bytes See Section 3.3 for defaults
Transmit Data Index in Array (LSB)	1 to 9-DataSize	Different for each	See Section 3.3 for defaults
Transmit Bit Index in Byte (LSB)	1 to 9-BitSize	Different for each	Only used with Bit Data Types
Transmit Data Resolution	-10^6 to 10^6	Different for each	See Section 3.3 for defaults
Transmit Data Offset	-10^4 to 10^4	Different for each	See Section 3.3 for defaults

4.15. CAN Tare Setpoints

The CAN Tare function block is defined in Section 1.14. It is used to calibrate/tare the strain gauge input of the 4CH-SG controller. Please refer to that section for detailed information about how all these setpoints are used.



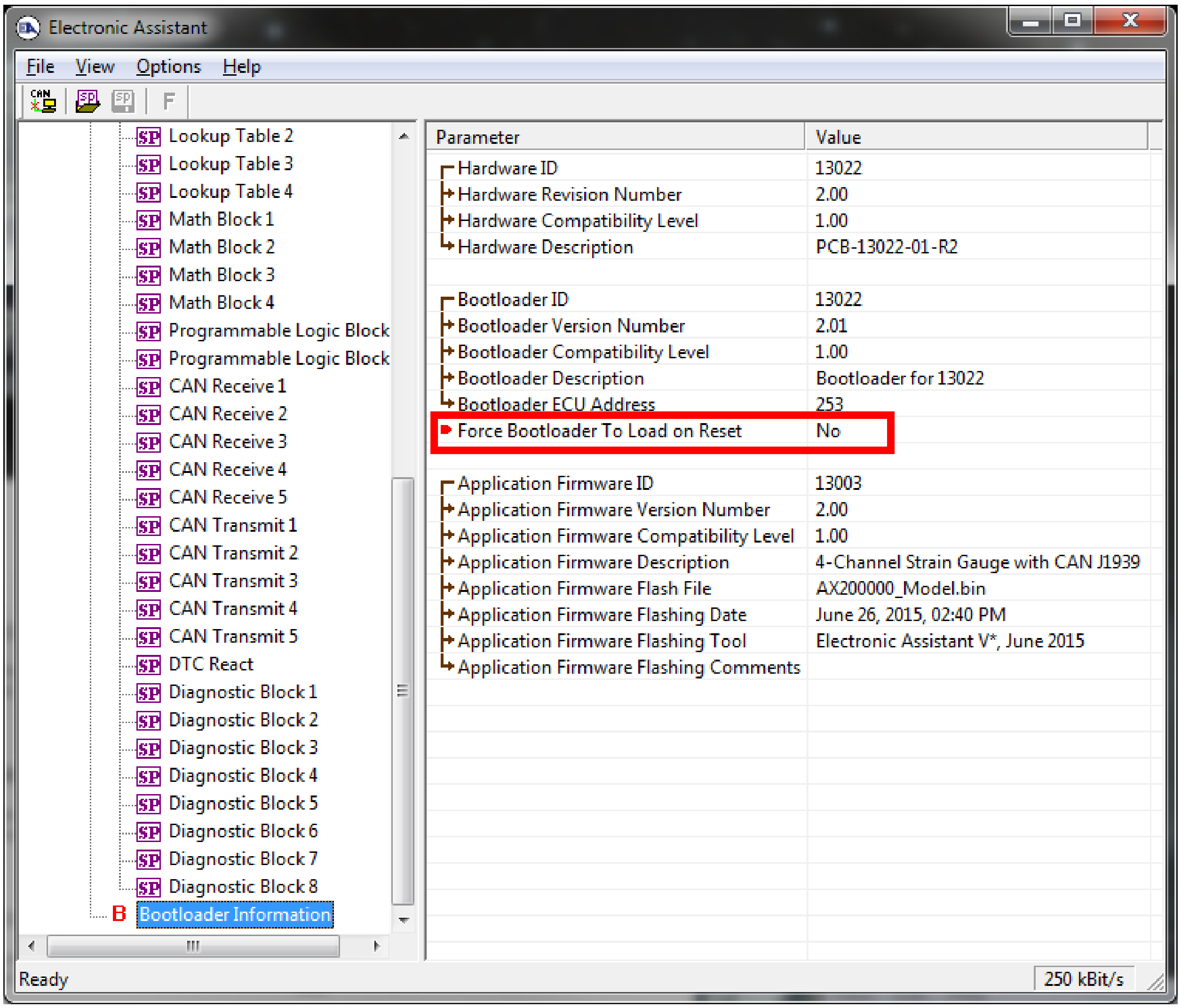
Screen Capture of Default CAN Tare Setpoints

Name	Range	Default	Notes
Received Message Enabled	Drop List	True	Enables or disables CAN Tare Function
Receive PGN	0 to 65535	0xFFA5	Any PGN
Specific Address That Sends	Drop List	False	If set to True, 4CH-SG communicates with ECU address selected
Address That Sends	0 to 254	0x00	ECU Address of sender

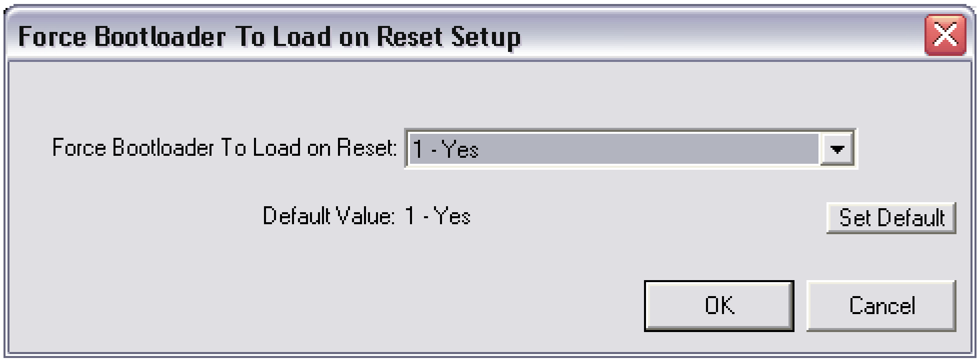
5. REFLASHING OVER CAN WITH EA ® BOOTLOADER

The AX200000 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.

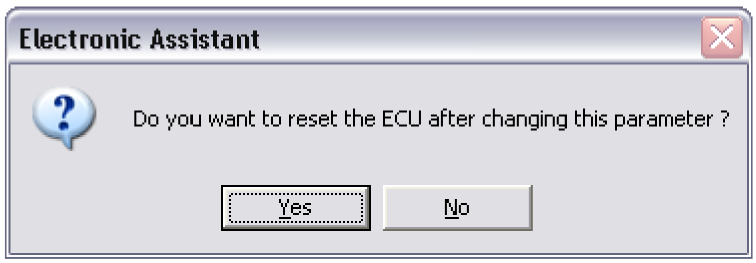
1. When EA first connects to the ECU, the **Bootloader Information** section will display the following information.



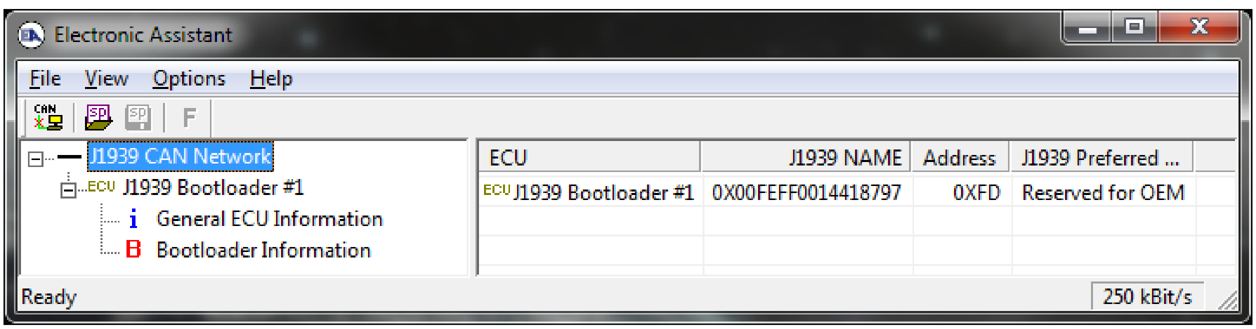
2. To use the bootloader to upgrade the firmware running on the ECU, change the variable **“Force Bootloader To Load on Reset**” to *Yes.*

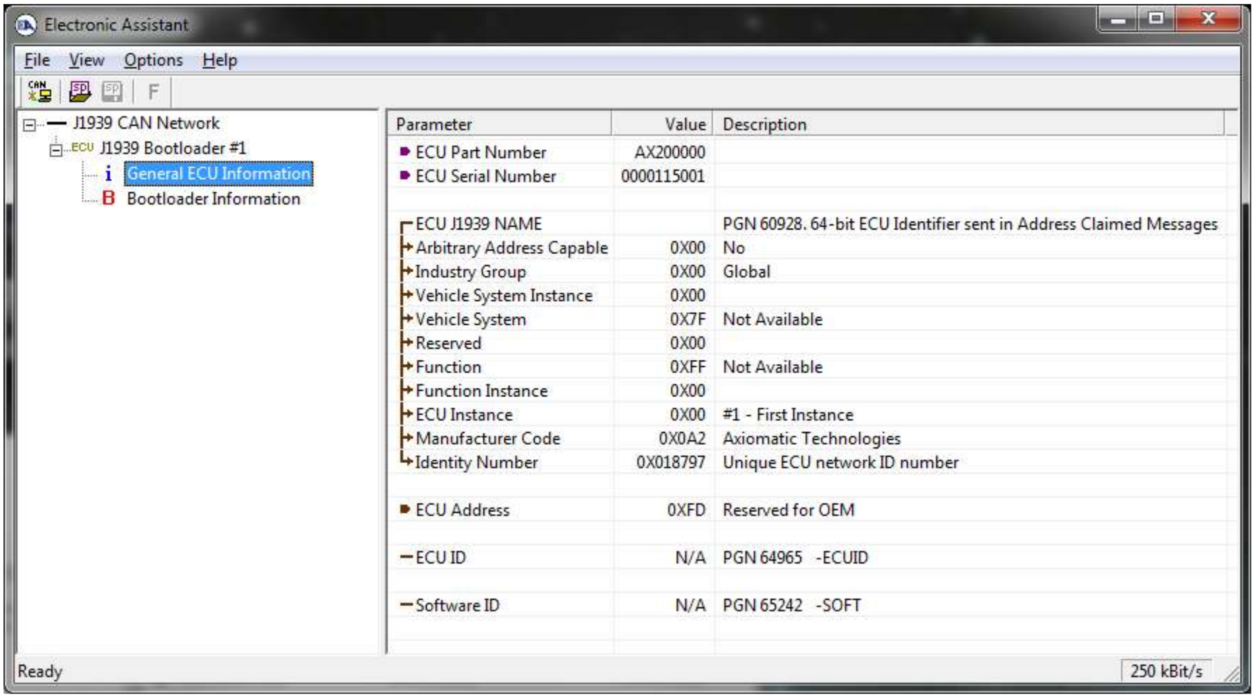


3. When the prompt box asks if you want to reset the ECU, select *Yes*.



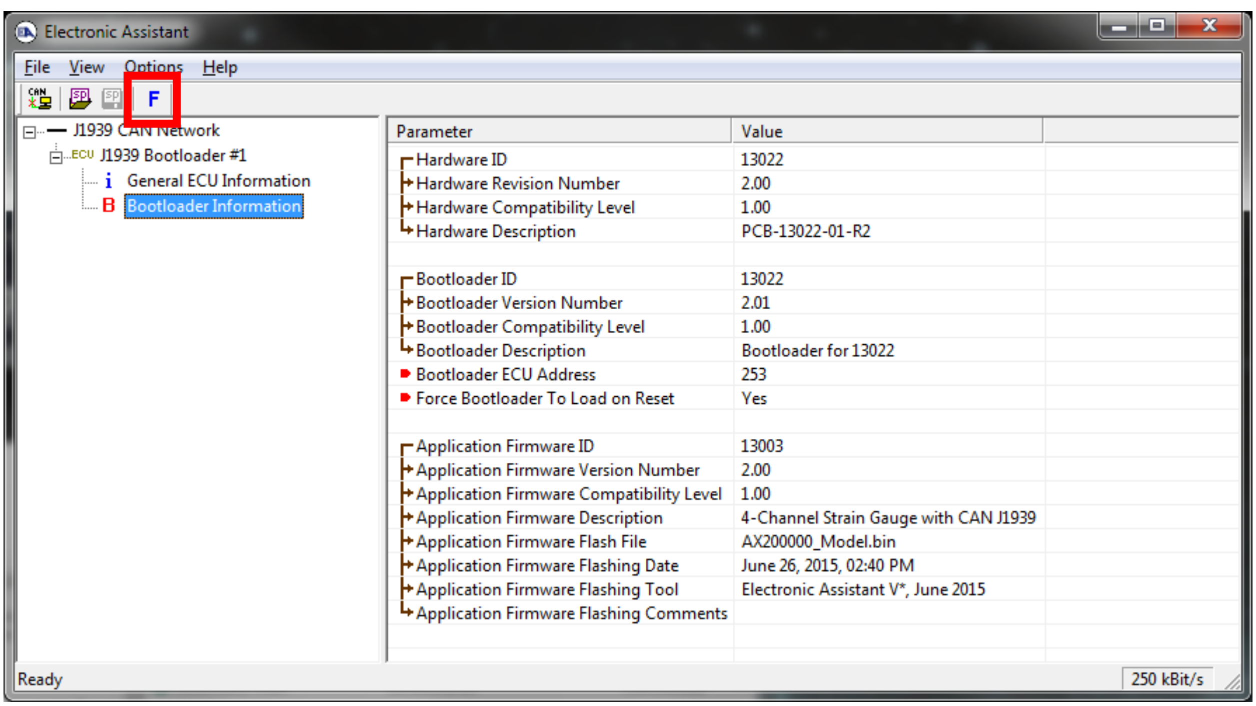
4. Upon reset, the ECU will no longer show up on the J1939 network as an AX200000 but rather as **J1939 Bootloader #1**.





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

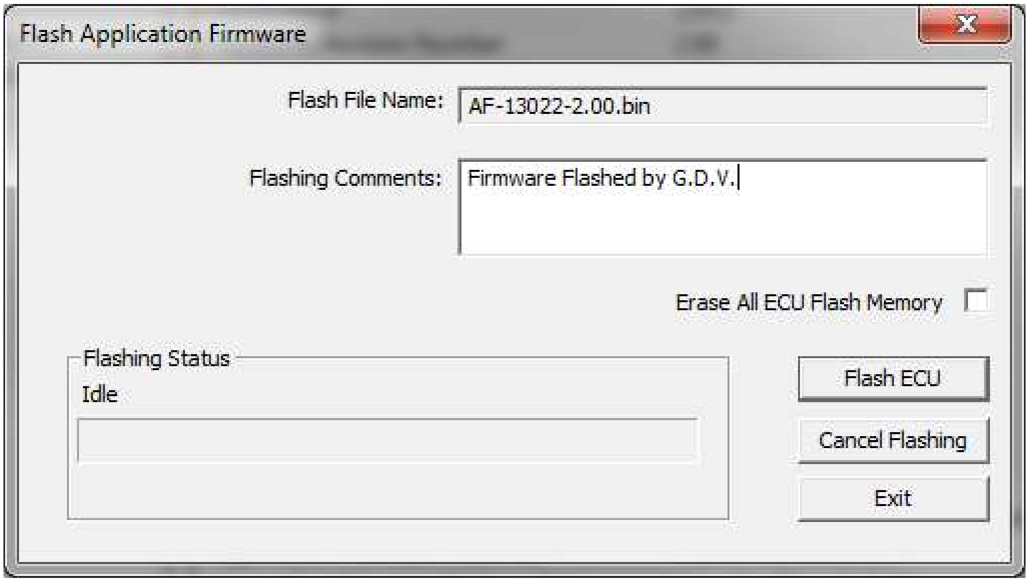
5. When the **Bootloader Information** section is selected, the same information is shown as when it was running the AX200000 firmware, but in this case the <u>F</u>lashing feature has been enabled.



6. Select the <u>F</u>lashing button and navigate to where you had saved the **AF-13022-x.yy.bin** file sent from Axiomatic. (Note: only binary (.bin) files can be flashed using the EA tool)

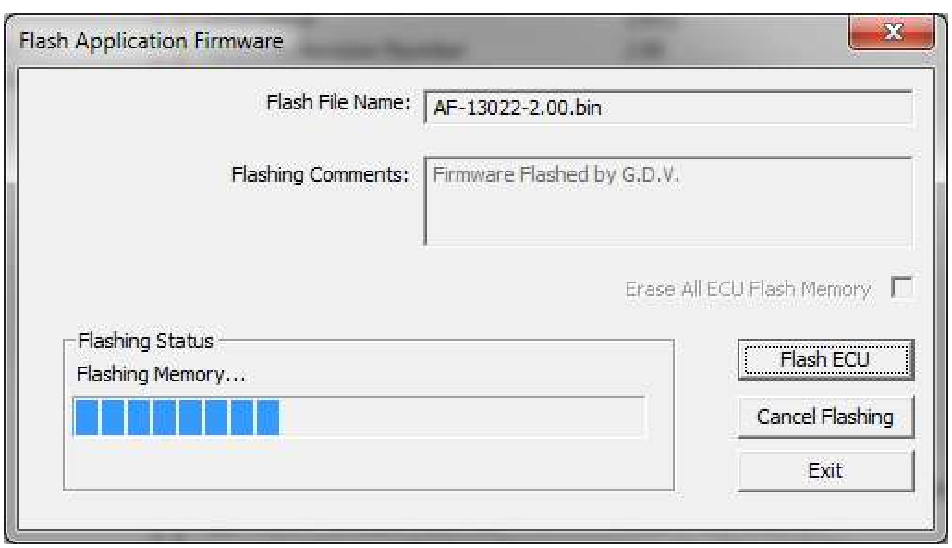
7. Once the Flash Application Firmware window opens, you can enter comments such as “Firmware upgraded by [Name]” if you so desire. This is not required, and you can leave the field blank if you do not want to use it.

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



WARNING: Do not check the “Erase All ECU Flash Memory” box unless instructed to do so by your Axiomatic contact. Selecting this will erased ALL data stored in non-volatile flash. It will also erase any configuration of the setpoints that might have been done to the ECU and reset all setpoints to their factory defaults. By leaving this box unchecked, none of the setpoints will be changed when the new firmware is uploaded.

8. 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.



9. Once the firmware has finished uploading, a message will popup indicating the successful operation. If you select to reset the ECU, the new version of the AX200000 application will start running, and the ECU will be identified as such by EA. Otherwise, The next time the ECU is power-cycled, the AX200000 application will run rather than the bootloader function.

Note: If at any time during the upload the process is interrupted, the data is corrupted (bad checksum) or for any other reason the new firmware is not correct, i.e. bootloader detects that the file loaded was not designed to run on the hardware platform, the bad or corrupted application will not run. Rather, when the ECU is reset or power-cycled the **J1939 Bootloader** will continue to be the default application until valid firmware has been successfully uploaded into the unit.

6. Technical Specifications

6.1. Power Supply

Power Supply Input - Nominal	12 or 24Vdc nominal operating voltage 8…36 Vdc power supply range for voltage transients
Surge Protection	Provided
Reverse Polarity Protection	Provided

6.2. Inputs

Strain Gauge Inputs	4 Channels Accepts 4-wire Strain Gauge inputs Input range selectable from +/- 19.5 mV to +/- 2.5 Vdc. All input channels have excitation and ground connections provided. All inputs send a message to the CAN bus.
Measurement rate	The measurement rate is 2.5 scans per second for all 4 channels. The update rate is 400 mSec. for all 4 channels.
Common-mode	Common-mode rejection is > 100 db@ 1V p-p, simultaneous 50/60 Hz. Common mode input range is +/- 3.5V maximum.
Resolution	18.2-Bit noise-free minimum
Drift	Overall drift with temperature is 50 ppm/°C of span (maximum).
Input Accuracy	+/- 0.5% throughout the entire range of the input
Excitation	4 +5V excitation connections
Other Input	1 Digital Input Active High to 5V or Active Low to GND Configurable Pull Up or Pull Down Resistor Amplitude: up to +Vps
Grounds	4 GND connections

6.3. Output

Digital On/Off Output	1 Digital On/Off Output Fully protected high side digital switch with low current readings 2A Overcurrent, overvoltage and undervoltage protection is provided.
Relay Output	An interlock relay with 2 contact pins is provided. 2A (nominal)

6.4. Communication

CAN	1 CAN 2.0B port, protocol SAE J1939
Network Termination	According to the CAN standard, 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.

6.5. General Specifications

Microprocessor	STM32F205VGT7
Communications	1 CAN port (SAE J1939)
User Interface	Electronic Assistant®, P/N: AX070502
Control Logic	Standard embedded control logic is provided. Application-specific control logic is available on request.
Simulink®	Model AX200000 was developed using Simulink®. Simulink® is a model-based design tool from Mathworks®.
SAE J1939 Compliance	The ECU is compliant with the following SAE J1939 standards. • 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 • J1939/81 Network Management, SAE, May 2003

<table>
<tr><td>Electrical Connections</td><td>Deutsch DTM series 24 pin receptacle: DTM13-12PA-12PB-R008
Mating plug: Deutsch DTM06-12SA and DTM06-12SB
with 2 wedgelocks (WM12S) and 24 contacts (0462-201-20141).
20 AWG wire is recommended for use with contacts 0462-201-20141.
<table>
<tr><th colspan="2">Grey Connector</th><th colspan="2">Black Connector</th></tr>
<tr><th>Pin #</th><th>Function</th><th>Pin #</th><th>Function</th></tr>
<tr><td>1</td><td>+5V Excitation 1</td><td>1</td><td>GND 3</td></tr>
<tr><td>2</td><td>IN 1+</td><td>2</td><td>IN 3-</td></tr>
<tr><td>3</td><td>+5V Excitation 2</td><td>3</td><td>GND 4</td></tr>
<tr><td>4</td><td>IN 2+</td><td>4</td><td>IN 4-</td></tr>
<tr><td>5</td><td>Tare Input</td><td>5</td><td>Interlock +/-</td></tr>
<tr><td>6</td><td>BATT-</td><td>6</td><td>CAN_H</td></tr>
<tr><td>7</td><td>BATT+</td><td>7</td><td>CAN_L</td></tr>
<tr><td>8</td><td>Digital Output</td><td>8</td><td>Interlock -/+</td></tr>
<tr><td>9</td><td>IN 2 -</td><td>9</td><td>IN 4+</td></tr>
<tr><td>10</td><td>GND 2</td><td>10</td><td>+5V Excitation 4</td></tr>
<tr><td>11</td><td>IN 1 -</td><td>11</td><td>IN 3+</td></tr>
<tr><td>12</td><td>GND 1</td><td>12</td><td>+5V Excitation 3</td></tr>
</table></td></tr>
<tr><td>Packaging and Dimensions</td><td>High Temperature Nylon housing - Deutsch IPD PCB Enclosure (EEC-325X4B)
4.62 x 5.24 x 1.43 inches 117.42 x 133.09 x 36.36 mm
(W x L x H excluding mating plugs)</td></tr>
<tr><td>Operating Conditions</td><td>-40 to 85°C (-40 to 185°F)</td></tr>
<tr><td>Weight</td><td>0.55 lb. (0.25 kg)</td></tr>
<tr><td>Protection</td><td>IP67, PCB assembly is conformal coated.</td></tr>
<tr><td>Vibration</td><td>MIL-STD-202G, Test 204D and 214A (Sine and Random)
10 g peak (Sine)
7.86 Grms peak (Random)</td></tr>
<tr><td>Shock</td><td>MIL-STD-202G, Test 213B
50g</td></tr>
<tr><td>Mounting</td><td>Mounting holes sized for ¼ inch or M6 bolts. The bolt length will be determined by the end-user’s mounting plate thickness. The mounting flange of the controller is 0.63 inches (16 mm) thick.

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).</td></tr>
</table>

7. VERSION HISTORY

Version	Date	Author	Modifications
1	December 29th, 2014	Gustavo Del Valle	Initial Draft
1A	December 30th, 2014	Gustavo Del Valle	Corrected typo on page 7
2A	June 29th, 2015	Gustavo Del Valle	Initial Draft Revision 2 Hardware
-	August 21, 2015	Amanda Wilkins	Added vibration compliance information
2B	March 2, 2017	Gustavo Del Valle	Added Part Numbers on title page for the higher baud rates available
3	October 2, 2018	Gustavo Del Valle	Corrected Figure and Table numbers Added CAN Tare Functionality Added Source Address masking to CAN Transmits
3A	October 4, 2018	Gustavo Del Valle	Updated CAN Transmit section to correct the number of CAN Transmit blocks supported by controller

OUR PRODUCTS

Actuator Controls

Battery Chargers

CAN bus Controls, Gateways

CAN/Wifi, CAN/Bluetooth

Current Converters

DC/DC Power Converters

DC Voltage/Current Signal Converters

Engine Temperature Scanners

Ethernet/CAN Converters

Fan Drive Controllers

Hydraulic Valve Controllers

I/O Controls

LVDT Simulators

Machine Controls

Motor Controls

PID Controls

Position Sensors, Angle Measurement Inclinometers

Power Supplies

PWM Signal Converters/Isolators

Resolver Signal Conditioners

Service Tools

Signal Conditioners

Strain Gauge CAN Controls

Surge Suppressors

OUR COMPANY

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

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

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

QUALITY DESIGN AND MANUFACTURING

Axiomatic is an ISO 9001:2008 registered facility.

SERVICE

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

Please provide the following information when requesting an RMA number:

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

When preparing the return shipping paperwork, please note the following. The commercial invoice for customs (and packing slip) should state the harmonized international HS (tariff code), valuation and return goods terminology, as shown in italics below. The value of the units on the commercial invoice should be identical to their purchase price.

Goods Made In Canada (or Finland)
Returned Goods for Warranty Evaluation, HS: 9813.00
Valuation Identical Goods
Axiomatic RMA#

WARRANTY, APPLICATION APPROVALS/LIMITATIONS

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

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