



**USER MANUAL UMAX143040**

Version 1.0.1

# **Fiber Optic / CAN Repeater**

## **SAE J1939**

### **USER MANUAL**

**P/N: AX143040**

## ACRONYMS

ACK	Positive Acknowledgement (from SAE J1939 standard)
BATT +/-	Battery positive (a.k.a. Vps) or Battery Negative (a.k.a. GND)
DM	Diagnostic Message (from SAE J1939 standard)
DTC	Diagnostic Trouble Code (from SAE J1939 standard)
EA	Axiomatic Electronic Assistant (A Service Tool for Axiomatic ECUs)
ECU	Electronic Control Unit (from SAE J1939 standard)
GND	Ground reference (a.k.a. BATT-)
MAP	Memory Access Protocol
NAK	Negative Acknowledgement (from SAE J1939 standard)
PDU1	A format for messages that are to be sent to a destination address, either specific or global (from SAE J1939 standard)
PDU2	A format used to send information that has been labeled using the Group Extension technique and does not contain a destination address.
PGN	Parameter Group Number (from SAE J1939 standard)
PropA	Message that uses the Proprietary A PGN for peer-to-peer communication.
PropB	Message that uses a Proprietary B PGN for broadcast communication.
SPN	Suspect Parameter Number (from SAE J1939 standard)
TP	Transport Protocol
Vps	Voltage Power Supply (a.k.a. BATT+)

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- J1939/81 Network Management, SAE, March 2017
- TDAX143040 Technical Datasheet, Axiomatic Technologies
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***This document assumes the reader is familiar with the SAE J1939 standard. Terminology from the standard is used but not described in this document.***

## 1. OVERVIEW OF CONTROLLER

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The following user manual describes architecture, functionality, configuration parameters and flashing instructions. It also contains controller technical specifications and installation instructions to help users build a custom solution on the base of this controller.

The Fiber Optic / CAN Repeater (later referred to as **FO-CAN**, and in some contexts also referred to as a **bridge**) is an electronic control unit (ECU) is a device that forwards messages between the CAN port Fiber Optic port based on a custom routing configuration. The configuration can be done using the Axiomatic Electronic Assistant.

The ECU has been designed to allow the maximum amount of versatility to optimize the performance of the machine. Numerous configurable variables, called setpoints, have been provided which are accessible using Axiomatic Electronic Assistant. The EA communicates with the controller over the J1939 CAN bus and uses Memory Access Protocol (MAP) to read/write each setpoint. Once the ECU has been set up as desired, the setpoints can be saved to a file, and flashed into other controllers over the CAN bus using EA.

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

### J1939 Network – Diagnostic Broadcast

Diagnostic messages are triggered by the internal function blocks and then broadcasted on the CAN bus network. However, in some applications this broadcast may not be required and so the user has the option to disable or enable this feature.

## 1.1. Hardware Block Diagram

The controller contains 1 Universal Input, 9 H-Bridges, CAN, transient and surge suppression polarity protection and a protected power supply. An embedded 32-bit microcontroller provides processing power to the controller.

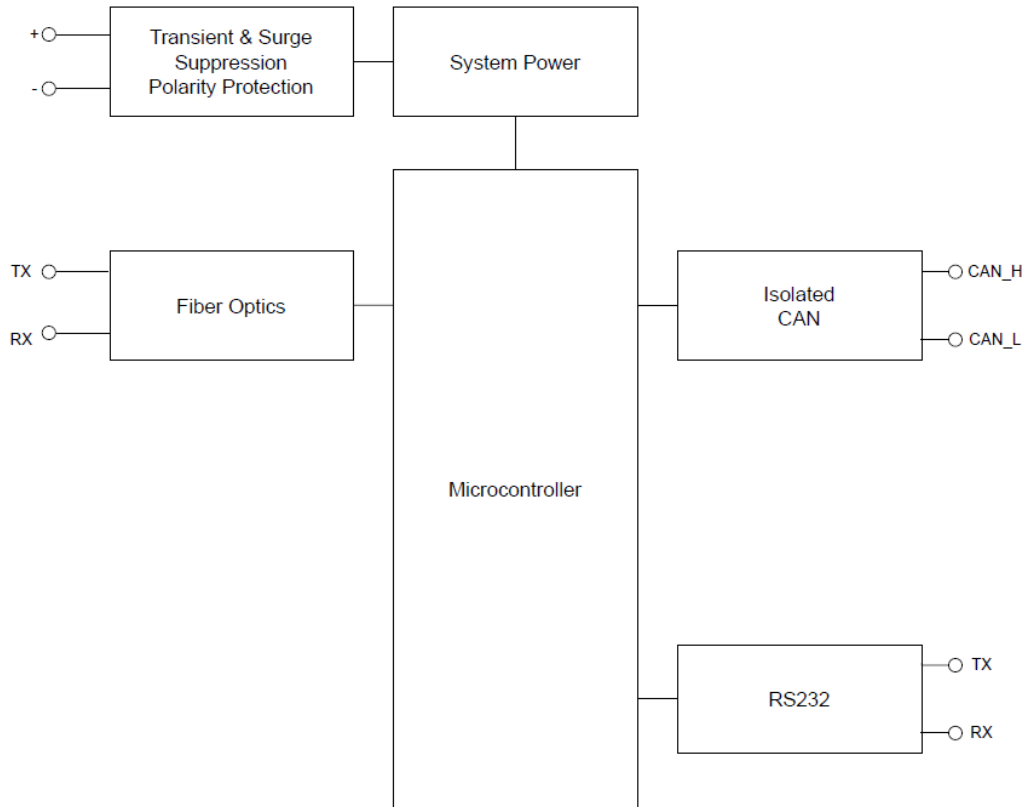


Figure 1. The ECU Flowchart

## 1.1. CAN Port Function Block

The CAN Port Function Block manages the reception, filtering and routing of CAN frames. It provides a configurable interface for forwarding CAN data based on specific filtering rules and routing logic.

### 1.1.1. Network Topology Configuration

The network topology is determined by the physical fiber-optic (FO) connections between bridges (how TX/RX fibers are wired between devices).

Supported FO network topologies include:

- **Peer-to-Peer (point-to-point):** Two bridges connected directly by FO.
- **Unidirectional ring:** Multiple bridges connected in a closed FO loop; frames circulate in one direction.

The *Output Interfaces* setpoint defines the forwarding destinations used by the routing rules after a frame passes the reception and software filters.

In all topologies, frames are first accepted or rejected by the configured CAN reception filtering (hardware acceptance filtering). Frames that pass reception filtering are processed by the data routing module, where routing rules can optionally apply software matching (*Match ID/Mask, ID type, RTR*) and CAN ID replacement (*Replace ID/Mask*).

The *Fiber Optic BaudRate* setpoint configures the serial baud rate used on the FO link. This setting must match between connected bridges; a mismatch can prevent communication over the FO connection or cause unreliable data transfer.

### Peer-to-Peer Topology

In a peer-to-peer topology, leave the **Output Interfaces** field empty to enable direct fiber-optic forwarding.

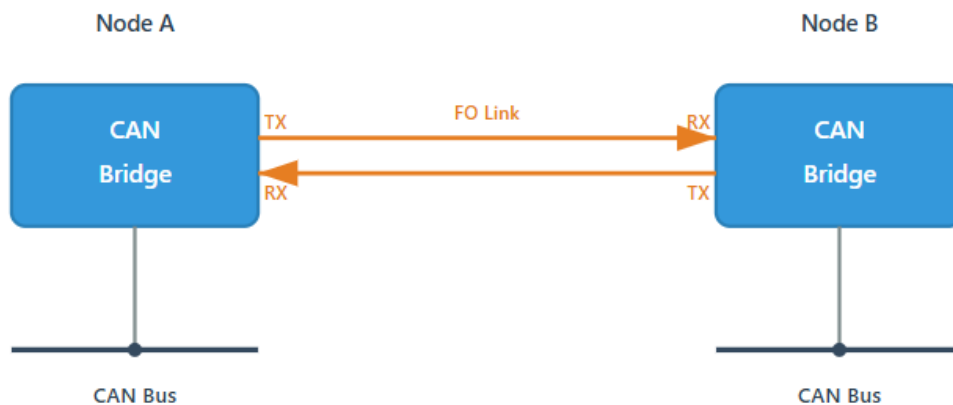


Figure 2. Peer-to-Peer (node-to-node)

In peer-to-peer topology, two bridges are connected directly via a fiber-optic link, forming a dedicated connection between exactly two endpoints. CAN frames that pass reception filtering are forwarded over the FO link according to the configured routing rules.

Peer-to-peer topology is typically used for simple CAN network extension over distance or where galvanic isolation is required between two CAN segments

## Unidirectional Ring Topology

In a unidirectional ring topology, one or more destination interfaces must be specified in the *Output Interfaces* setpoint as a comma-separated list of SPNs in decimal format. Each matched CAN frame is forwarded only to the explicitly listed interfaces, creating direct point-to-point or point-to-multipoint connections.

The ECU tracks frames as they traverse the ring using internal monitoring mechanisms. When a frame completes a full circuit around the ring and returns to its originating node, the bridge automatically discards it to prevent re-circulation.

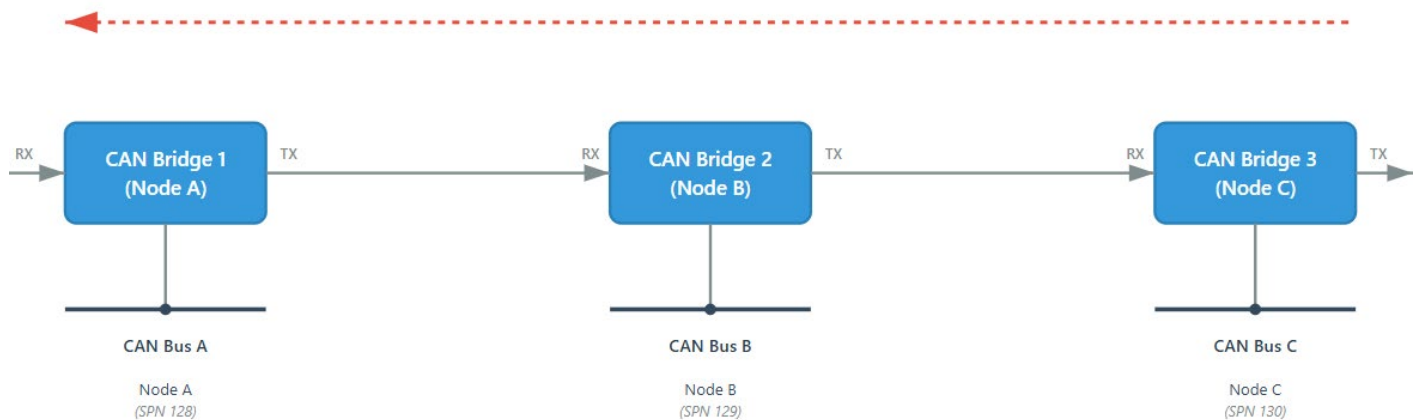


Figure 3. Unidirectional Ring Topology

In this configuration, data circulates unidirectionally through all nodes in the ring. Each bridge routes frames to specific downstream nodes based on the configured Output Interfaces list. When a frame completes the circuit, the originating bridge automatically discards it to prevent infinite looping.

### 1.1.2. Data Filtering Configuration

The data filtering configuration selects which CAN frames are received by the CAN Port. All received CAN frames that pass the reception filter are forwarded to the data routing module. The configured CAN ID filter is assigned directly to the CAN port's hardware acceptance filter registers

The CAN Port has default and unchanged J1939 CAN filtering set. This is required for accessing the device using the Axiomatic Electronic Assistant (EA) and J1939 messaging (CAN Input/Output messages). The EA communicates with the controller over J1939 CAN and uses the Memory Access Protocol (MAP) to read/write each setpoint.

- **No Software Filtering:** There is no additional software filtering performed during the message reception phase; filtering is handled strictly by hardware to ensure performance.
- **Filter Logic:** In case all filters are disabled, no CAN frames for forwarding will be accepted. The *Filter ID* defines the 29-bit extended or 11-bit standard frame ID. The *Filter Mask* determines which bits are checked: a '1' forces a compare, while a '0' marks the bit as 'don't care'.
- **Receiving All Frames:** To configure a filter to receive all possible frames, set the ID and Mask to 0 and enable the Filter State for both Extended and Standard IDs.

### 1.1.3. Data Routing Configuration

Data routing is performed on all frames that pass the reception filtering. However, the data routing module supports its own software filtering to select which frames are routed to specific outputs in case of Unidirectional Ring Topology.

- **Rule Configuration:** Each rule consists of a list of *Output Interfaces*, *Match ID*, *Match Mask* (software filter), and *Data Replacing* options.
- **Output Interfaces:** These should be entered as a comma-separated list with no spaces.
- **Software Filter:** The *Match ID* and *Match Mask* function identically to the hardware filter configuration but are used here as a software filter to determine routing.
- **Data Replacing:** The *Replace ID* and *Replace Mask* can be used to modify specific bits of the CAN frame before routing (e.g., modifying the Source Address, PGN, or Priority bits of a J1939 frame). This replacement is applied to all frames that pass the software filter.

### 1.1.4. Disable Control

Setpoints *Disable Source* and *Disable Number* are used to dynamically disable or enable the forwarding of CAN frames based on external signals or logic conditions.

### **1.1.5. FO-CAN Module Isolation**

The FO-CAN module has an isolated CAN port. FO connection is inherently isolated.

Digital isolation is as follows.

Battery Power <-> Chassis

1500VDC, 0.4mA, 60s

1500VAC, 5mA, 60s

CAN <-> Chassis

1500VDC, 0.4mA, 60s

1500VAC, 5mA, 60s

Battery Power <-> All Else (No Chassis)

1500VDC, 0.4mA, 60s

1500VAC, 5mA, 60s

### **1.1.6. Module / Network Status LED**

The FO-CAN Module has two LEDs Green for CAN status and Red for Fiber Optic status.

Solid light – Connected

Blinking – transferring/receiving

Red-Green toggling – Bootloader mode.

## 1.2. Diagnostic Function Block

The ECU 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 which is a combination of:

SPN	Suspect Parameter Number	(user defined)
FMI	Failure Mode Identifier	(see Table 3)
CM	Conversion Method	(always set to 0)
OC	Occurrence Count	(number of times the fault has happened)

In addition to supporting the DM1 message, the ECU Input also supports:

DM2	Previously Active Diagnostic Trouble Codes	Sent only on request
DM3	Diagnostic Data Clear/Reset of Previously Active DTCs	Done only on request
DM11	Diagnostic Data Clear/Reset for Active DTCs	Done only on request.

Fault detection and reaction is a standalone functionality that can be configured to monitor and report diagnostics of various controller parameters.

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 like 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 errors** let the user specify four thresholds, each with independent diagnostic parameters. The diagnostic status and threshold values are determined and expected as show in Figure 4 below.

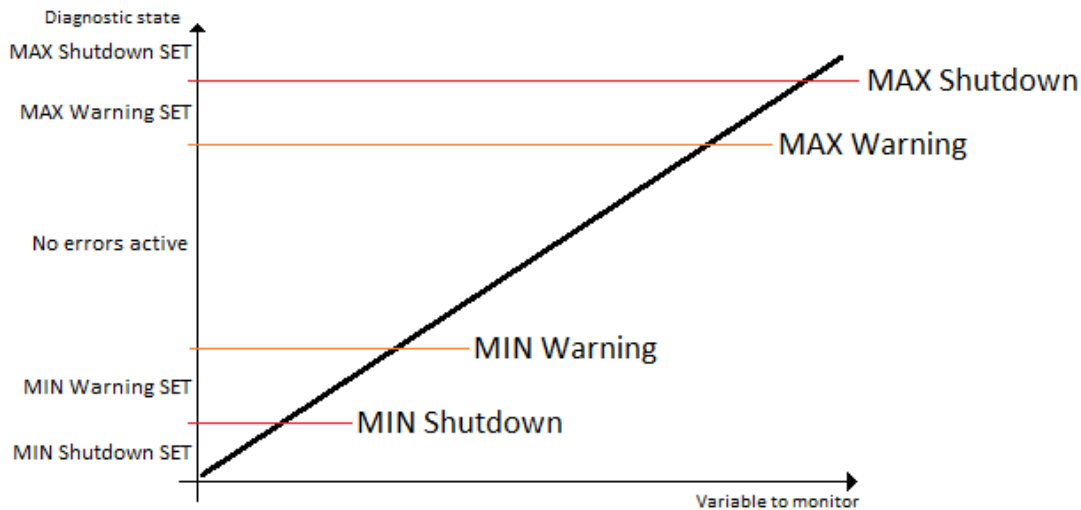


Figure 4. Double Minimum and Maximum Error Thresholds

There is also built in error status flags for power supply and CPU temperature monitoring. In case any of the diagnostics blocks is measuring these two parameters, the corresponding internal error status flags can be used for shutting down the unit in case of failure. The setpoints **“Power Fault Disables Outputs”** and **“Over Temperature Shutdown”** can be used for enabling the shutdown of the unit (shutdown == output driving is turned off).

While there are no active DTCs, the ECU 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 indicates 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 increase 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 the error condition that has caused it goes away. The DTC was made Previously Active and it was 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 1. By default, the ‘Amber, Warning’ lamp is typically the one set be any active fault.

0	Protect
1	Amber Warning
2	Red Stop
3	Malfunction

Table 1. Lamp Set by Event in DM1 Options

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

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

Table 2. 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 2. When an FMI is selected from Low Fault FMIs in Table 3 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 3. 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 3. Low Fault FMIs and corresponding High Fault FMIs

In this example the Diagnostic Function Block is configured to monitor the power supply voltage level and send the DM1 message if the voltage level drops under 11V.

Here is the DM1 message configuration:

SP MINIMUM SHUTDOWN, Event Generates a DTC in DM1	1	True
SP MINIMUM SHUTDOWN, Lamp Set by Event	1	Amber,Warning
SP MINIMUM SHUTDOWN, SPN for Event	0x007FF00	SPN: 524032
SP MINIMUM SHUTDOWN, FMI for Event	0	Data Valid But Above Normal Operational Range - Most Severe Level
SP MINIMUM SHUTDOWN, Delay Before Event is Flagged	1000	ms

Please note: even though the Diagnostics Function Block is configured as “Min and Max Error”, only the low limit will be monitored. Thus a “Event Generates a DTC in DM1” setpoint for a maximum shutdown limit is set to 0, False.

To monitor the supply voltage, the “Function Type to Monitor” setpoint is set to ‘Power Supply Measured’. The rest of configurations are shown on the Figure 5.

SP Fault Detection Type	0	Min and Max Error
SP Maximum Value for Diagnostic Data	24.00	
SP Minimum Value for Diagnostic Data	0.00	
SP Use Hysteresis When Defining Thresholds	1	True
SP Hysteresis	1.00	
SP Event Cleared Only by DM11	0	False
SP Set Limit for MINIMUM WARNING		Parameter not used with current Fault Detection Type
SP Clear Limit for MINIMUM WARNING		Parameter not used with current Fault Detection Type
SP Set Limit for MAXIMUM WARNING		Parameter not used with current Fault Detection Type
SP Clear Limit for MAXIMUM WARNING		Parameter not used with current Fault Detection Type
SP Set Limit for MINIMUM SHUTDOWN	11.00	
SP Clear Limit for MINIMUM SHUTDOWN		Parameter not used - Hysteresis used when defining thresholds
SP Set Limit for MAXIMUM SHUTDOWN	22.00	

Figure 5. The Diagnostics Configuration

With this configuration, when the power supply voltage measured drops below “Set Limit for MINIMUM SHUTDOWN”, the DM1 message with a fault information will be broadcasted after a programmed in “Delay Before Event is Flagged” value in milliseconds.

An example of the DM1 message is shown below.

PR	PGN	DA	SA	Len	D0	D1	D2	D3	D4	D5	D6	D7
6	0FECA	-	80	8	04	FF	00	FF	E0	01	FF	FF

Figure 6. The Example of DM1 Message

### 1.3. Constant Data

The Constant Data Block contains 2 fixed setpoints (**False** and **True**) and 13 configurable constant data setpoints that can be used as control sources for other functions. These setpoints are available as control sources for all functions, with a range of 0 to 100 for positive values and -100 to 0 for negative values.

## 1.4. DTC React

DTC React is a function block that allows the ECU to receive and process the DM1 messages. There are 16 separated function blocks that can capture up to 16 different DM1 messages. Each DTC React has two mandatory and 2 optional parameters. The mandatory parameters are SPN and FMI. If only these parameters are used, the output will be set to high if the DM1 messages with the combination of selected SPN and FMI. The state will remain high for five seconds and will be set if the DM1 message is received again.

Among optional parameters there are lamp settings and the source address. To enable them, the “**Lamp Used to Trigger Reaction**” and “**Source Address Used to Trigger Reaction**” should be set to 1, *True*. In this case, beside SPN and FMI the ECU will compare the Lamp Setting and/or Source Address of the received message.

The exceptions are the following SPN:

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

In case the SPNs above are chosen, the DTC React function block will set the output to HIGH if SPN and Lamp Status match even if FMI doesn't match. However, if the “**Source Address Used to Trigger Reaction**” is set to 1, *True* and selected address doesn't match, the DTC React output will be set to FALSE.

Also, if the SPN 0x7FFFF is set, the function block will accept any SPN instead.

## 1.5. CAN Transmit Message Function Block

The CAN Transmit function block is used to send any output from another function block (i.e. input, CAN receive) to the J1939 network. The AX143040 ECU has five CAN Transmit Messages, and each message has ten completely user defined signals.

### 1.5.1. CAN Output Message Setpoints

Each CAN Output Message has associated signals, which define data inside the Output message. “**Signal # Source**” setpoint together with “**Signal # Number**” setpoint define the signal source of the message. “**Signal # Source**” and “**Signal # Number**” options are listed in Table 4. Setting “**Signal # Source**” to ‘*Control Not Used*’ disables the signal.

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

“**Signal # Resolution**” setpoint determines the scaling done on the signal data before it is sent to the bus. “**Signal # Offset**” setpoint determines the value that is subtracted from the signal data before it is scaled. **Offset** and **Resolution** are interpreted in units of the selected source signal.

The “**PGN**” setpoint sets PGN used with the message. **Users should be familiar with the SAE J1939 standard and select values for PGN/SPN combinations as appropriate from section J1939/71.**

“**Autoreset Time**” setpoint defines the interval used to send the message to the J1939 network. If the “**Repetition Rate**” is set to zero, the message is disabled unless it shares its PGN with another message. In the case of a shared PGN repetition rate of the LOWEST numbered message are used to send the message ‘bundle’.



At power up, transmitted messages will not be broadcasted until after a 5 second delay. This is done to prevent any power up or initialization conditions from creating problems on the network.

By default, all messages are sent on Proprietary B PGNs as broadcast messages. Thus “**Transmit Message Priority**” is always initialized to 6 (low priority) and the “**Destination Address**” setpoint is not used. This setpoint is only valid when a PDU1 PGN has been selected, and it can be set either to the Global Address (0xFF) for broadcasts or sent to a specific address as set up by the user.

## 1.6. CAN Receive Function Block

The CAN Receive function block is designed to take any SPN from the J1939 network and use it as an input to another function block (i.e. Outputs).

“**CAN Interface**” setpoint is used to define from which of the two CAN Interfaces the message is received.

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

Once a message has been enabled, a Lost Communication fault will be flagged if that message is not received off the bus within the “**Receive Message Timeout**” period. This could trigger a Lost Communication event. To avoid timeouts on a heavily saturated network, it is recommended to set the period at least three times longer than the expected update rate. To disable the timeout feature, simply set this value to zero, in which case the received message will never trigger a Lost Communication fault.

By default, all control messages are expected to be sent to the AX143040 on Proprietary B PGNs. However, should a PDU1 message be selected, the AX143040 can be setup to receive it from any ECU by setting the “**PGN From Specific Address**” to False (0x00). If a specific address is selected instead, then any other ECU data on the PGN will be ignored.

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

As mentioned earlier, a CAN receive function clock can be selected as the source of the control input for the output function blocks. When this is case, the “**Received Data Min (Off Threshold)**” and “**Received Data Max (On Threshold)**” setpoints determine the minimum and maximum values of the control signal. As the names imply, they are also used as the On/Off thresholds for digital output types. These values are in whatever units the data is AFTER the resolution and offset is applied to CAN receive signal.

The AX143040 supports up to 10 unique CAN Receive Messages. Defaults setpoint values are listed in section 4.5.

## 1.7. Available Control Sources

Many of the Function Blocks have selectable input signals, which are determined with “[Name] Source” and “[Name] Number” setpoints. Together, these setpoints uniquely select how the I/O of the various function blocks are linked together. “[Name] Source” setpoint determines the type of the source and “[Name] Number” selects the actual source if there is more than one of the same types. Available “[Name] Source” options and associated “[Name] Number” ranges are listed in Table 4. All sources are available for all blocks, including output control blocks and CAN Transmit messages. Though input Sources are freely selectable, not all options would make sense, and it is up to the user to program the controller in a logical and functional manner.

Control Source	Range	Notes
0: Control Not Used	N/A	When this is selected, it disables all other setpoints associated with the signal in question.
1: Received CAN Message	1 to 10	
2: DTC React	1 to 5	
3: Constant Data	1 to 15	[0] - Constant Signal = 0.0 [1] - Constant Signal = 1.0 [2...15] - Data
4: Fiber Optic Connection Status		0-Not Established, 1-Established
5: CAN Reception Timeout	1 to 10	
6: Power Supply Measured	0 to 255	Measured power supply value in Volts. The Parameter sets the threshold in Volts to compare with.
7: Processor Temperature Measured	0 to 255	Measured processor temperature in °C. The Parameter sets the threshold in Celsius to compare with.

Table 4. Available Control Sources

If a non-digital signal is selected to drive a digital input, the signal is interpreted as being OFF at or below the minimum of selected source and ON at or above the maximum of the selected source, and it will not change in between those points. Thus, analog to digital interpretation has a built-in hysteresis defined by minimum and maximum of the selected source, as shown in Figure 7. For example, Universal Input signal is interpreted to be ON at or above “Maximum Range” and OFF at or below “Minimum Range”.

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

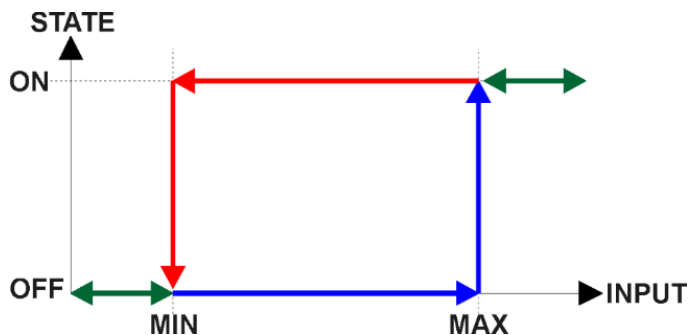


Figure 7. Analog source to Digital input

## 2. DIMENSIONAL DRAWING

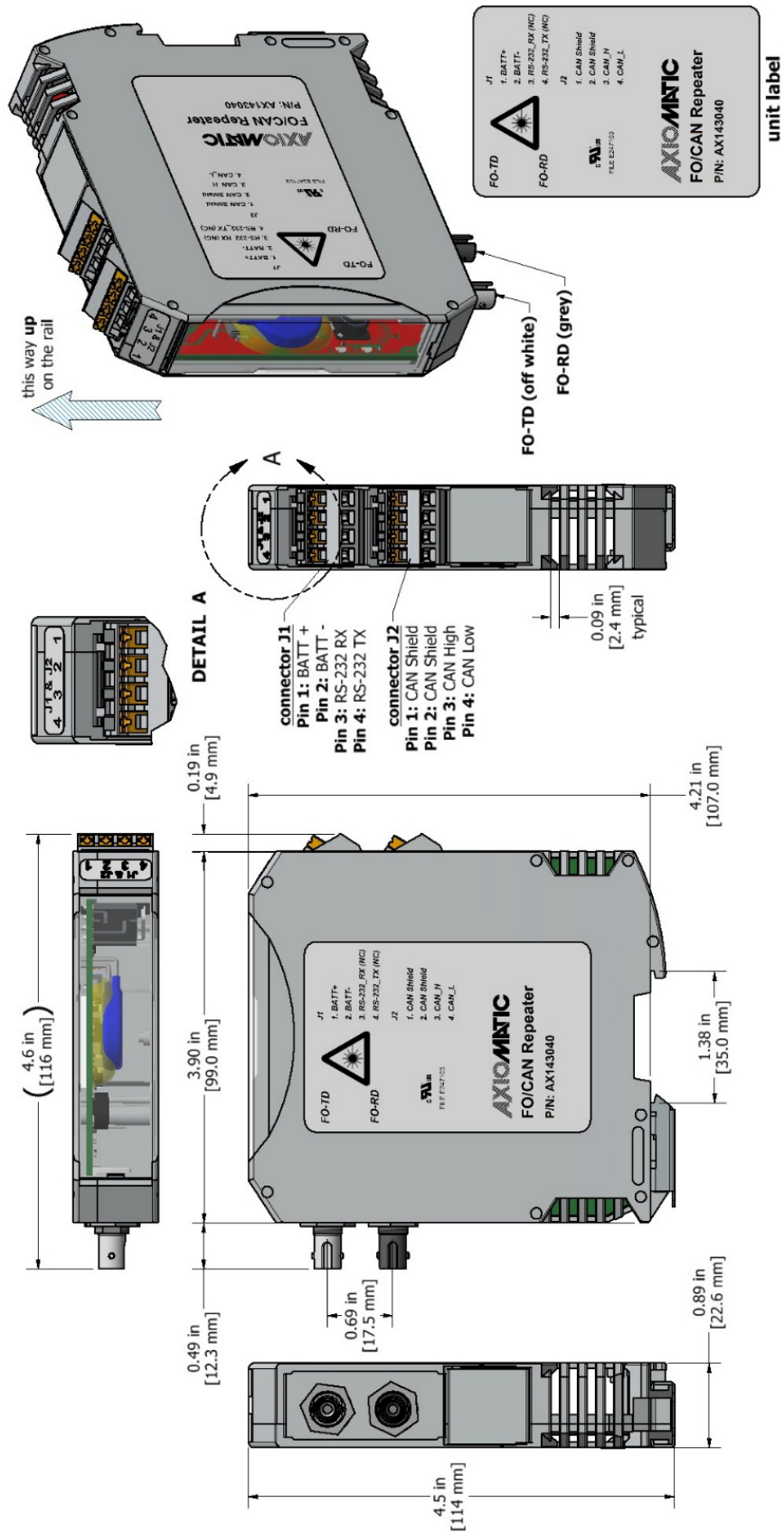


Figure 8. Dimensional Drawing

### 3. OVERVIEW OF J1939 FEATURES

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

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

#### 3.1. Introduction to Supported Messages

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

##### From J1939-21 – Data Link Layer

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

##### From J1939-73 – Diagnostics

- |  |       |          |
|--|-------|----------|
| • DM1 – Active Diagnostic Trouble Codes                        | 65226 | 0x00FECA |
| • DM2 – Previously Active Diagnostic Trouble Codes             | 65227 | 0x00FECB |
| • DM3 – Diagnostic Data Clear/Reset for Previously Active DTCs | 65228 | 0x00FECC |
| • DM11 – Diagnostic Data Clear/Reset for Active DTCs           | 65235 | 0x00FED3 |

##### From J1939-81 – Network Management

- |                                |       |          |
|--------------------------------|-------|----------|
| • Address Claimed/Cannot Claim | 60928 | 0x00EE00 |
| • Commanded Address            | 65240 | 0x00FED8 |

##### From J1939-71 – Vehicle Application Layer

- |                            |       |          |
|----------------------------|-------|----------|
| • Software Identification  | 65242 | 0x00FEDA |
| • Software Identification  | 65242 | 0x00FEDA |
| • Component Identification | 65259 | 0x00FEED |

None of the application layer PGNs are supported as part of the default configurations, but they can be selected as desired for transmit function blocks.

Setpoints are accessed using standard Memory Access Protocol (MAP) with proprietary addresses. The Axiomatic Electronic Assistant (EA) allows for quick and easy configuration of the unit over CAN network.

### 3.2. NAME, Address and Software ID

The AX143040 ECU has the following default for the J1939 NAME. The user should refer to the SAE J1939/81 standard for more information on these parameters and their ranges.

Arbitrary Address Capable	Yes
Industry Group	0, Global
Vehicle System Instance	0
Vehicle System	0, Non-specific system
Function	89, Axiomatic I/O Controller
Function Instance	5, Axiomatic AX143040
ECU Instance	0, First Instance
Manufacture Code	162, Axiomatic Technologies
Identity Number	Variable, uniquely assigned during factory programming for each ECU

The ECU Instance is a configurable setpoint associated with the NAME. Changing this value will allow multiple ECUs of this type to be distinguishable from one another when they are connected on the same network.

#### 3.2.1. 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 controller will continue select the next highest address until it finds one that it can claim. See J1939/81 for more details about address claiming.

### 3.2.2. 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
1	1 Byte	Number of software identification fields
2-n	Variable	Software identification(s), Delimiter (ASCII “**”) 234

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

<b>(Version)*</b>
-------------------

EA shows all this information in “General ECU Information”, as shown below.

Electronic Assistant

File View Options Help

CAN SP SP F

J1939 CAN Network

- ECU AX143040, FO to CAN Controller
  - General ECU Information**
  - Setpoint File
  - Bootloader Information

Parameter	Value	Description
ECU Part Number	AX143040	
ECU Serial Number	000012600	
ECU J1939 NAME		PGN 60928. 64-bit ECU Identifier sent in Address Claimed Messages
Arbitrary Address Capable	0X01	Yes
Industry Group	0X00	Global
Vehicle System Instance	0X00	
Vehicle System	0X00	Non-specific system
Reserved	0X00	
Function	0X59	Network Interconnect ECU
Function Instance	0X05	
ECU Instance	0X00	#1 - First Instance
Manufacturer Code	0X0A2	Axiomatic Technologies
Identity Number	0X02887B	Unique ECU network ID number
ECU Address	0X80	Reserved for future assignment by SAE, but available for use by self conf
ECU ID		PGN 64965 -ECUID
ECU Part Number	AX143040	
ECU Serial Number	000012600	
ECU Type	Controller	
ECU Manufacturer Name	Axiomatic	
Software ID		PGN 65242 -SOFT
Field #1	AX143040, FO-CAN Repeater, SAE J1939, Proj_26107	
Field #2	Firmware: v99.99, March 2026	

Ready 250 kbit/s

Figure 9. General ECU Information

## 4. ECU SETPOINTS ACCESSED WITH AXIOMATIC ELECTRONIC ASSISTANT

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

### 4.1. J1939 Network Setpoints

The J1939 Network setpoints deal with setpoints such as *ECU Instance Number* and *ECU Address*. Figure 10 and Table 5. Default J1939 Network Setpoints Function blocks in EA below will explain these setpoints and their ranges.

Setpoint Name	Value	Comment
SP ECU Instance Number	0x00	#1 - First Instance
SP ECU Address	0x80	Reserved for future assignment by SAE, but available for use by self configurable ECUs
SP Automatic Baud Rate Detection	Yes	Set to "No" once ECU is permanently installed on the CAN network
SP Baud Rate	250 kBaud	Not used in this mode

Figure 10. Screen Capture of Default J1939 Network Setpoints

Name	Range	Default	Notes
ECU Address	0..253	0x80	Preferred address for a self-configurable ECU
ECU Instance	0..7	0x00	Per J1939-81
Automatic Baud Rate Detection	0 - No, 1 - Yes	1 - Yes	Set to "No" once ECU is permanently installed on the CAN network.
Baud Rate	{125, 250, 500, 667, 1000}	250	Current baud rate on the CAN network.

Table 5. Default J1939 Network Setpoints Function blocks in EA

## 4.2. CAN Port Setpoints

The CAN Port is defined in section 1.1.

The screenshot shows the 'Electronic Assistant' software interface. The left pane displays a tree view of the 'J1939 CAN Network' configuration, with 'CAN Port' selected. The right pane shows a table of setpoints with columns for 'Setpoint Name', 'Value', and 'Comment'.

Setpoint Name	Value	Comment
SP Enabled	Yes	
SP Disable Source	0	Control Source Not Used
SP Disable Number	1	Not used in this mode
SP Break Rule Chain If Match	Yes	
SP Fiber Optic BaudRate	2000000	
SP Filter #1	Enabled for both ID types	
SP Filter ID #1	0x00	
SP Filter Mask #1	0x00	
SP Filter #2	Disabled	
SP Filter ID #2	0x00	Not used in this mode
SP Filter Mask #2	0x00	Not used in this mode
SP Filter #3	Disabled	
SP Filter ID #3	0x00	Not used in this mode
SP Filter Mask #3	0x00	Not used in this mode
SP Filter #4	Disabled	
SP Filter ID #4	0x00	Not used in this mode
SP Filter Mask #4	0x00	Not used in this mode
SP Filter #5	Disabled	
SP Filter ID #5	0x00	Not used in this mode
SP Filter Mask #5	0x00	Not used in this mode
SP Filter #6	Disabled	
SP Filter ID #6	0x00	Not used in this mode
SP Filter Mask #6	0x00	Not used in this mode
SP Filter #7	Disabled	
SP Filter ID #7	0x00	Not used in this mode
SP Filter Mask #7	0x00	Not used in this mode
SP Filter #8	Disabled	
SP Filter ID #8	0x00	Not used in this mode
SP Filter Mask #8	0x00	Not used in this mode
SP Filter #9	Disabled	
SP Filter ID #9	0x00	Not used in this mode
SP Filter Mask #9	0x00	Not used in this mode
SP Filter #10	Disabled	
SP Filter ID #10	0x00	Not used in this mode
SP Filter Mask #10	0x00	Not used in this mode
SP Rule #1	Match ID & Mask is 'dont care'	
SP Output Interfaces #1		Comma is used as a separator
SP Match ID #1	0x00	
SP Match Mask #1	0x00	
SP Match ID Type #1	ID Type is 'dont care'	
SP RTR Bit #1	RTR bit is 'dont care'	
SP Replacing data #1	No	
SP Replace ID #1	0x00	Not used in this mode
SP Replace Mask #1	0x00	Not used in this mode
SP Rule #2	Disabled	

The status bar at the bottom indicates 'Ready' and a data rate of '250 kbit/s'.

Figure 11. Screen Capture of CAN Port Setpoints

Name	Range	Default	Notes
Enabled	Drop List	True	
Disable Source	Drop List	Different for each	See Table 4
Disable Number	Drop List	Different for each	See Table 4
Break Rule Chain If Match	Drop List	Yes	See Section 1.1
Fiber Optic BaudRate	9600..12000000	2000000	See Section 1.1
Filter #	Drop List	Enabled for both ID types	See Section 1.1
Filter ID #	0..0xFFFFFFFF	0x00	See Section 1.1
Filter Mask #	0..0xFFFFFFFF	0x00	See Section 1.1
Rule #	Drop List	Match ID & Mask is 'don't care'	See Section 1.1
Output Interfaces #	List		See Section 1.1
Match ID #	0..0xFFFFFFFF	0x00	See Section 1.1
Match Mask #	0..0xFFFFFFFF	0x00	See Section 1.1
Match ID Type #	Drop List	ID Type is 'don't care'	See Section 1.1
RTR Bit #	Drop List	RTR bit is 'don't care'	See Section 1.1
Replacing Data #	Drop List	No	See Section 1.1
Replace ID #	0..0xFFFFFFFF	0x00	See Section 1.1
Replace Mask #	0..0xFFFFFFFF	0x00	See Section 1.1

Table 6. CAN Port Setpoints

To forward all CAN data, the following setup would need to be used:

Filter: **'Enabled for both ID types'** selected  
Filter ID (hex): **0x00**  
Filter Mask (hex): **0x00**  
Rule: **'Match ID & Mask is 'don't care'** selected  
Output Interfaces: <empty> (direct FO-connection)  
Match ID: **0x00**  
Match Mask: **0x00**  
Match ID Type: **'ID Type is 'don't care''** selected  
RTR: **'don't care'** selected  
Replacing data: **No**  
Replace ID (hex): **0x00**  
Replace Mask (hex): **0x00**

To forward all data from frames to interfaces with SPN 0x80 & 0x81 and modify the forwarded PGN 0xFF01 to 0xFF82, the following setup would need to be used:

Filter: **'Enabled for both ID types'** selected  
Filter ID (hex): **0x00**  
Filter Mask (hex): **0x00**  
Rule: **'Use Match ID & Mask'** selected  
Output Interfaces: **128,129** (decimal SPN 0x80,0x81)  
Match ID (hex): **0xFF0100**  
Match Mask (hex): **0xFFFF00**  
Match ID Type: **'Extended (29bit)'** selected  
RTR: **'don't care'** selected  
Replacing data: **Yes**  
Replace ID (hex): **0xFF8200**  
Replace Mask (hex): **0xFFFF00**

### 4.3. Constant Data List

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

The first two constants are fixed values of 0 (False) and 1 (True) for use in binary logic. The remaining 13 constants are fully user programmable to any value between +/- 100. The default values (shown in Figure 12) are arbitrary and should be configured by the user as appropriate for their application.

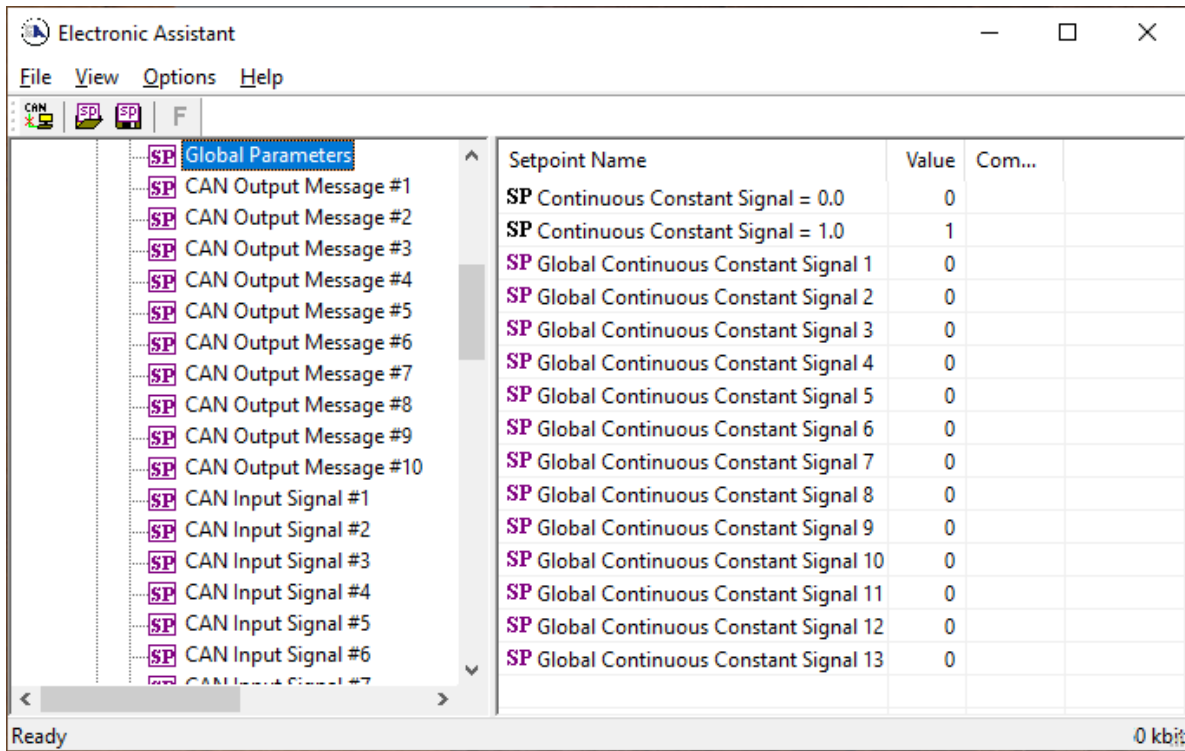


Figure 12. Screen Capture of Constant Data List Setpoints

## 4.4. CAN Output Message Setpoints

CAN Output Message Function Block be presented in section 1.5. Please refer therefor detailed information on how these setpoints are used. **“Transmission Rate”** is 0ms by default, thus no message will be sent.

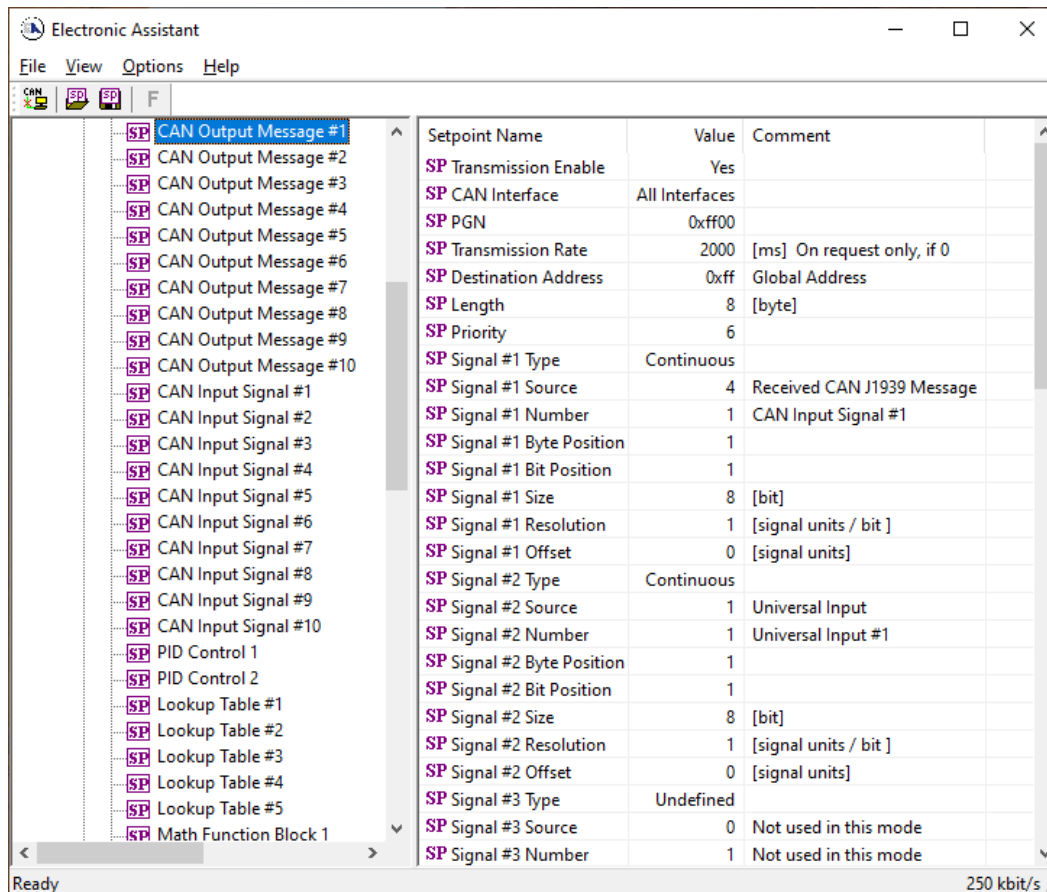


Figure 13. Screen Capture of CAN Output Message Setpoints

Name	Range	Default	Notes
Transmission Enabled	Drop List	0, False	
CAN Interface	Drop List	ALL	
PGN	0xff00 ... 0xffff	Different for each	See section 1.5.1
Transmission Rate	0 ... 65000 ms	0ms	0ms disables transmit
Destination Address	0...255	255	Not used by default
Length	0...8	8	
Priority	0...7	6	Proprietary B Priority
Signal X Type	Drop List	Undefined	
Signal X Source	Drop List	Different for each	See Table 4
Signal X Number	Drop List	Different for each	See Table 4
Signal X Byte Position	1-8	1	
Signal X Bit Position	1-64	1	
Signal X Size	1-64	8bit	
Signal X Resolution	-100000.0 to 100000	1/bits	
Signal X Offset	-10000 to 10000	0.0	

Table 7. CAN Output Message Setpoints

## 4.5. CAN Input Signal Setpoints

The CAN Input Signal Block is defined in section 1.6. Please refer there for detailed information about how these setpoints are used. **“Autoreset Time”** is set to 0ms by default. To enable CAN Input message set **“Signal Type”** to Continuous/Discrete.

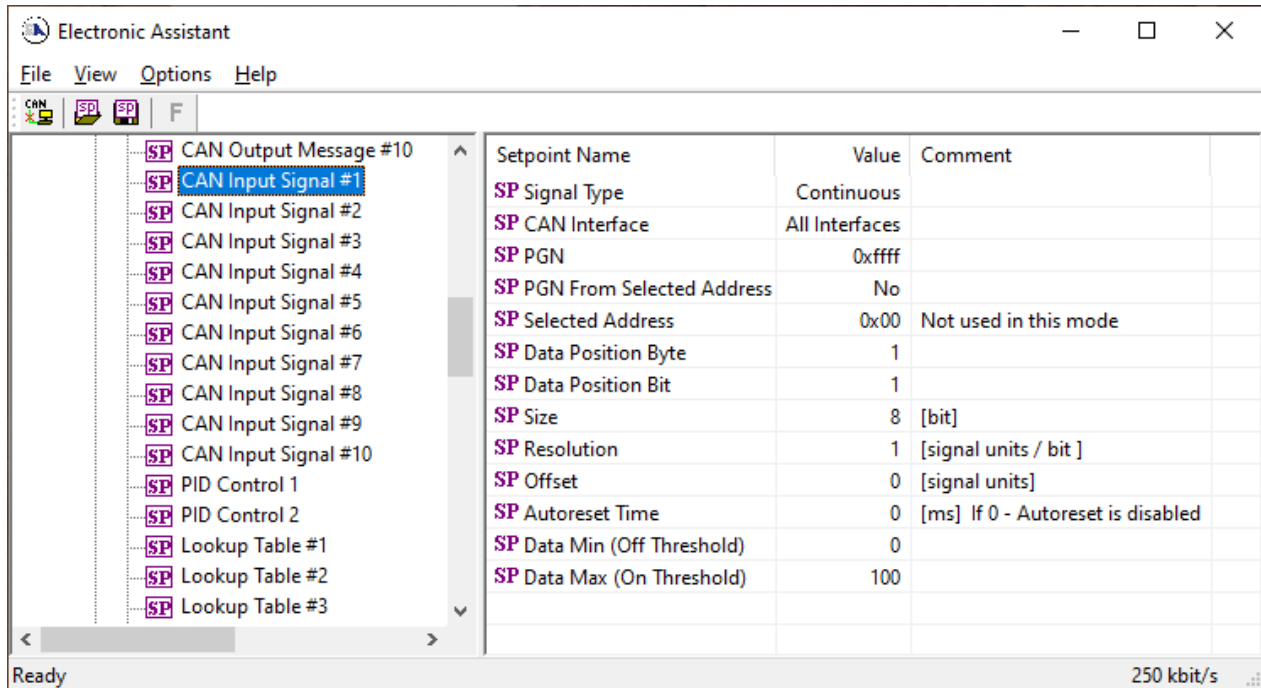


Figure 14. Screen Capture of CAN Receive Message Setpoints

Name	Range	Default	Notes
Signal Type	Drop List	Undefined	
CAN Interface	Drop List	ALL	
PGN	0 to 65536	Different for each	
PGN From Selected Address	Drop List	No	
Selected Address	0 to 255	254 (0xFE, Null Addr)	
Data Position Byte	1-8	1	
Data Position Bit	1-64	1	
Size	1-64	8bits	
Resolution	-100000.0 to 100000	0.001	
Offset	-10000 to 10000	0.0	
Autoreset Time	0 to 60 000 ms	0ms	
Data Min (Off Threshold)	-1000000 to Max	0.0	
Data Max (On Threshold)	-100000 to 100000	100	

Table 8. CAN Receive Setpoints

## 4.6. General Diagnostics Options

These setpoints control the shutdown of the ECU in case of a power supply or CPU temperature related errors.

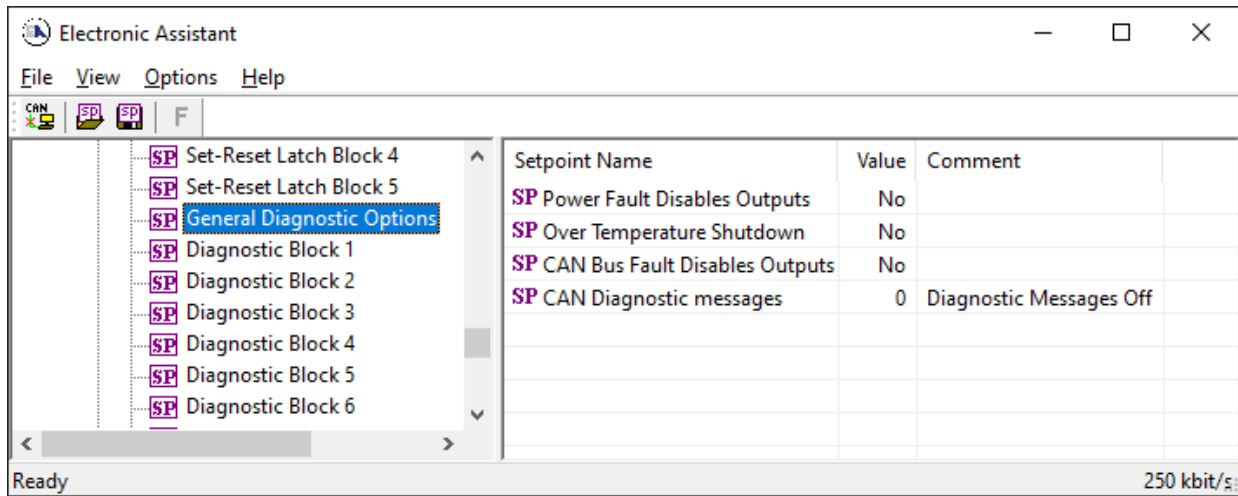


Figure 15. Screen Capture of General Diagnostics Options Setpoints

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

Table 9. General Diagnostics Options Setpoints

## 4.7. Diagnostics Blocks

There are 16 Diagnostics blocks that can be configured to monitor various parameters of the Controller. The Diagnostic Function Block is defined in section 1.1. Please refer there for detailed information on how these setpoints are used.

Setpoint Name	Value	Comment
SP Fault Detection is Enabled	Yes	
SP Function Type to Monitor	5	Received CAN J1939 Message
SP Function Parameter to Monitor	1	CAN Input Signal #1
SP Enable Source	0	Control Source Not Used
SP Enable Number	1	Not used in this mode
SP Enable Response	3	Not used in this mode
SP Fault Detection Type	0	Min and Max Error
SP Maximum Value for Diagnostic Data	1	
SP Minimum Value for Diagnostic Data	0	
SP Use Hysteresis When Defining Thresholds	No	
SP Hysteresis	1	Not used in this mode
SP Event Cleared Only by DM11	No	
SP Set Limit for MINIMUM WARNING	0	Not used in this mode
SP Clear Limit for MINIMUM WARNING	0	Not used in this mode
SP Set Limit for MAXIMUM WARNING	1	Not used in this mode
SP Clear Limit for MAXIMUM WARNING	1	Not used in this mode
SP Set Limit for MINIMUM SHUTDOWN	0	
SP Clear Limit for MINIMUM SHUTDOWN	0	Not used in this mode
SP Set Limit for MAXIMUM SHUTDOWN	1	
SP Clear Limit for MAXIMUM SHUTDOWN	1	Not used in this mode
SP MAXIMUM SHUTDOWN, Event Generates a DTC in DM1	No	
SP MAXIMUM SHUTDOWN, Lamp Set by Event	0	Protect
SP MAXIMUM SHUTDOWN, SPN for Event	0x7ff00	
SP MAXIMUM SHUTDOWN, FMI for Event	0	Data Valid But Above Normal Operational Range - Most Severe L
SP MAXIMUM SHUTDOWN, Delay Before Event is Flagged	1000	
SP MAXIMUM WARNING, Event Generates a DTC in DM1	No	Not used in this mode
SP MAXIMUM WARNING, Lamp Set by Event	0	Not used in this mode
SP MAXIMUM WARNING, SPN for Event	0x7ff00	Not used in this mode
SP MAXIMUM WARNING, FMI for Event	0	Not used in this mode
SP MAXIMUM WARNING, Delay Before Event is Flagged	1000	Not used in this mode
SP MINIMUM WARNING, Event Generates a DTC in DM1	No	Not used in this mode
SP MINIMUM WARNING, Lamp Set by Event	0	Not used in this mode
SP MINIMUM WARNING, SPN for Event	0x7ff00	Not used in this mode
SP MINIMUM WARNING, FMI for Event	0	Not used in this mode
SP MINIMUM WARNING, Delay Before Event is Flagged	1000	Not used in this mode
SP MINIMUM SHUTDOWN, Event Generates a DTC in DM1	No	
SP MINIMUM SHUTDOWN, Lamp Set by Event	0	Protect
SP MINIMUM SHUTDOWN, SPN for Event	0x7ff00	
SP MINIMUM SHUTDOWN, FMI for Event	0	Data Valid But Above Normal Operational Range - Most Severe L
SP MINIMUM SHUTDOWN, Delay Before Event is Flagged	1000	

Figure 16. Screen Capture of Diagnostic Block Setpoints

<b>Name</b>	<b>Range</b>	<b>Default</b>	<b>Notes</b>
Fault Detection is Enabled	Drop List	False	
Function Type to Monitor	Drop List	0 – Control not used	
Function parameter to Monitor	Drop List	0 – No selection	
Fault Detection Type	Drop List	0 – Min and Max Error	See Section 1.1
Maximum Value for Diagnostic Data	Minimum Value for Diagnostic Data ... 4.28e <sup>9</sup>	5.0	
Minimum Value for Diagnostic Data	0.0 ... Maximum Value for Diagnostic Data	0.0	
Use Hysteresis When Defining Thresholds	Drop List	False	
Hysteresis	0.0 ... Maximum Value for Diagnostic Data	0.0	
Event Cleared only by DM11	Drop List	False	
Set Limit for MAXIMUM SHUTDOWN	Minimum Value for Diagnostic Data ... Maximum Value for Diagnostics Data	4.8	
Clear Limit for MAXIMUM SHUTDOWN	Minimum Value for Diagnostic Data ... Maximum Value for Diagnostics Data	4.6	
Set Limit for MAXIMUM WARNING	Minimum Value for Diagnostic Data ... Maximum Value for Diagnostics Data	0.0	
Clear Limit for MAXIMUM WARNING	Minimum Value for Diagnostic Data ... Maximum Value for Diagnostics Data	0.0	
Clear Limit for MINIMUM WARNING	Minimum Value for Diagnostic Data ... Maximum Value for Diagnostics Data	0.0	
Set Limit for MINIMUM WARNING	Minimum Value for Diagnostic Data ... Maximum Value for Diagnostics Data	0.0	
Clear Limit for MINIMUM SHUTDOWN	Minimum Value for Diagnostic Data ... Maximum Value for Diagnostics Data	0.4	
Set Limit for MINIMUM SHUTDOWN	Minimum Value for Diagnostic Data ... Maximum Value for Diagnostics Data	0.2	
MAXIMUM SHUTDOWN, Event Generates a DTC in DM1	Drop List	True	
MAXIMUM SHUTDOWN, Lamp Set by Event	Drop List	0 – Protect	See Table 1

<b>Name</b>	<b>Range</b>	<b>Default</b>	<b>Notes</b>
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 2
MAXIMUM SHUTDOWN, Delay Before Event is Flagged	0...60000 ms	1000	
MAXIMUM WARNING, Event Generates a DTC in DM1	Drop List	True	
MAXIMUM WARNING, Lamp Set by Event	Drop List	0 – Protect	See Table 1
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 2
MAXIMUM WARNING, Delay Before Event is Flagged	0...60000 ms	1000	
MINIMUM WARNING, Event Generates a DTC in DM1	Drop List	True	
MINIMUM WARNING, Lamp Set by Event	Drop List	0 – Protect	See Table 1
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 2
MINIMUM WARNING, Delay Before Event is Flagged	0...60000 ms	1000	
MINIMUM SHUTDOWN, Event Generates a DTC in DM1	Drop List	True	
MINIMUM SHUTDOWN, Lamp Set by Event	Drop List	Amber Warning	See Table 1
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 2
MINIMUM SHUTDOWN, Delay Before Event is Flagged	0...60000 ms	1000	

Table 10. Diagnostic Block Setpoints

## 4.8. DTC React Function Block

The DTC React function block is described in Section 1.4. The Figure below shows the DTC React function block setpoints. The Table below shows the default values. Please note: The setpoint “DTC React is Enabled” was changed to 1, True.

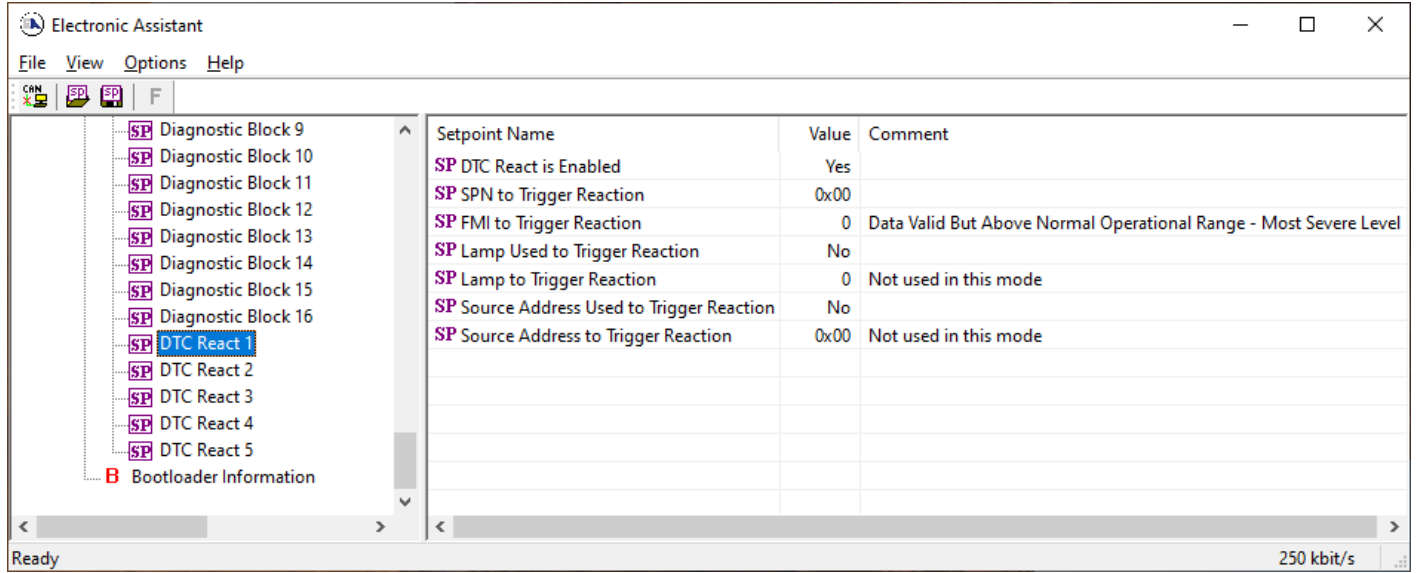


Figure 17. DTC React Setpoints

Name	Range	Default	Notes
DTC React is Enabled	Drop List	0, False	
SPN to Trigger Reaction	0x00 to 0x7FFFF	0	
FMI to Trigger Reaction	Drop List	0	
Lamp Used to Trigger Reaction	Drop list	0, False	
Lamp to Trigger Reaction	Drop List	0, Protect	
Source Address Used to Trigger Reaction	Drop list	0, False	
Source Address to Trigger Reaction	0x00 to 0xFF	0	

Table 11. DTC React Setpoints

## 5. REFLASHING OVER CAN WITH EA BOOTLOADER

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

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

To flash the new firmware, the user should activate the embedded bootloader. To do so, start the EA and, on the *Bootloader Information* group screen, click on the *Force Bootloader to Load on Reset* parameter. The following dialog will appear, see Figure 18.

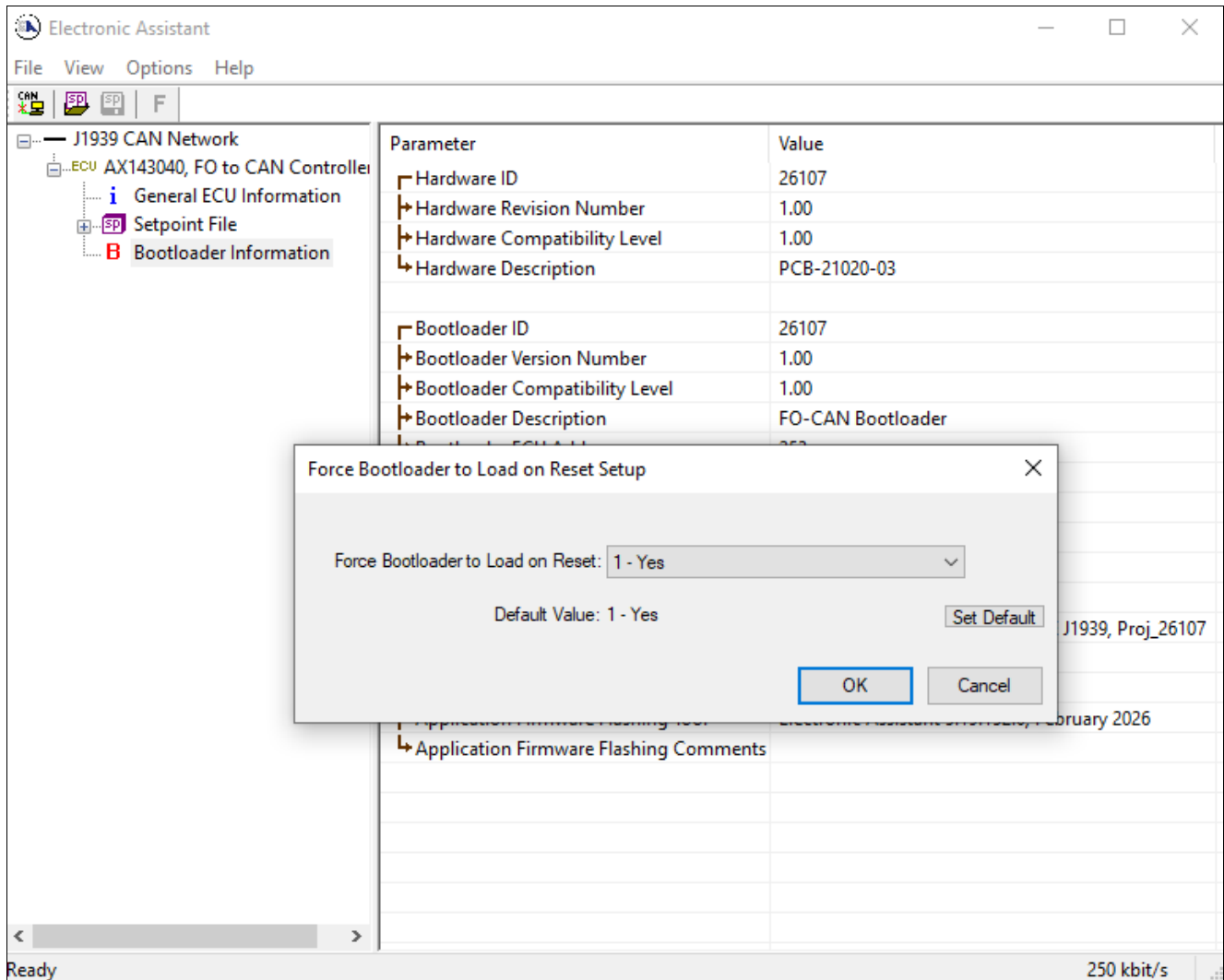


Figure 18. Bootloader Activation. First Step

The EA will prompt the user to change the *Force Bootloader to Load on Reset* parameter flag to “Yes”. This will automatically activate the bootloader on the next ECU reset. After accepting the change, the next screen will ask the user if the reset is required. Select “Yes”.

After automatic reset, instead of the firmware info, the user will see *J1939 Bootloader* ECU in the *J1939 CAN Network* top-level group in the EA. This means that the bootloader is activated and ready to accept the new firmware.

All the bootloader specific information: controller hardware, bootloader details, and the currently installed application firmware remains the same in the bootloader mode and the user can read it in the *Bootloader Information* group screen, see Figure 19. The information can be slightly different for different versions of the bootloader.

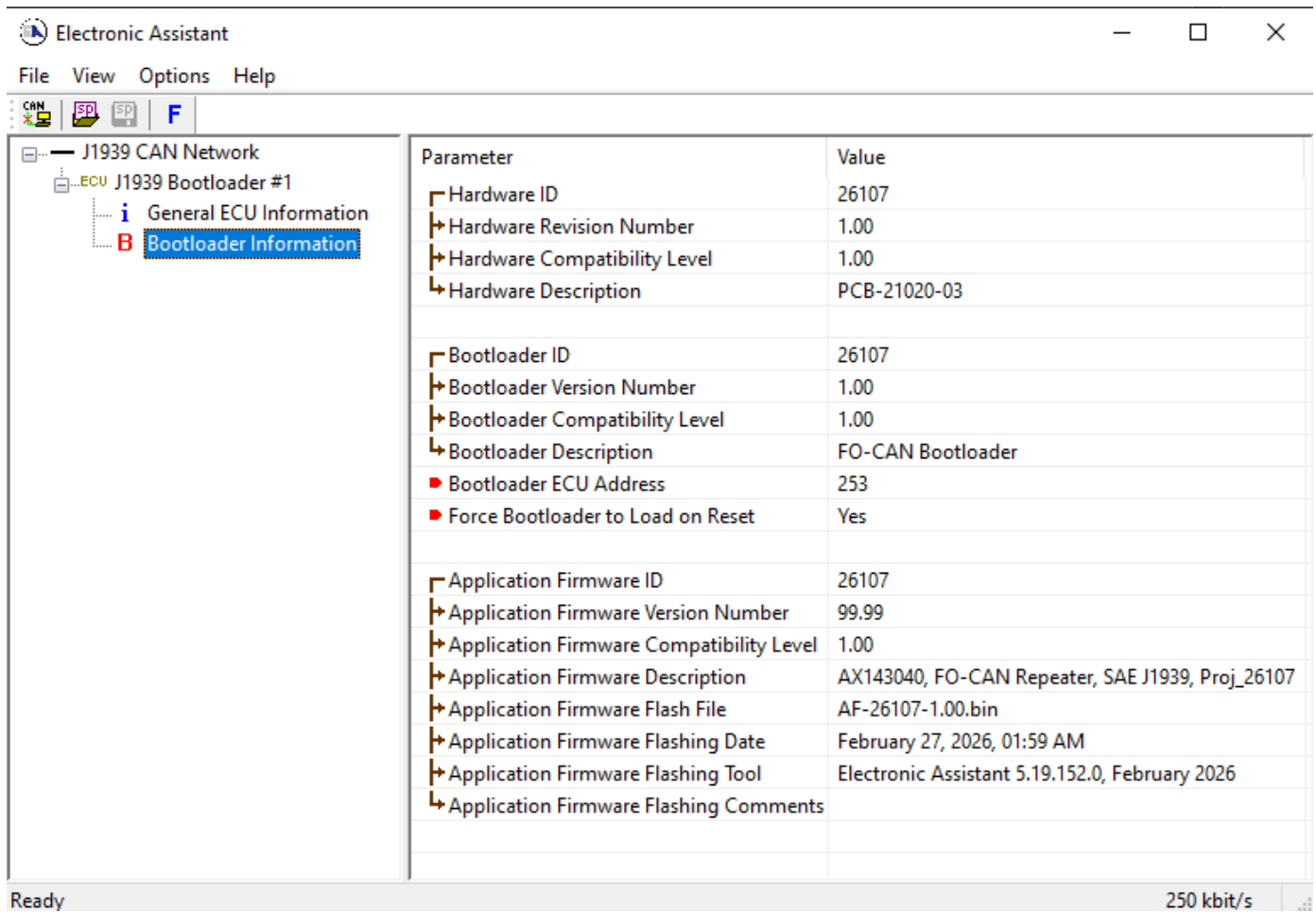


Figure 19. Bootloader Information Screen

At this point, the user can return to the installed controller firmware by changing the *Force Bootloader to Load on Reset* flag back to *No* and resetting the ECU.

To flash the new firmware, the user should click on **F** toolbar icon or from the *File* menu select the *Open Flash File* command. The *Open Application Firmware Flash File* dialog will appear. Pick up the flash file with the new converter firmware and confirm the selection by pressing the *Open* button. The *Flash Application Firmware* dialog window will appear, see Figure 20.

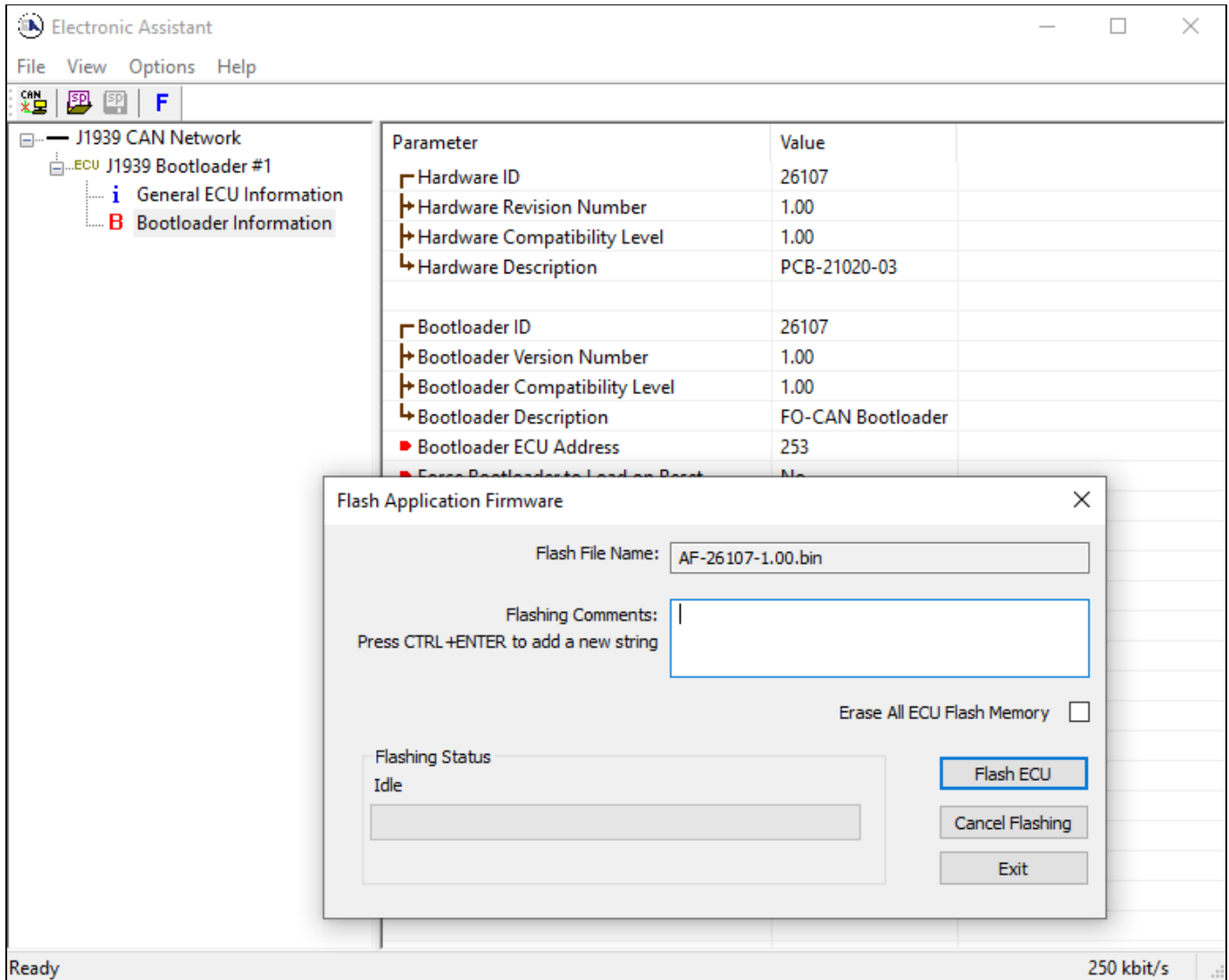


Figure 20. Flashing New Firmware. Preparation

Now the user can add any comments to the flashing operation in the *Flashing Comments* field. They will be stored in the *Bootloader Information* group after flashing.

The user can also check the *Erase All ECU Flash Memory* flag to erase all flash memory. This operation, used in other products to reset configuration parameters kept in the flash memory to their default values, has no effect on this product. This is because the configuration parameters of the inclinometer are stored in a separate EEPROM memory.

Select the *Flash ECU* button to start flashing. A reminder that the old application firmware will be destroyed by the flashing operation will appear. Press *Ok* to continue and watch the dynamics of the flashing operation in the *Flashing Status* field. When flashing is done, the following screen will appear prompting the user to reset the ECU, see Figure 21.

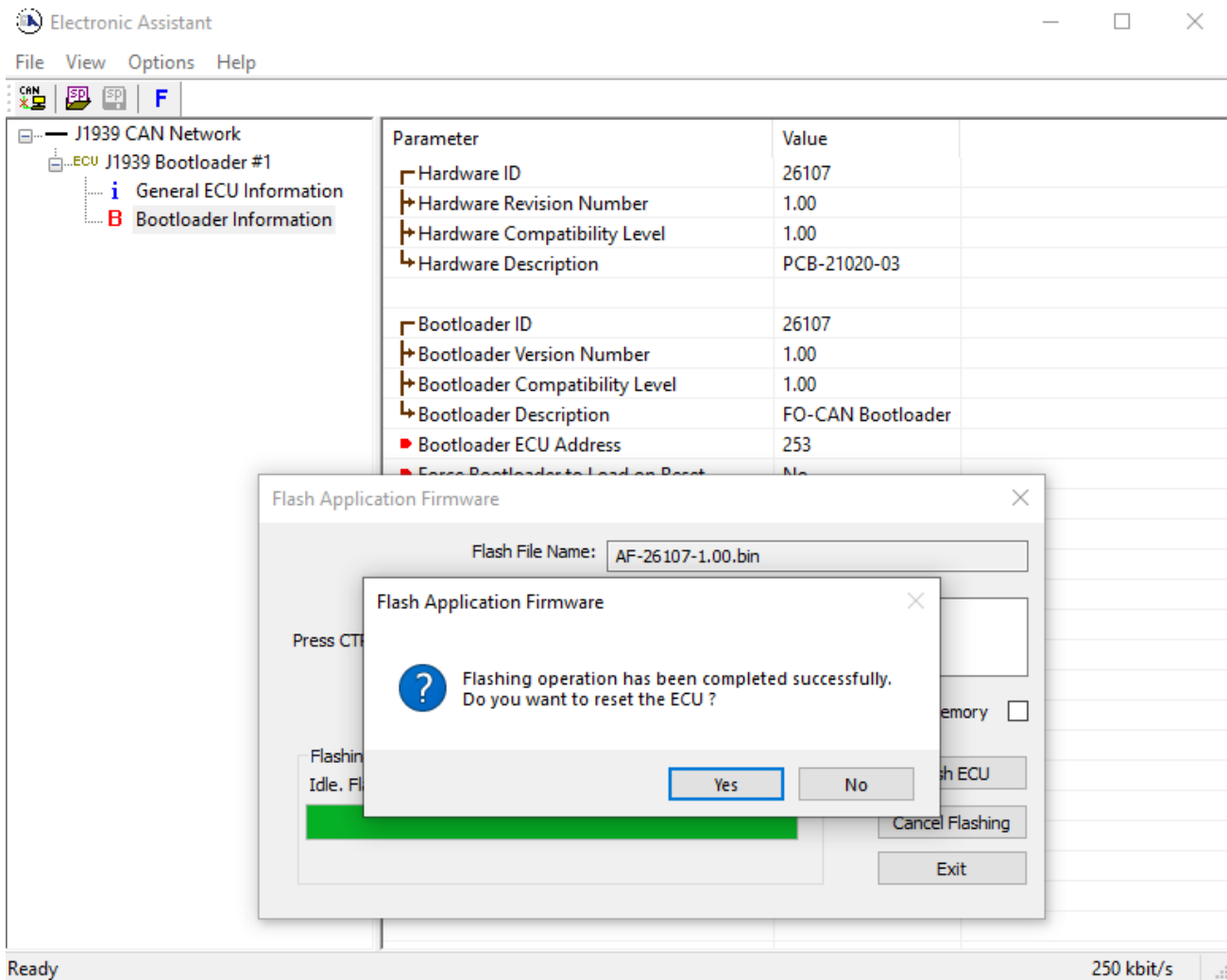


Figure 21. Flashing New Firmware. Final Reset.

Select Yes and see the ECU running the new firmware, see Figure 22. This will indicate that the flashing operation has been performed successfully.

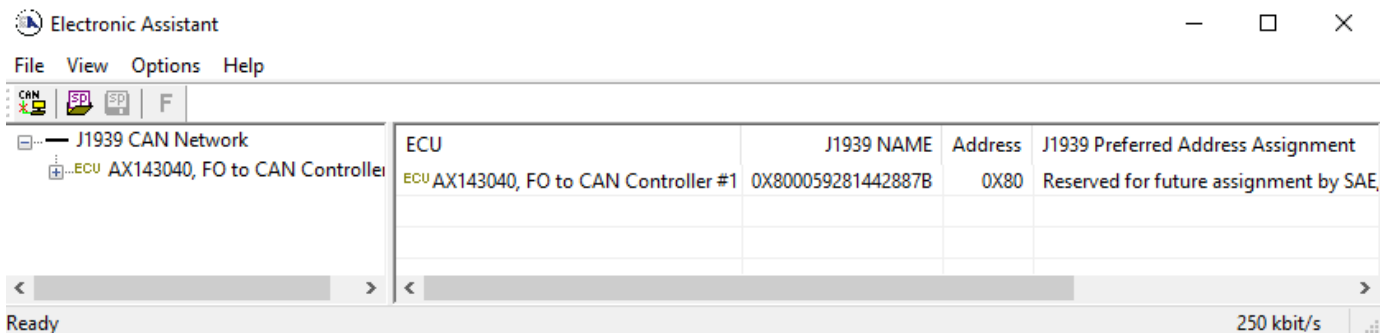


Figure 22. Firmware has been Updated. New Firmware Screen

For more information, see the *J1939 Bootloader* section of the EA user manual.

## 6. TECHNICAL SPECIFICATION

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

### Power Supply

Power Supply Input	12 or 24 V <sub>DC</sub> nominal (8 to 36 VDC range) Shutdown voltage is 8 V <sub>DC</sub> .
Quiescent Current	35.0 mA @ 12 V <sub>DC</sub> ; 18.8 mA @ 24 V <sub>DC</sub> (typical)
Protection	Reverse polarity protection Overvoltage protection up to 38 V

### Fiber Optic

Fiber Optic	820 nm wavelength, 62.5/125 µm fiber size, ST connector
Fiber Optic Connectors	2x connectors (Broadcom P/N: HFBR-1412TZ and HFBR-2412TZ)
Fiber Optic Cable	Not supplied. An example of the cable can be Tripp Lite Model N302-003 Duplex Multimode 62.5/125 Fiber Patch Cable used in our test setups.

### General Specifications

Microcontroller	STM32F413CGU6 1 MB flash memory, 320 KB RAM																								
Isolation	300 Vrms 2-way isolation for fiber optic and CAN																								
CAN	1x isolated CAN port (SAE J1939) Supported Baud Rates: 125 kbit/s, 250 kbit/s, 500 kbit/s, 667 kbit/s, and 1 Mbps with auto-baud-rate detection The auto-baud-rate detection feature can be disabled to set the baud rate to a fixed value.																								
Network Termination	It is necessary to terminate the network with external termination resistors. The resistors are 120 Ω, 0.25 W minimum, metal film or similar type. They should be placed between CAN High and CAN Low terminals at both ends of the network.																								
LED Indicators	2x bicolour red/green LEDs Solid Red = FO Connected Solid Green = CAN Connected Blinking = Network activity (transferring / receiving) Alternating Red/Green = Bootloader mode																								
User Interface	Axiomatic Electronic Assistant – P/N: AX070502 or AX070506K																								
Compliance	RoHS																								
Protection	IP20 (for PCB) IP54 (for FO connectors)																								
Operating Conditions	-40 to 85 °C (-40 to 185 °F)																								
Storage Temperature	-55 to 125 °C (-67 to 257 °F)																								
Vibration and Shock	The enclosure has the following vibration rating. IEC 60068-2-6: 2007-12 (Sine), 2 g peak (Sine) IEC 60068-2-27: 2008-02, 15 g  The fiber optic connectors have the following vibration rating from the manufacturer. A7a Mechanical Shock MIL-STD-883 Method 2002B 1500g, 0.5ms, 5 shocks/axis, 6 axis A7b Vibration MIL-STD-883 Method 2007A 20G, 20-2000Hz, 4 min/cycle, 4 cycles/axis, 3 axis																								
Weight	0.25 lb. (0.11 kg)																								
Enclosure	Phoenix Contact DIN Rail Housing ME MAX 22,5 3-U1 KMGY – P/N:2201538 Polyamide, UL94V0, cULus recognized, China RoHS 4.47 in. x 4.57 in. x 0.89 in. (113.7 mm x 116 mm x 22.6 mm) L x H x W does not include mating connectors. Refer to the dimensional drawing for details.																								
Mounting	DIN rail mount TH 35-7.5 The unit is intended to be mounted within a control housing without vibration isolators. It should not be mounted directly on an engine.																								
Electrical Connections	2x Phoenix Contact spring clamp connectors PSPT 2,5/ 4-ST KMGY (P/N: 2202344) Use 24-14 AWG wires. <table border="1" data-bbox="389 1738 1036 1894"> <thead> <tr> <th colspan="2">Connector J1</th> <th colspan="2">Connector J2</th> </tr> <tr> <th>Pin</th> <th>Function</th> <th>Pin</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Battery +</td> <td>1</td> <td>CAN Shield</td> </tr> <tr> <td>2</td> <td>Battery -</td> <td>2</td> <td>CAN Shield</td> </tr> <tr> <td>3</td> <td>RS-232 RX</td> <td>3</td> <td>CAN High</td> </tr> <tr> <td>4</td> <td>RS-232 TX</td> <td>4</td> <td>CAN Low</td> </tr> </tbody> </table>	Connector J1		Connector J2		Pin	Function	Pin	Function	1	Battery +	1	CAN Shield	2	Battery -	2	CAN Shield	3	RS-232 RX	3	CAN High	4	RS-232 TX	4	CAN Low
Connector J1		Connector J2																							
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1	Battery +	1	CAN Shield																						
2	Battery -	2	CAN Shield																						
3	RS-232 RX	3	CAN High																						
4	RS-232 TX	4	CAN Low																						

## VERSION HISTORY

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User Manual Version	Firmware Version	Date	Author	Modifications
1.0.0	1.xx	Feb. 27, 2026	VR	Initial release
1.0.1	1.xx	Jun. 2, 2026	M Ejaz	Updated title Updated technical specifications
1.0.2	1.xx	Jun. 4, 2026	M Ejaz	Added dimensional drawing

## OUR PRODUCTS

AC/DC Power Supplies  
Actuator Controls/Interfaces  
Automotive Ethernet Switches  
Battery Chargers  
CAN Controls, Routers, Repeaters  
CAN/WiFi  
CAN/Bluetooth (Classic, BLE)  
CAN bus Routers  
CANopen I/O Modules  
Current/Voltage/PWM Converters  
DC/DC Power Converters  
Engine Temperature Scanners  
Ethernet/CAN Converters, Gateways  
Ethernet Switches  
Fan Drive Controllers  
Gateways, CAN/Modbus, RS-232  
Gyroscopes, Inclinometers  
Hydraulic Valve Controllers  
Inclinometers, Triaxial  
I/O Controls  
LVDT Signal Converters  
Machine Controls  
Media Converters  
Modbus, RS-422, RS-485 Controls  
Motor Controls, Inverters  
Power Supplies, DC/DC, AC/DC  
PWM Signal Converters/Isolators  
Resolver Signal Conditioners  
SAE J1939 I/O Modules  
Service Tools  
Signal Conditioners, Converters  
Strain Gauge CAN Controls  
Surge Suppressors

## OUR COMPANY

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

## QUALITY DESIGN AND MANUFACTURING

We have an ISO9001 registered R&D, electronics design and manufacturing facility in Canada.

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

## COMPLIANCE

Product compliance details can be found in the product literature and/or on [axiomatic.com](http://axiomatic.com). Any inquiries should be sent to [sales@axiomatic.com](mailto:sales@axiomatic.com).

## SAFE USE

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



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

## TECHNICAL SUPPORT

Contact technical support by emailing [support@axiomatic.com](mailto:support@axiomatic.com).

## WARRANTY, APPLICATION APPROVALS/LIMITATIONS

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

## SERVICE

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

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

## DISPOSAL

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

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