USER MANUAL UMAX143030-AX180610
Version 1.0.1

RTD to Fiber Optic Module
&
Fiber Optic to CAN, RTD Isolator Module
(SAE J1939)

USER MANUAL

P/N:
AX180610 (RTD-FO)
AX143030 (FO-CAN)

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VERSION HISTORY

Version	Date	Author	Modification
1.0.0	Apr. 20, 2026	Peter Sotirakos	Initial draft; Preliminary
1.0.1	Apr. 22, 2026	M Ejaz	Marketing review Updated technical specifications Updated pinout

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)
FMI	Failure Mode Identifier
GND	Ground reference (a.k.a. BATT-)
MAP	Memory Access Protocol
NAK	Negative Acknowledgement (from SAE J1939 standard)
OC	Occurrence Count
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+)

REFERENCES

J1939	Recommended Practice for a Serial Control and Communications Vehicle Network, SAE, April 2011
J1939/21	Data Link Layer, SAE, December 2010
J1939/71	Vehicle Application Layer, SAE, March 2011
J1939/73	Application Layer-Diagnostics, SAE, February 2010
J1939/81	Network Management, SAE, March 2017
TDAX143030	Technical Datasheet, Fiber Optic RTD Isolator to CAN Module, Axiomatic Technologies
TDAX180610	Technical Datasheet, RTD to Fiber Optic Module, Axiomatic Technologies
UMAX07050x	User Manual, Axiomatic Electronic Assistant and USB-CAN, Axiomatic Technologies

This document assumes the reader is familiar with the SAE J1939 standard. Terminology from the standard is used but not described in this document.

NOTE: This product is supported by Axiomatic Electronic Assistant. The Axiomatic Electronic Assistant KIT may be ordered under P/N: AX070502 or AX070506K.

TABLE OF CONTENTS

1. OVERVIEW OF CONTROLLER

This User Manual will explain two modules: the RTD to Fiber Optic (RTD-FO) Module and the Fiber Optic to CAN, RTD Isolator (FO-CAN) Module. The two modules are meant to work in tandem with each other over a Fiber Optic (FO) connection to perform their full functions.

The RTD-FO module, part number AX180610, is a Resistive Temperature Detector (RTD) Scanner with FO Connection that monitors up to 8 Platinum RTD input channels with 2, 3, or 4 wire configurations. It includes digital isolation from battery power to chassis, and from battery power to inputs. The FO-CAN Module, part number AX143030, is a Fiber Optic to CAN Bridge that is configurable to communicate the temperature and resistance data from the RTD-FO module over a SAE J1939 CAN Network, operating at a fixed baud rate of 250kbps.

The two modules communicate with each other over the FO connection to provide inherent isolation between the modules. The RTD-FO module sends all 8 channels of input data to the FO-CAN module, which uses its configurable features to relay that data over the CAN network. The FO-CAN module also relays configuration data back from the CAN network to the RTD-FO module. The FO connection, as well as the isolated CAN connection, operate automatically when power is applied with no additional programming or configuration required.

The FO-CAN controller additionally provides a comprehensive set of configurable settings, allowing users to create custom configurations without the need for reprogramming. Axiomatic Electronic Assistant (EA) is used to configure the FO-CAN module. Included in these settings are a set of parameters included with each RTD input to support diagnostic messaging for RTD integrity and fault notification, as well as Averaging Blocks which are configurable to provide grouping and filtering options for the RTD inputs. Instructions for programming the configurable parameters, or EA setpoints, are listed in Section 4. Setpoint configuration can be saved in a file which can then be utilized to program the same configuration to different units of the same ECU. Throughout this document, setpoint names are referred to with bolded text in double-quotes, and the setpoint option is referred to with italicized text in single-quotes. For example, the “**RTD Type**” setpoint can be configured to the option *‘2-Wire’*.

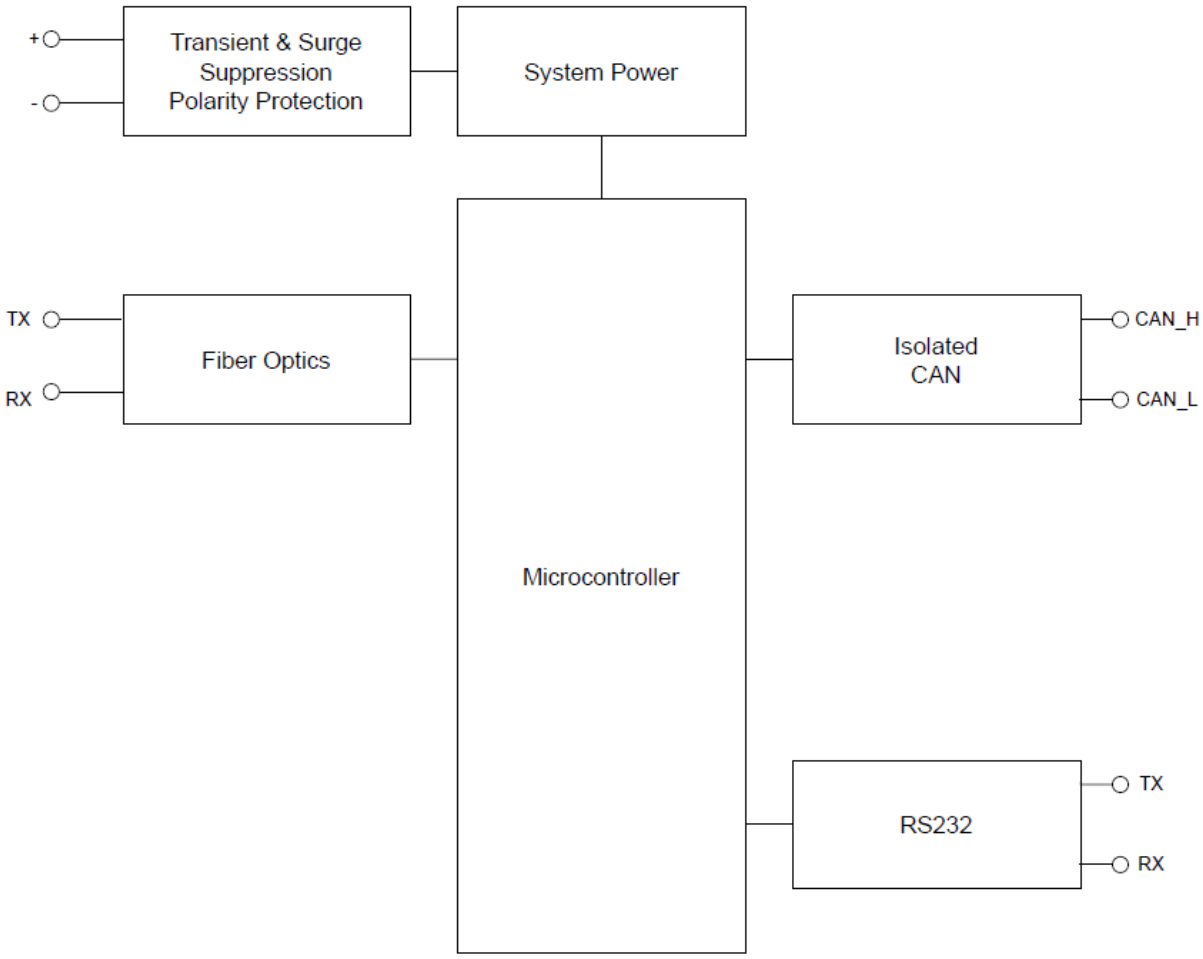


Figure 1 – Block Diagram for the FO-CAN Module

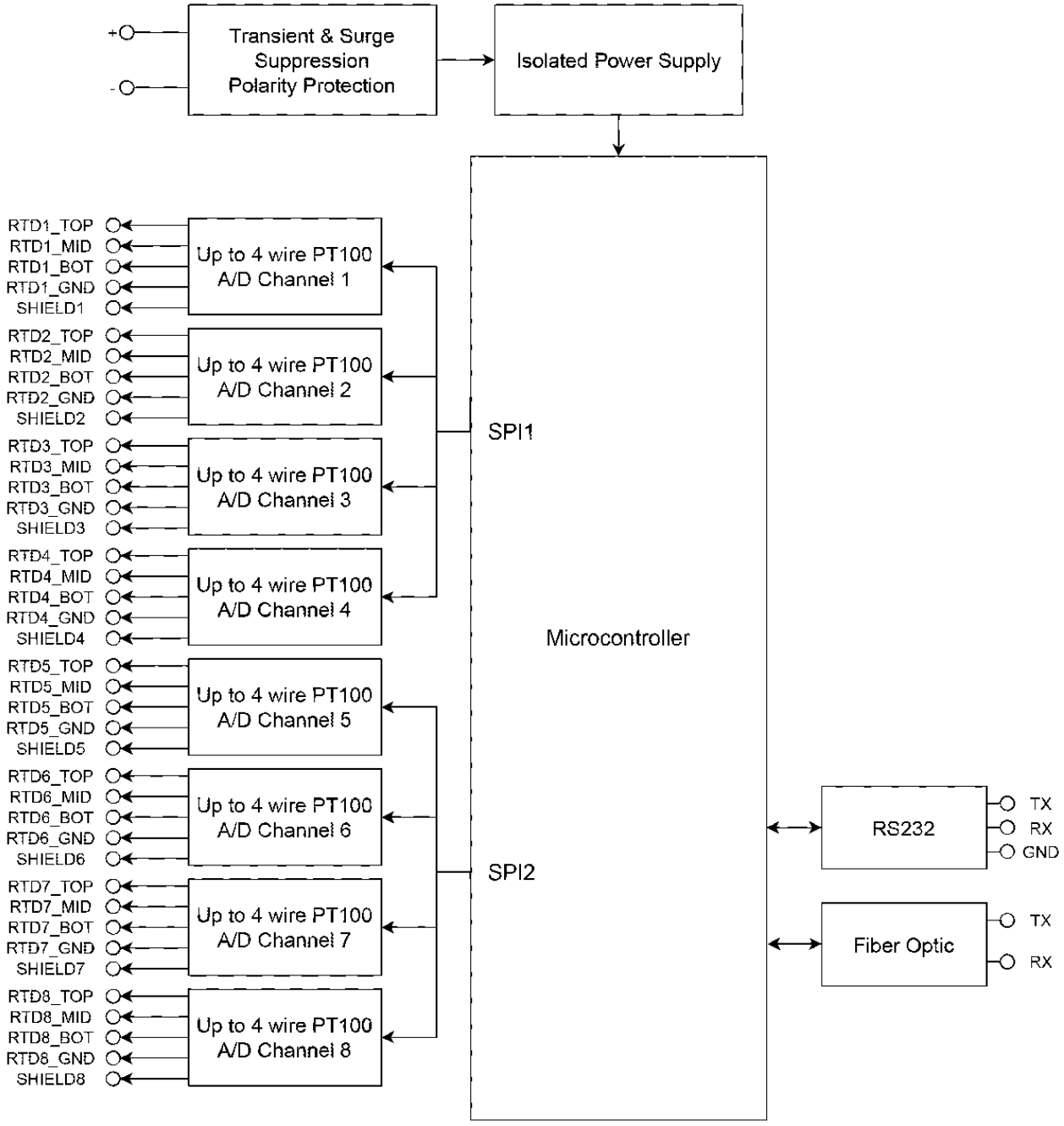


Figure 2 – Block Diagram for the RTD-FO Module

1.1. Control Sources

This section lists the different available control sources and their respective index ranges. Control Sources are defined in using a "**Source**" setpoint and accompanying "**Number**" setpoint. The source will define which type of signal is selected, and the number will determine the index of the selected type. Table 1 below lists the available control sources defined in the controller, along with the unique value used internally to define each source, and the range of available sources for each item listed.

Index	Value	Control Source	Range
0	0	Control Not Used	[0…0]
1	14	RTD Temperature	[1…8]
2	23	RTD Resistance	[1…8]
3	182	Averaging Block	[1…3]
4	29	Global Temperature	[1…1]
5	30	Global Power Supply Voltage	[1…1]

Table 1 – Control Source List

1.2. RTD Input Function Block

The 8 Channel RTD Scanner has eight RTD channels, each provided with four pins in the connector for 2, 3 or 4 wire connection and additionally, a shield pin. Each RTD Input function block contains 2 sets of parameters, the first to configure the RTD channel, and the second to configure the associated diagnostic messaging.

1.2.1. RTD Channel Parameters

The connection type is set by the "**RTD Type**" parameter. It's important to select this type first before configuring other setpoints for the RTD, because depending on the type selected the other setpoints may be enabled or disabled. Table 2 outlines the possible types selectable.

Index	RTD Type
0	Disabled
1	2-Wire
2	3-Wire
3	4-Wire

Table 2 – RTD Type Options

Eight individual analog-to-digital converters are used to measure voltages between pins of each channel, to calculate resistance of the RTD element. In the case of a 2-wire connection, the voltage between pin A and GND pin, with no lead wire compensation, is measured. For 3-wire connection, automatic lead wire resistance compensation is implemented by using second excitation current. The 4-wire connection allows to measure the voltage over RTD element, which is not affected by the lead wire resistance. All connection types are implemented as ratiometric measurements, where any excitation current noise and drift are effectively cancelled.

The Callendar-Van Dusen equation is used to convert measured resistance to a temperature value. According to IEC751, the non-linearity of the platinum thermometer can be expressed as: in which C is only applicable when t < 0 °C. The coefficients A, B and C for the standard sensor are stated at IEC751.There are five predefined Callendar Van Dusen Coefficient sets, which can be selected through the "**RTD Coefficient**" setpoint. Available setpoints options and corresponding Constant values are listed in the tables below. The *'User Defined'* option allows the user to define Callendar Van Dusen constants manually, to match the sensor of their choosing.

Index	RTD Coefficient
0	IEC 0.00385
1	JIS 0.003916
2	US 0.003902
3	Legacy 0.003920
4	SAMA 0.003923
5	User Defined

Table 3 – RTD Coefficient Options

Index	Constant A (E-03)	Constant B (E-07)	Constant C (E-012)
0	3.90830	-5.77500	-4.18301
1	3.974673	-5.89730	-4.35300
2	3.96	-5.93	-4.30
3	3.9848	-5.870	-4.000
4	3.981531	-5.853116	-4.354530

Table 4 – Predefined Callendar Van Dusen Constants

1.2.2. RTD Diagnostic Parameters

Every RTD channel is capable of producing five faults: High Temperature Shutdown, High Temperature Warning, Low Temperature Warning, Open Circuit, and Short Circuit. Each fault is communicated using DM1 messages containing Diagnostic Trouble Codes (DTC) sent over the J1939 Network when they are 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 5)
CM	Conversion Method	(always set to 0)
OC	Occurrence Count	(number of times the fault has happened)

In addition to supporting DM1 messages, the converter 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

All diagnostic messages produced from the RTD channel use the same SPN. The "**RTD SPN**" setpoint is used to set the Suspect Parameter Number associated with the respective RTD channel. The default value zero is not allowed by the standard, thus no DM will be sent unless the SPN is configured to be different from zero. It is the user's responsibility to select a SPN that will not violate J1939 standard. When the SPN is changed, the OC of the associated error log is automatically reset to zero. The communication for that channel can be enabled or disabled using the "**Generate Diagnostic Messages**" setpoint.

The FMI Values for each fault is fixed as shown in the table below.

Fault	FMI	
High Temperature Shutdown	0	*Data Valid But Above Normal Operational Range - Most Severe Level*
High Temperature Warning	15	*Data Valid But Above Normal Operating Range – Least Severe Level*
Low Temperature Warning	17	*Data Valid But Below Normal Operating Range – Least Severe Level*
Open Circuit	5	*Current Below Normal Or Open Circuit*
Short Circuit	4	*Voltage Below Normal, Or Shorted To Low Source*

Table 5 – Fixed FMI Values

The Temperature-related faults are triggered for an RTD channel when the input temperature value crosses the respective thresholds. Figure 3 below illustrates the temperature thresholds: the "**High Shutdown Temperature**" setpoint sets the MAX Shutdown threshold, the "**High Warning Temperature**" setpoint sets the MAX Warning threshold, and the "**Low Warning Temperature**" setpoint sets the MIN Warning threshold.

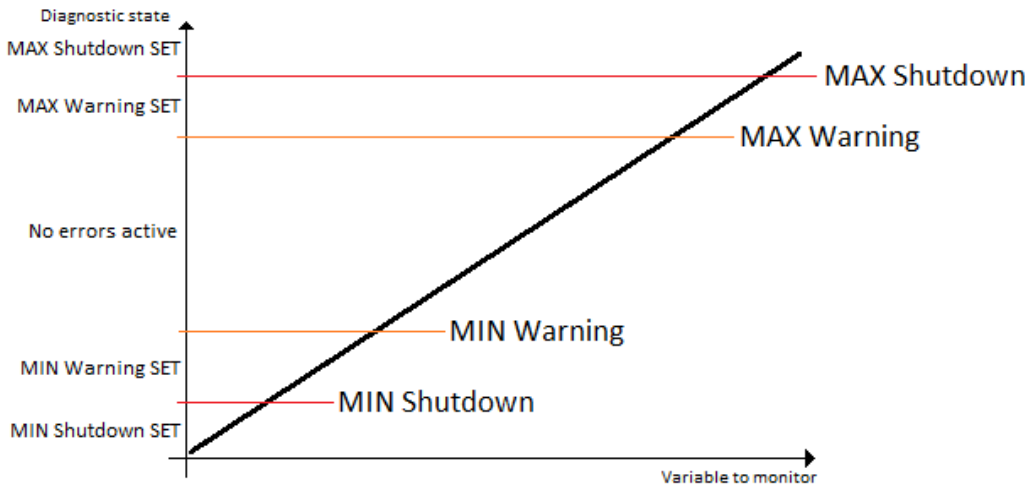


Figure 3 – Double Minimum and Maximum Error Thresholds

The Open and Short Circuit faults operate as *'State Errors'* where the threshold to trigger the faults are simply '0' and '1'.

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

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

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

When the fault is linked to a DTC, a non-volatile log of the occurrence count (OC) is kept. As soon as the controller detects a new (previously inactive) fault, it will start decrementing the "**Delay**" 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 the 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 "**Use Sticky Logic**" 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. Each fault has a fixed lamp value, as listed in Table 6.

Fault	Lamp	
High Temperature Shutdown	0x10	Red Stop
High Temperature Warning	0x04	Amber Warning
Low Temperature Warning	0x04	Amber Warning
Open Circuit	0x04	Amber Warning
Short Circuit	0x04	Amber Warning

Table 6 – Lamp Set by Event in DM1 Values

1.3. Averaging Block

There are three Averaging Blocks included in the system, with the purpose of each block to allow different configurations of inputs to be averaged together. An Averaging block first contains the "**Number of Values**" setpoint, which selects the number of values, up to 8, to be included in the averaging. Then for every value, the "**Value x**" setpoint allows for any of the 8 RTD inputs to be selected, with the ability to leave the value as *'Disabled'*. The block will then produce a value which calculates a single temperature reading by dividing the sum of all non-disabled value by the number of non-disabled values.

1.4. Miscellaneous Parameters

The Miscellaneous setpoint group is used to set parameters that affect the general performance of the FO-CAN module. The “**Temperature Unit**” setpoint controls which temperature unit is used when Temperature data is transmitted through CAN, selectable between Celsius and Fahrenheit. This does not affect the temperature values displayed in EA, all configuration values are presented in Celsius.

The **“CAN Diagnostic Setting”** parameter is used to control all diagnostics with one general setting. This can be used to disable diagnostics entirely, only transmit messages without a blank SPN, or transmit diagnostic messages normally.

1.5. CAN Transmit Message Parameters

The CAN Transmit function block is used to send any data from a control source to the J1939 network. This setpoint group includes parameters to configure and setup all signals used to create a CAN message. These setpoints are presented in this section. The setpoints that configure an individual signal are presented in the next section.

Each Transmit block can be either enabled or disabled using the "**Transmit Enabled**" setting.

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**.

"**Repetition Rate**" defines the interval used to send the message to the J1939 network. If the 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 message will not be broadcasted until after a 5 second delay. This is done to prevent any power up or initialization conditions from creating problems on the network.

By default, all messages are sent on Proprietary B PGNs as broadcast messages. Thus "**Transmit Message Priority**" is always initialized to 6 (low priority) and the "**Destination Address (PDU1)**" 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.

1.5.1. CAN Transmit Signal Parameters

Each CAN transmit message has four associated signals, which define data inside the Transmit message. Each signal can be configured with the "**Signal Data Type**" setpoint to either be disabled or configured as a '*Discrete*' or '*Continuous*' signal. The "**Control Source**" setpoint together with "**Control Number**" setpoint define the signal source of the message. The options for those setpoints are listed in Table 1. Setting "**Control Source**" to '*Control Not Used'* disables the signal.

The "**Signal Data Size**" setpoint determines how many bits within the message will be reserved for that signal. "**Signal Byte Index**" determines in which byte of the CAN message the LSB of the signal is located. Similarly, "**Signal Bit Index**" determines in which bit within the byte that the LSB of the signal is located. These setpoints are freely configurable, and it is up to user discretion to configure signals that are not overlapping or masking data from each other.

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

2. INSTALLATION INSTRUCTIONS

2.1. Dimensions and Pinout

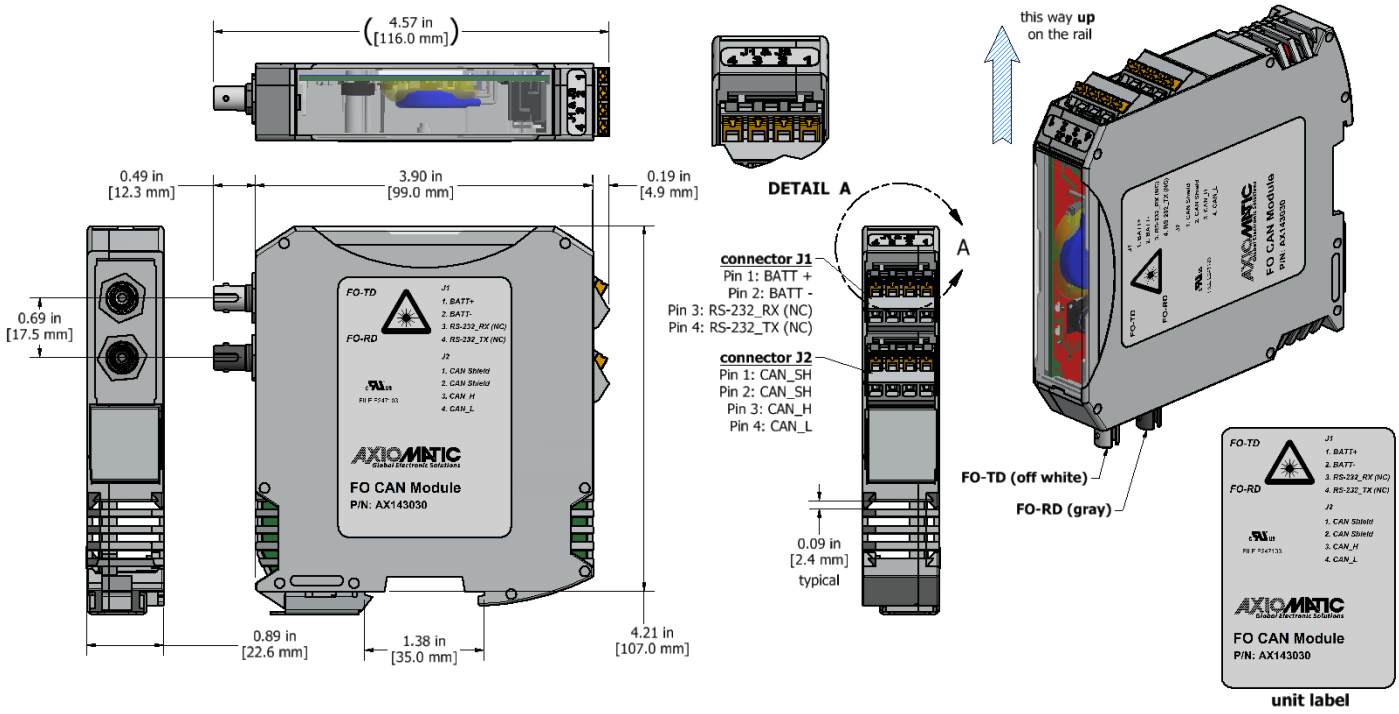


Figure 4 – AX143030 Dimensional Drawing

2x Phoenix Contact spring clamp connectors PSPT 2,5/ 4-ST KMGY (P/N: 2202344).
Accepts 24-14 AWG wire

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

Table 7 – AX143030 Connector Pinout

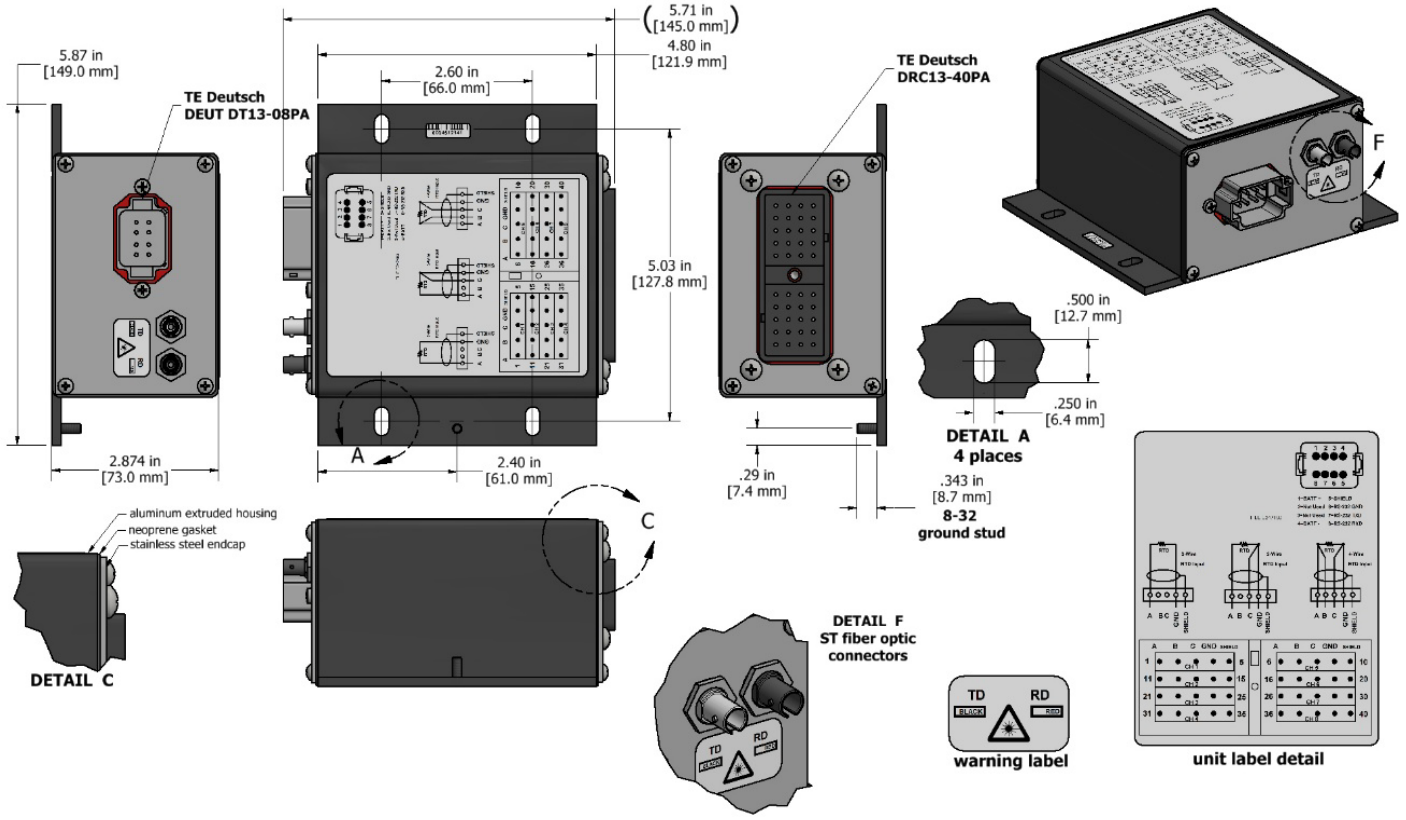
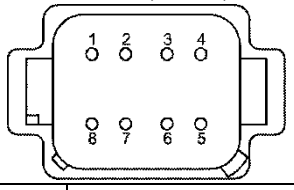


Figure 5 – AX180610 Dimensional Drawing

1x 8-pin TE Deutsch connector – P/N: DT13-08PA
Mates with TE Deutsch P/N DT06-08SA, W8S, and 8x sockets 0462-201-16141.



Pin	Function
1	Power +
2	Not Used
3	Not Used
4	Power -
5	Not Used
6	RS-232 Ground
7	RS-232 TXD
8	RS-232 RXD

Table 8 – AX180610 Power Connector Pinout

1x 40-pin TE Deutsch connector – P/N: DRC13-40PA
Mates with P/N DRC16-40SE-A or DRC18-40SA or DRC16-40S with 40x sockets 0462-201-16141.

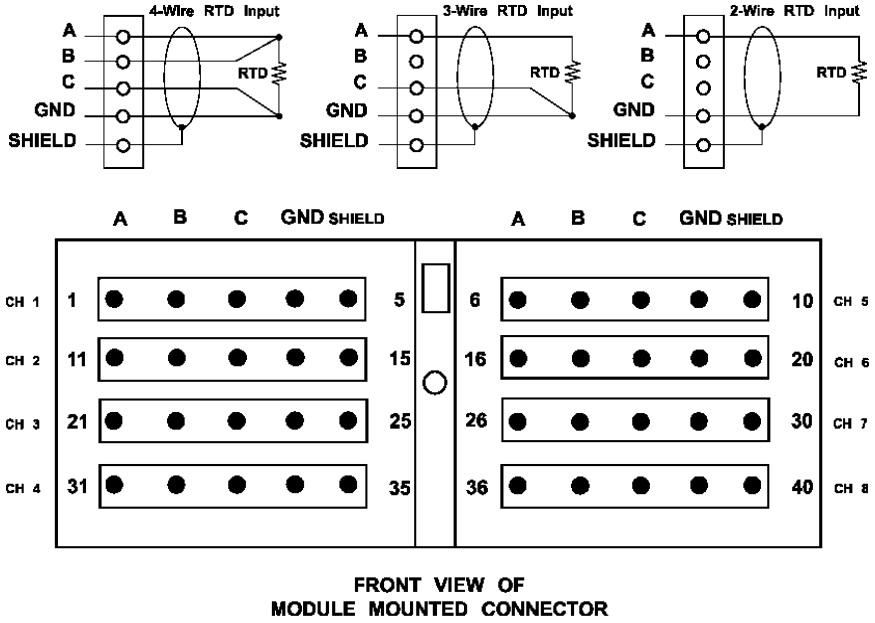


Figure 6 – AX180610 RTD Connector Pinout

3. OVERVIEW OF J1939 FEATURES

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

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

3.1. Introduction to Supported Messages

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

From J1939-21 – Data Link Layer

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

From J1939-73 – Diagnostics

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

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	0x00FEEB

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

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

3.2. NAME, Address and Software ID

The converter 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	5, Industrial
Vehicle System Instance	0
Vehicle System	0, Non-specific system
Function	128, Supplemental Engine Sensing
Function Instance	20, Axiomatic AX143030
ECU Instance	0, First Instance
Manufacture Code	162, Axiomatic Technologies
Identity Number	Variable, uniquely assigned during factory programming for each ECU

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

The default value of the “ECU Address” setpoint is 128 (0x80), which is the preferred starting address for self-configurable ECUs as set by the SAE in J1939 tables B3 and B7. The Axiomatic EA supports the selection of any address between 0 and 253. ***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 converter will continue select the next highest address until it finds one that it can claim. See J1939/81 for more details about address claiming.

ECU Identification Information

PGN 64965	ECU Identification Information	-ECUID
Transmission Repetition Rate:	On request	
Data Length:	Variable	
Extended Data Page:	0	
Data Page:	0	
PDU Format:	253	
PDU Specific:	197 PGN Supporting Information:	
Default Priority:	6	
Parameter Group Number:	64965 (0x00FDC5)	

Start Position	Length	Parameter Name	SPN
a	Variable	ECU Part Number, Delimiter (ASCII “*”)	2901
b	Variable	ECU Serial Number, Delimiter (ASCII “*”)	2902
c	Variable	ECU Location, Delimiter (ASCII “*”)	2903
d	Variable	ECU Type, Delimiter (ASCII “*”)	2904
e	Variable	ECU Manufacturer Name, Delimiter (ASCII “*”)	4304

(a)*(b)*(c)*(d)*(e)*

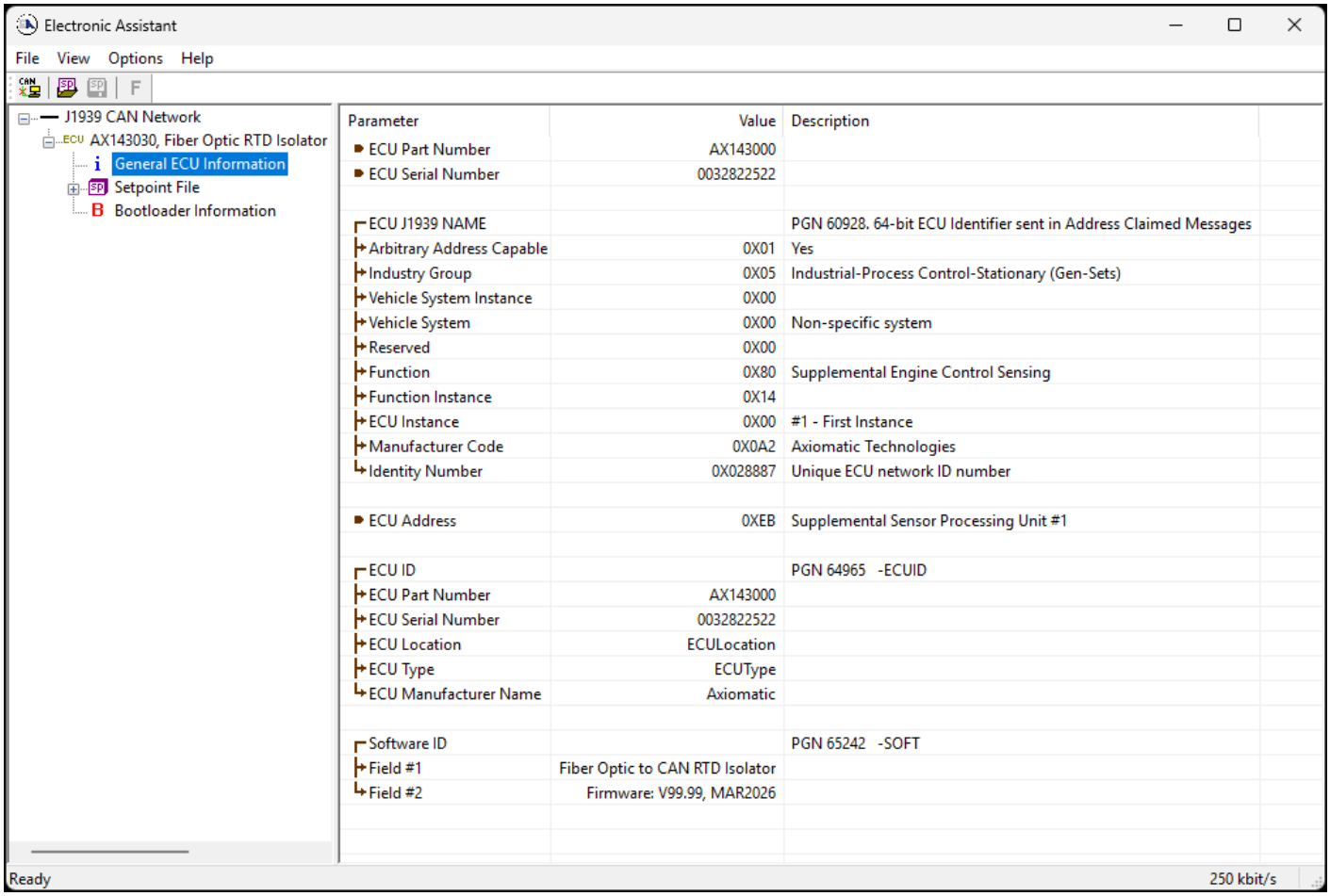


Figure 7 – General ECU Information

Software Identifier

PGN 65242		Software Identification	- SOFT
Transmission Repetition Rate:		On request	
Data Length:		Variable	
Extended Data Page:		0	
Data Page:		0	
PDU Format:		254	
PDU Specific:		218 PGN Supporting Information:	
Default Priority:		6	
Parameter Group Number:		65242 (0xFEDA)	
Start Position	Length	Parameter Name	SPN
1	1 Byte	Number of software identification fields	965
2-n	Variable	Software identification(s), Delimiter (ASCII “*”)	234

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

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

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

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

Component Identification

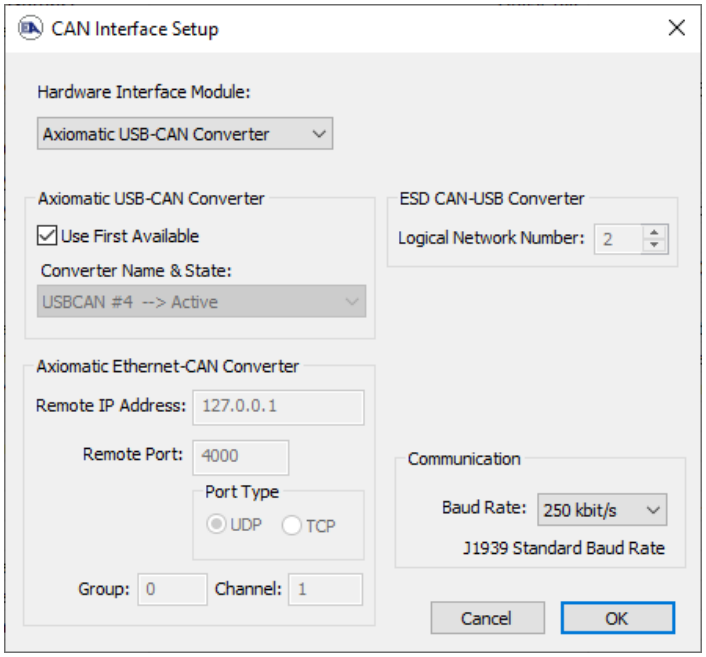
PGN 65259		Component Identification	-CI
Transmission Repetition Rate:		On request	
Data Length:		Variable	
Extended Data Page:		0	
Data Page:		0	
PDU Format:		254	
PDU Specific:		235 PGN Supporting Information:	
Default Priority:		6	
Parameter Group Number:		65259 (0x00FEEB)	
Start Position	Length	Parameter Name	SPN
a	1-5 Byte	Make, Delimiter (ASCII “*”)	586
b	Variable	Model, Delimiter (ASCII “*”)	587
c	Variable	Serial Number, Delimiter (ASCII “*”)	588
d	Variable	Unit Number (Power Unit), Delimiter (ASCII “*”)	233
(a)*(b)*(c)*(d)*(e)*			

4. ECU SETPOINTS ACCESSED WITH AXIOMATIC ELECTRONIC ASSISTANT

This section describes in detail each setpoint, and their defaults and ranges. The setpoints are divided into setpoint groups as they are shown in the Axiomatic EA. For more information on how each setpoint is used by the converter, refer to the relevant section in this user manual.

4.1. Accessing the ECU Using Axiomatic Electronic Assistant

An ECU with P/N AX143030 does not need any specific setup for the Axiomatic EA. To access the high-speed versions, the CAN bus Baud Rate needs to be set accordingly. The CAN Interface Setup can be found from the ‘Options’ menu in EA. Please refer to UMAX07050x **Connecting to the J1939 Bus** section for Axiomatic Electronic Assistant CAN Interface Setup instructions.



4.2. J1939 Network Setpoints

“ECU Instance Number” and “ECU Address” setpoints and their effect are defined in section 3.2.

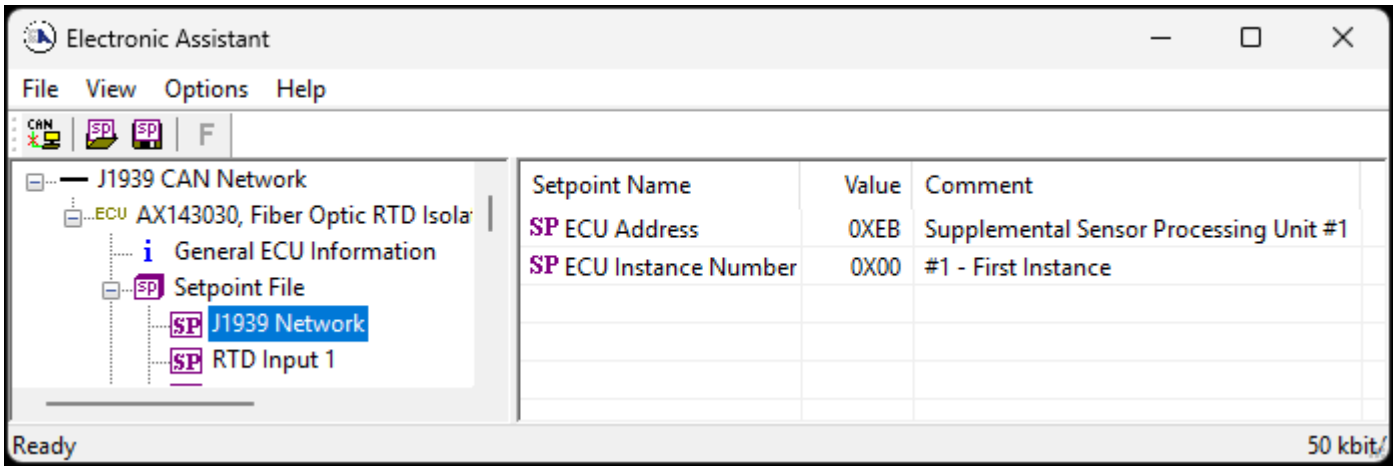


Figure 8 – Screen Capture of J1939 Setpoints

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

Table 9 – J1939 Network Setpoints

If non-default values for the **“ECU Instance Number”** or **“ECU Address”** are used, they will be mirrored during a setpoint file flashing and will only take effect once the entire file has been downloaded to the unit. After the setpoint flashing is complete, the unit will claim the new address and/or re-claim the address with the new NAME. If these setpoints are changing, it is recommended to close and re-open the CAN connection on the Axiomatic EA after the file is loaded, such that only the new NAME and address appear in the J1939 CAN Network ECU list.

4.3. RTD Input Setpoints

The Universal Input Setpoint block is defined in Section 1.2. Please refer to that section for further details on how to configure each setpoint and their effect on the input.

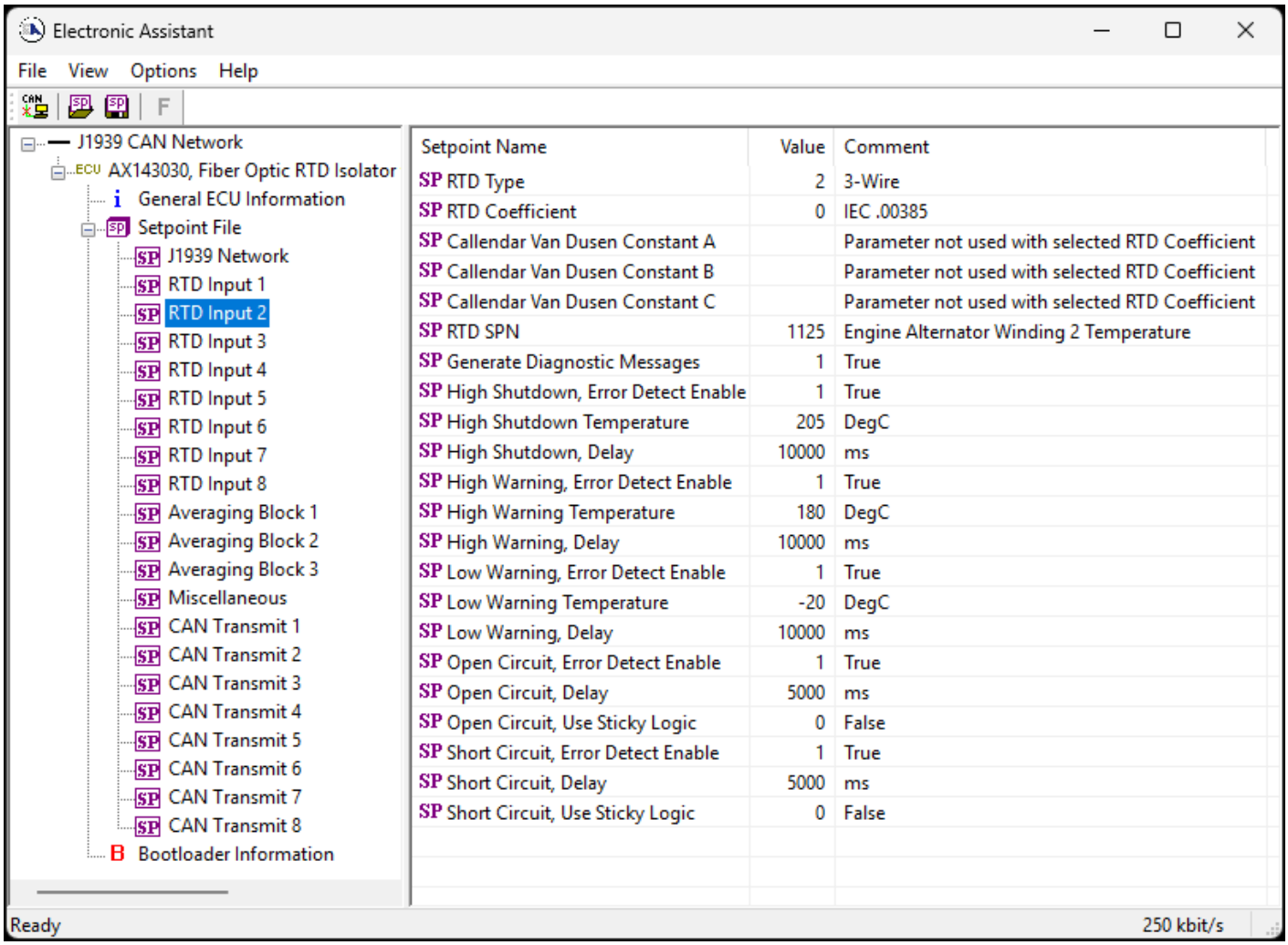


Figure 9 – Screen Capture of Universal Input Setpoints

Name	Range	Default	Notes
RTD Type	Drop List	3-Wire	See Section 1.2.1
RTD Coefficient	Drop List	IEC .00385	See Section 1.2.1
Callendar Van Dusen Constant A	-10 .. 10	3.90830 (IEC .00385 A)	See Section 1.2.1
Callendar Van Dusen Constant B	-10 .. 10	-5.77500 (IEC .00385 B)	See Section 1.2.1
Callendar Van Dusen Constant C	-10 .. 10	-4.18301 (IEC .00385 C)	See Section 1.2.1
RTD SPN	Drop List	N/A	See Section 1.2.2
Generate Diagnostic Messages	Drop List	False	See Section 1.2.2
High Shutdown, Error Detect Enable	Drop List	True	See Section 1.2.2
High Shutdown Temperature	-273 .. 1735 °C	205 °C	See Section 1.2.2
High Shutdown, Delay	0..60,000 ms	10,000 ms	See Section 1.2.2
High Warning, Error Detect Enable	Drop List	True	See Section 1.2.2
High Warning Temperature	-273 .. 1735 °C	180 °C	See Section 1.2.2
High Warning, Delay	0..60,000 ms	10,000 ms	See Section 1.2.2
Low Warning, Error Detect Enable	Drop List	True	See Section 1.2.2
Low Warning Temperature	-273 .. 1735 °C	-20 °C	See Section 1.2.2
Low Warning, Delay	0 .. 60,000 ms	10,000 ms	See Section 1.2.2
Open Circuit, Error Detect Enable	Drop List	True	See Section 1.2.2
Open Circuit, Delay	0 .. 60,000 ms	5,000 ms	See Section 1.2.2
Open Circuit, Use Sticky Logic	Drop List	False	See Section 1.2.2
Short Circuit, Error Detect Enable	Drop List	True	See Section 1.2.2
Short Circuit, Delay	0 .. 60,000 ms	5,000 ms	See Section 1.2.2
Short Circuit, Use Sticky Logic	Drop List	False	See Section 1.2.2

Table 10 – Universal Input Setpoints

4.4. Averaging Block Setpoints

The Digital Input Setpoint block is defined in Section1.1. Please refer to that section for further details on the configuration of each setpoint and their effect on the input.

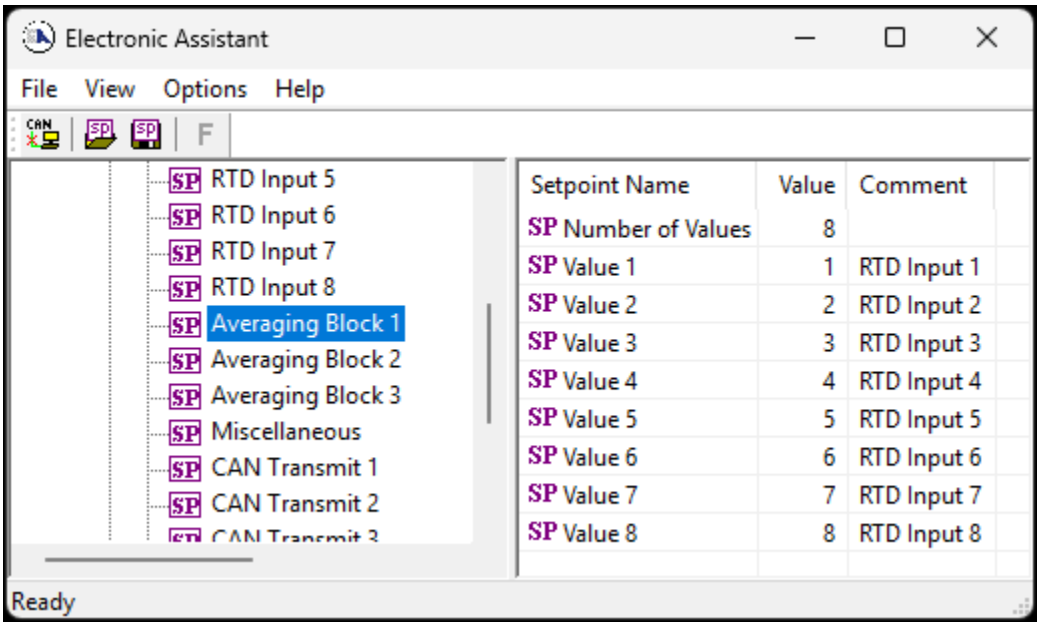


Figure 10 – Screen Capture of Digital Input Setpoints

Name	Range	Default	Notes
Number of Values	0 .. 8	0	See Section 1.3
Value x [x=1 to 8]	Drop List	Disabled	See Section 1.3

Table 11 – Digital Input Setpoints

4.5. Miscellaneous Setpoints

These setpoints control the shutdown of the ECU in case of a power supply or CPU temperature related errors. Refer to Section 1.1 for more info.

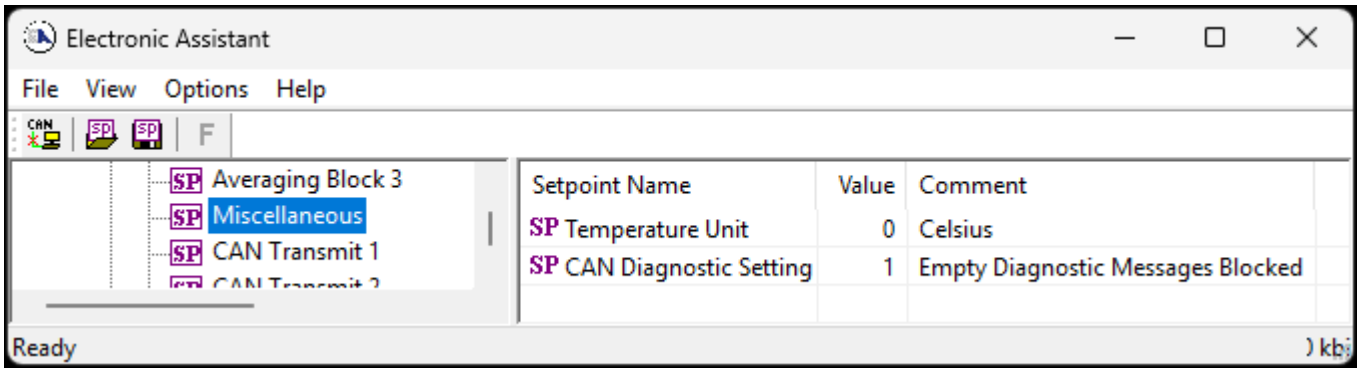


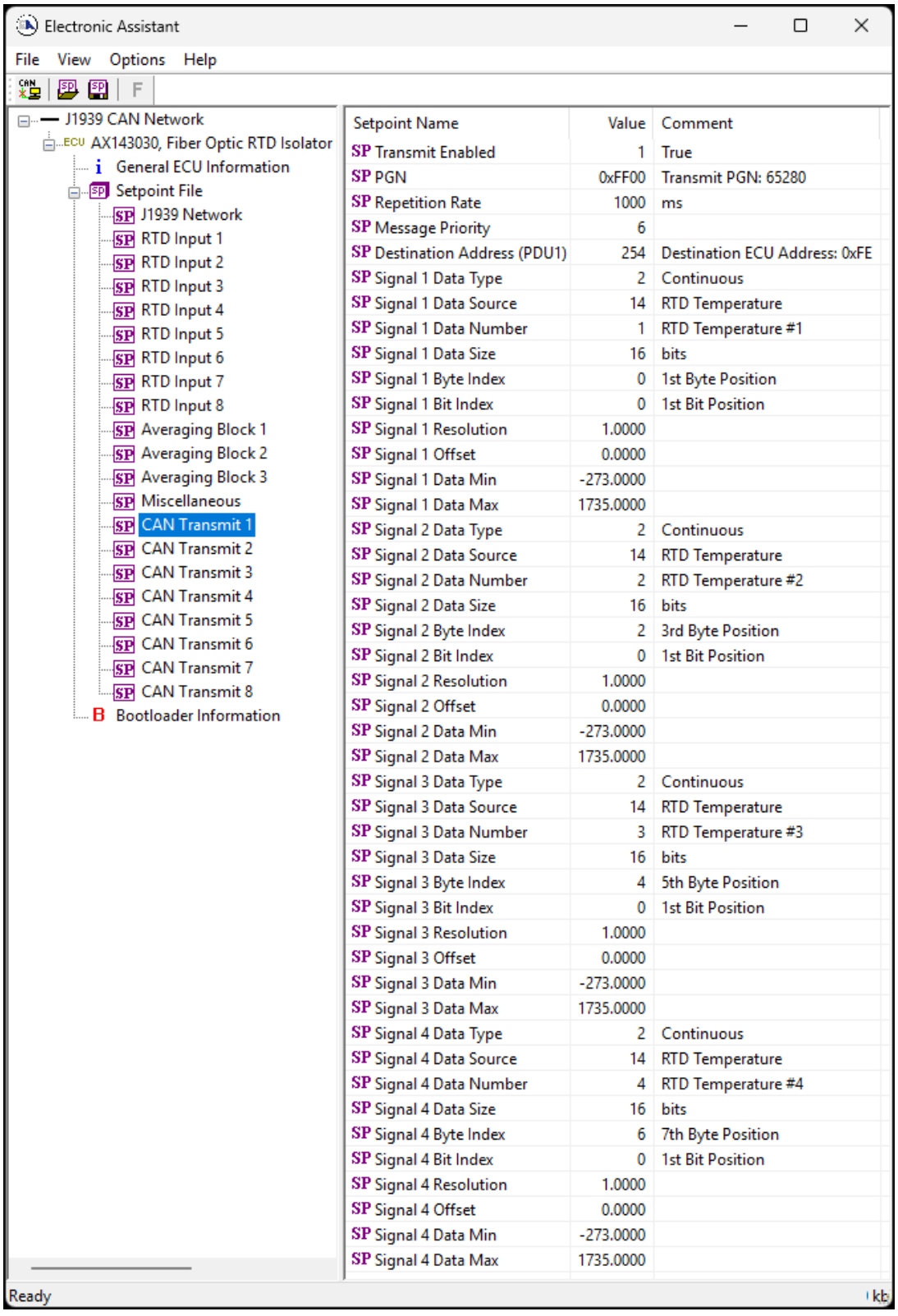
Figure 11 – Screen Capture of General Diagnostics Options Setpoints

Name	Range	Default	Notes
Temperature Unit	Drop List	False	See Section 1.4
CAN Diagnostic Setting	Drop List	Diagnostic Messages Off	See Section 1.4

Table 12 – General Diagnostics Options Setpoints

4.6. CAN Transmit Setpoints

CAN Transmit Message Function Block be presented in Section 1.5. Please refer there for detailed information on how these setpoints are used.



Setpoint Name	Value	Comment
SP Transmit Enabled	1	True
SP PGN	0xFF00	Transmit PGN: 65280
SP Repetition Rate	1000	ms
SP Message Priority	6	
SP Destination Address (PDU1)	254	Destination ECU Address: 0xFE
SP Signal 1 Data Type	2	Continuous
SP Signal 1 Data Source	14	RTD Temperature
SP Signal 1 Data Number	1	RTD Temperature #1
SP Signal 1 Data Size	16	bits
SP Signal 1 Byte Index	0	1st Byte Position
SP Signal 1 Bit Index	0	1st Bit Position
SP Signal 1 Resolution	1.0000	
SP Signal 1 Offset	0.0000	
SP Signal 1 Data Min	-273.0000	
SP Signal 1 Data Max	1735.0000	
SP Signal 2 Data Type	2	Continuous
SP Signal 2 Data Source	14	RTD Temperature
SP Signal 2 Data Number	2	RTD Temperature #2
SP Signal 2 Data Size	16	bits
SP Signal 2 Byte Index	2	3rd Byte Position
SP Signal 2 Bit Index	0	1st Bit Position
SP Signal 2 Resolution	1.0000	
SP Signal 2 Offset	0.0000	
SP Signal 2 Data Min	-273.0000	
SP Signal 2 Data Max	1735.0000	
SP Signal 3 Data Type	2	Continuous
SP Signal 3 Data Source	14	RTD Temperature
SP Signal 3 Data Number	3	RTD Temperature #3
SP Signal 3 Data Size	16	bits
SP Signal 3 Byte Index	4	5th Byte Position
SP Signal 3 Bit Index	0	1st Bit Position
SP Signal 3 Resolution	1.0000	
SP Signal 3 Offset	0.0000	
SP Signal 3 Data Min	-273.0000	
SP Signal 3 Data Max	1735.0000	
SP Signal 4 Data Type	2	Continuous
SP Signal 4 Data Source	14	RTD Temperature
SP Signal 4 Data Number	4	RTD Temperature #4
SP Signal 4 Data Size	16	bits
SP Signal 4 Byte Index	6	7th Byte Position
SP Signal 4 Bit Index	0	1st Bit Position
SP Signal 4 Resolution	1.0000	
SP Signal 4 Offset	0.0000	
SP Signal 4 Data Min	-273.0000	
SP Signal 4 Data Max	1735.0000	

Figure 12 – Screen Capture of CAN Transmit Message Setpoints

Name	Range	Default	Notes
Transmit Enabled	Drop List	0; False	See Section 1.5
PGN	0xff00 .. 0xffff	Different for each	See Section 1.5
Repetition Rate	0 .. 65000 ms	0ms	See Section 1.5
Message Priority	0 .. 7	6	See Section 1.5
Destination Address (PDU1)	0 .. 255	255	See Section 1.5
Signal X Data Type	Drop List	Continuous	See Section 1.5.1
Signal X Data Source	Drop List	0; No Source	See Section 1.5.1
Signal X Data Number	Depends on Source	1	See Section 1.5.1
Signal X Data Size	0 .. 32 bits	16 bits	See Section 1.5.1
Signal X Byte Index	0 .. 7	0	See Section 1.5.1
Signal X Bit Index	0 .. 7	0	See Section 1.5.1
Signal X Resolution	-100000 .. 100000	1/bits	See Section 1.5.1
Signal X Offset	-10000 .. 10000	0.0	See Section 1.5.1
Signal X Data Min	-100000 ..100000	0.0	See Section 1.5.1
Signal X Data Max	-100000 .. 100000	65535.0	See Section 1.5.1

Table 13 – CAN Transmit Message Setpoints

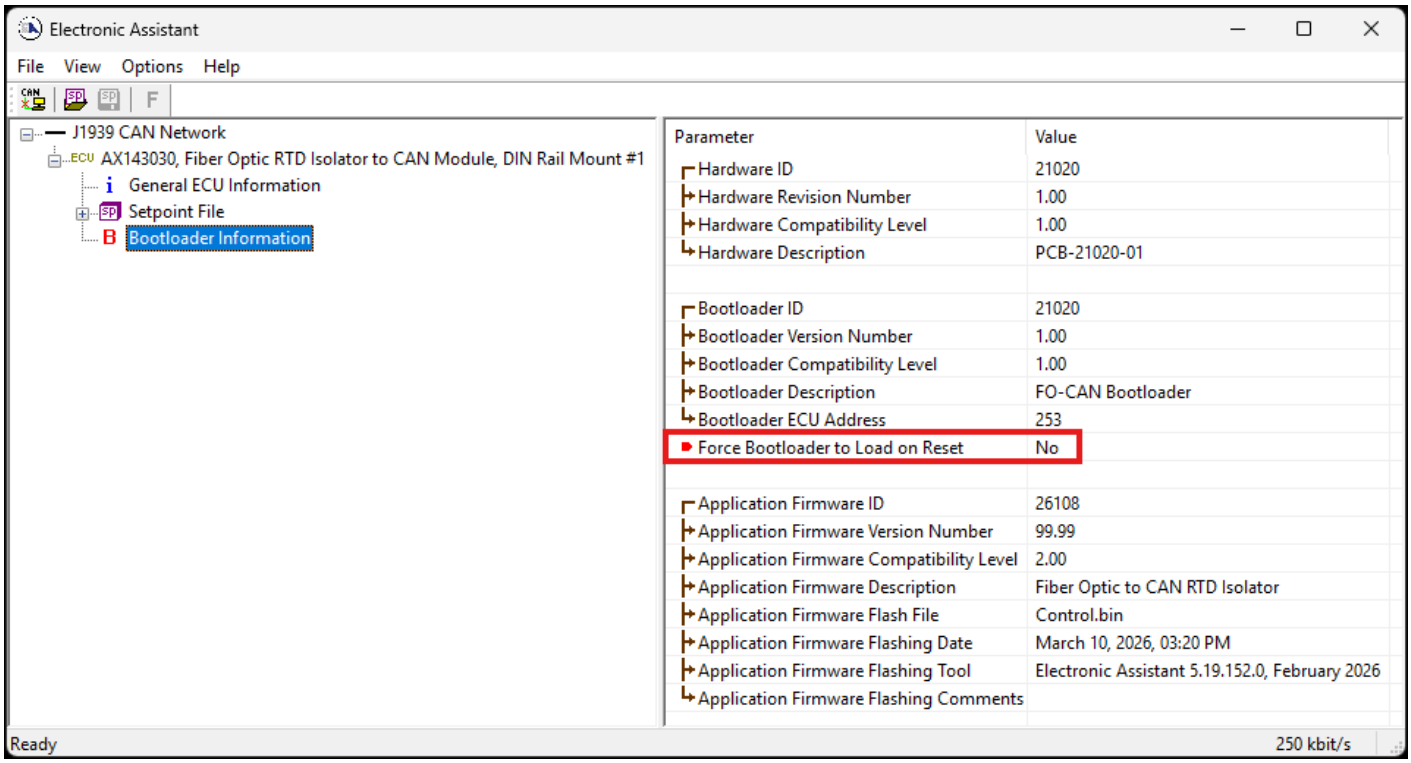
5. REFLASHING OVER CAN WITH THE AXIOMATIC EA BOOTLOADER

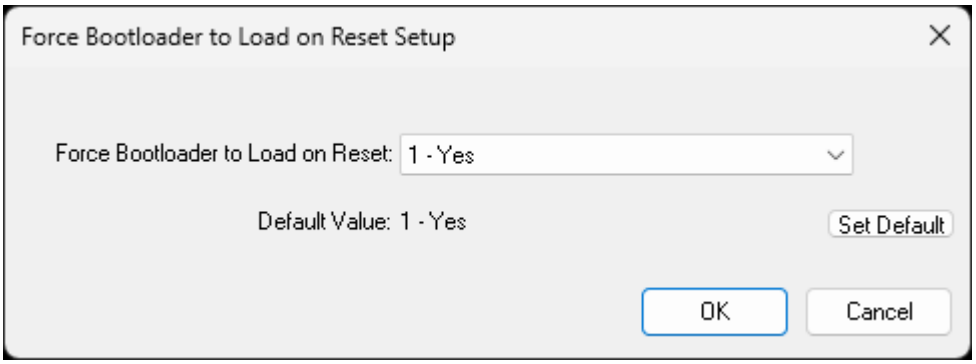
The AX143030 can be upgraded with new application firmware using the **Bootloader Information** section. This section details the simple step-by-step instructions to upload new firmware provided by Axiomatic onto the unit via CAN, without requiring it to be disconnected from the J1939 network.

Note: To upgrade the firmware, use Axiomatic Electronic Assistant Vx.x.xx.x or higher.

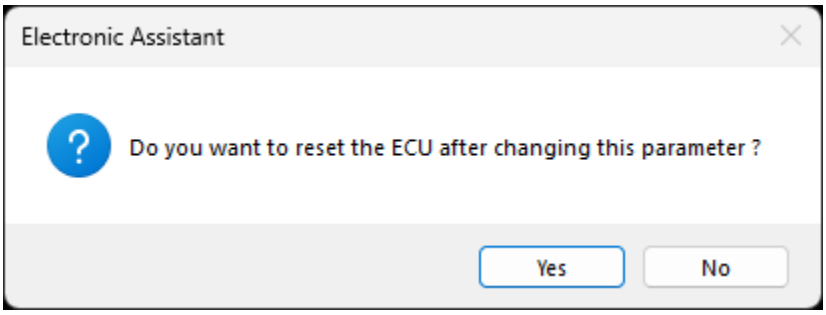
1. When the Axiomatic EA first connects to the ECU, the **Bootloader Information** section will display the following information.

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

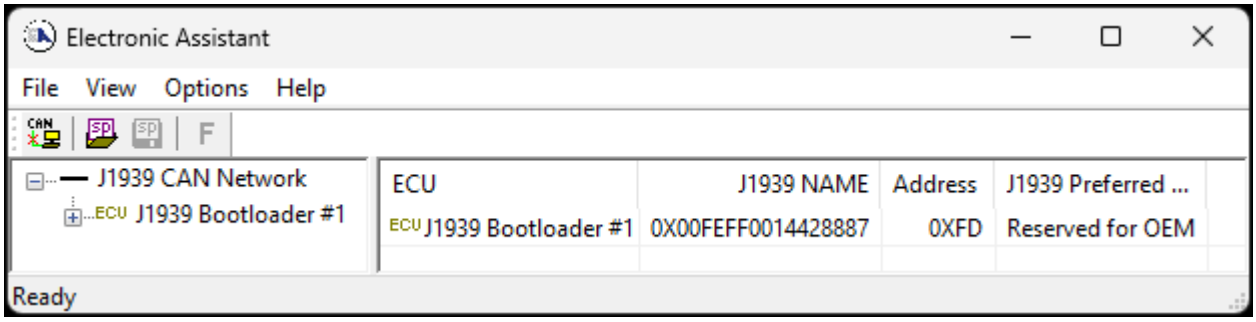


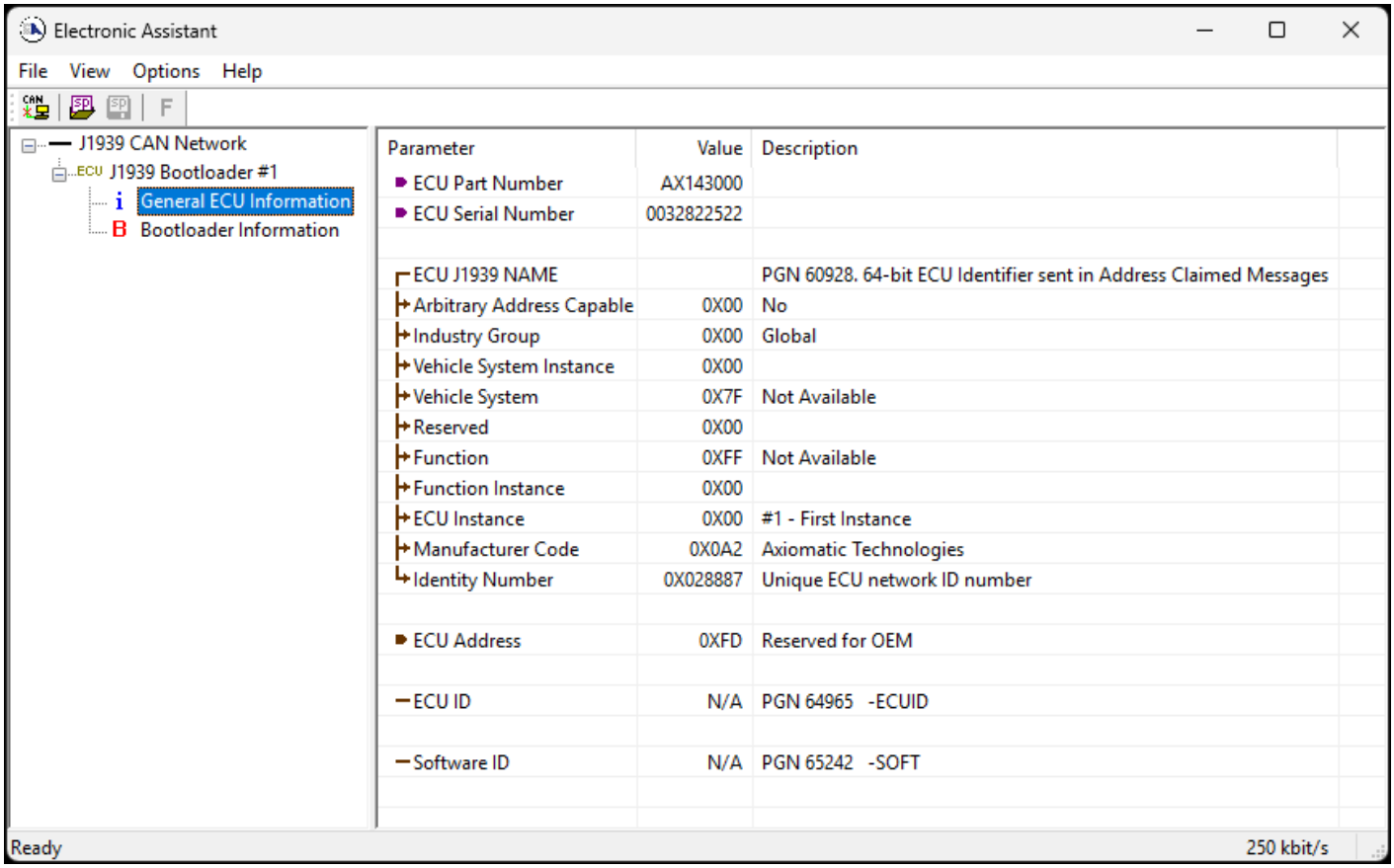


3. When the prompt box asks if you want to reset the ECU, select *Yes*.



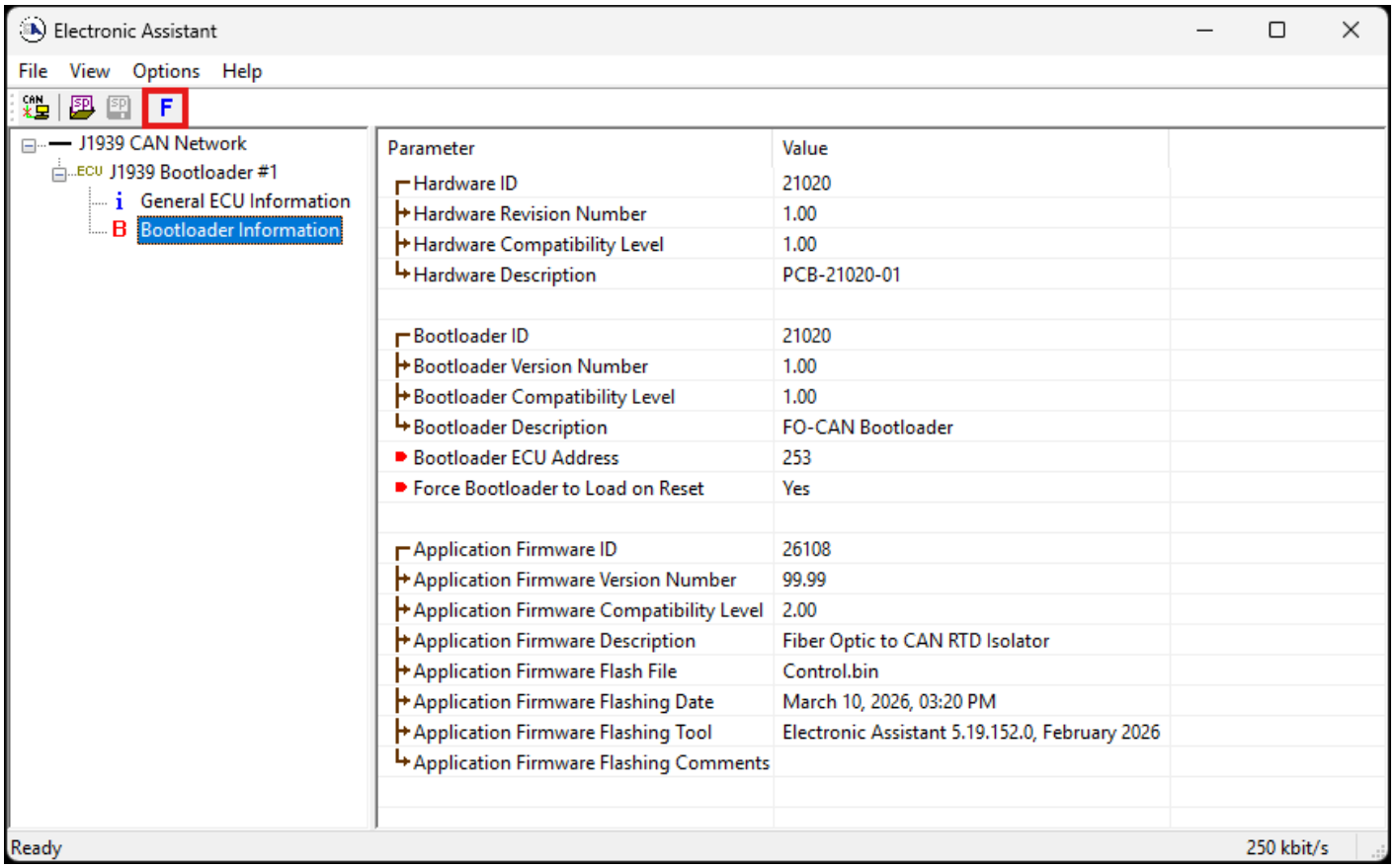
4. Upon reset, the ECU will no longer show up on the J1939 network as an AX143030 but rather as **J1939 Bootloader #1**.





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.

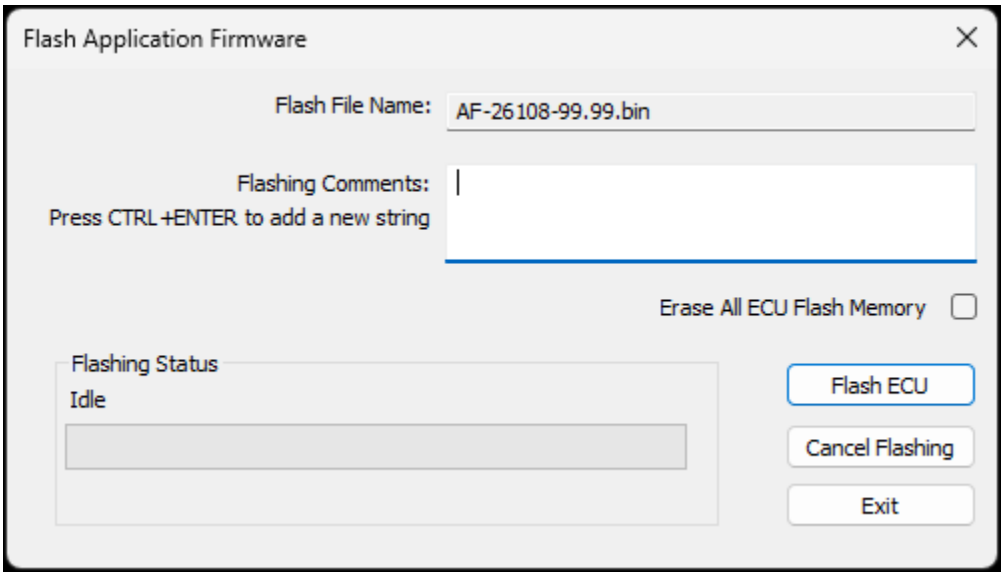
5. When the **Bootloader Information** section is selected, the same information is shown as when it was running the AX143030 firmware, but in this case the **F**lashing feature has been enabled.



6. Select the **F**lashing button and navigate to where you had saved the **AF-24011-X.XX.bin** file sent from Axiomatic. (Note: only binary (.bin) files can be flashed using the Axiomatic EA tool.)

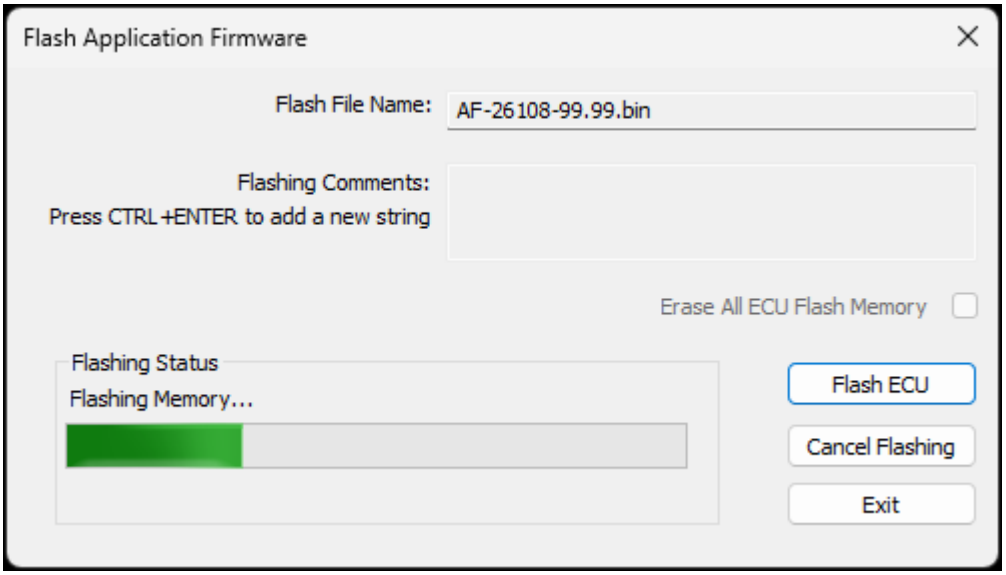
7. Once the Flash Application Firmware window opens, you can enter comments such as “Firmware upgraded by [Name]” if you so desire. This is not required, and you can leave the field blank if you do not want to use it.

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

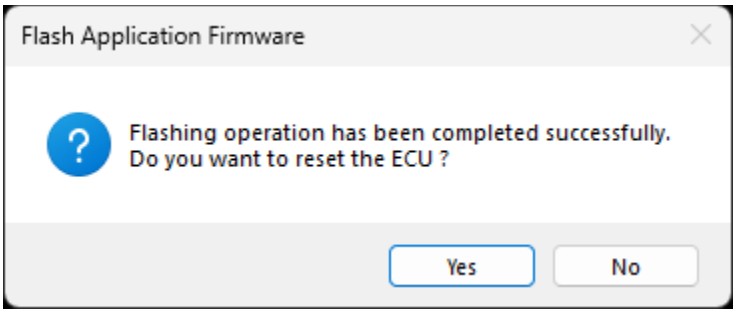


WARNING: Do not check the “Erase All ECU Flash Memory” box unless instructed to do so by your Axiomatic contact. Selecting this will erase ALL data stored in non-volatile flash, including the calibration done by Axiomatic during factory testing. It will also erase any configuration of the setpoints that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

A progress bar will show how much of the firmware has been sent as the upload progresses. The more traffic there is on the J1939 network, the longer the upload process will take.



Once the firmware has finished uploading, a message will pop up indicating the successful operation. If you select to reset the ECU, the new version of the AX143030 application will start running, and the ECU will be identified as such by the Axiomatic EA. Otherwise, the next time the ECU is power cycled, the AX143030 application will run rather than the bootloader function.



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

APPENDIX A - AX143030 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 VDC nominal (8 to 36 VDC range) Shutdown voltage is 8 VDC.
Quiescent Current	35.0 mA @ 12 VDC; 18.83 mA @ 24 VDC (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	Broadcom P/N HFBR-1412TZ and HFBR-2412TZ IP54
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) Baud-Rate: 250 kbit/s
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	2 LEDs for fiber optic status Green = Connected, Red = Disconnected / Not Working
User Interface	Axiomatic Electronic Assistant – P/N: AX070502 or AX070506K
Compliance	RoHS
Protection	IP20
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	0.30 lb. (0.14 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.
Installation	DIN rail mount TH 35-7.5

APPENDIX B - AX180610 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/.

All specifications are typical at nominal input voltage and 25 °C unless otherwise specified.

Power Supply

Power Input	12 or 24 VDC nominal (9 to 32 VDC range)
Supply Current	41 mA @ 12 VDC; 19 mA @ 24 VDC (typical)
Protection	Reverse polarity protection is provided. The power input circuit protects against transient surges and short circuits. The fiber optic connection provides inherent isolation.

Inputs

RTD Types	Up to 8x channels, independently configurable for 2, 3, or 4 wire Class B 100 Ω Platinum RTDs (Pt100)
RTD Inputs	Each channel independently supports specific sensors: IEC 0.00385, JIS 0.003916, US 0.003902, Legacy 0.003920, and SAMA 0.003923. A user defined coefficient would enable custom Callendar-Van Dusen constants to be set for sensors not listed above. The device accepts inputs within the range of 10 to 350 Ω. Resolution: 0.001 °C Accuracy: ±1 °C (typical) at ambient temperature *(Note: Operating with two wire RTD inputs connected will show an extra ±0.5 Ω of accuracy error.)*
Scan Rate	100 ms per channel, total sweep time maximum 900 ms
Common Mode Readings	Input range ± 4 V maximum Rejection is 100 db at 5 Vp-p (50 to 60 Hz)
Thermal Drift	150 ppm/°C of span (max.)
Isolation	Digital isolation is 1000 VDC for 1 minute with current limit 0.4 mA (or 800 VAC for 2 s with current limit 5 mA) from battery power to chassis. Isolation is 500 VDC for 1 minute with current limit 0.4 mA (or 700 VAC for 2 s with current limit 5 mA) from battery power to RTD inputs.
Protection	Open circuit detection Frozen data detection Over or under-temperature detection High temperature shutdown detection

General Specifications

<table>
<tr><td>Microcontroller</td><td>STM32F413CGU6
1.5 MB flash memory, 320 KB RAM</td></tr>
<tr><td>Isolation</td><td>Digital isolation from battery power to chassis and from battery power to inputs.
Communication over FO provides inherent isolation between the AX143030 and AX180610 modules.</td></tr>
<tr><td>User Interface</td><td>The AX143030 is configurable via CAN bus using the Axiomatic Electronic Assistant KIT – AX070502 or AX070506K.</td></tr>
<tr><td>Compliance</td><td>UL and cUL: Standard for Controllers for Use in Power Production, CAN/ULC 6200, 1st edition
RoHS</td></tr>
<tr><td>Protection</td><td>For the product assembly, the rating for the seal between the AX180610 housing and the fiberoptic connector bodies is IP54.
The 40-pin TE connector has an IP67 rating.</td></tr>
<tr><td>Humidity</td><td>Protected against 95 % humidity (non-condensing) at 30 to 60 ºC</td></tr>
<tr><td>Vibration</td><td>7.32 Grms</td></tr>
<tr><td>Operating Temperature</td><td>-40 to 80 ºC (-40 to 176 ºF)</td></tr>
<tr><td>Storage Temperature</td><td>-50 to 120 ºC (-58 to 248 ºF)</td></tr>
<tr><td>Weight</td><td>2.15 lb. (0.98 kg)</td></tr>
<tr><td>Enclosure</td><td>Rugged aluminum housing
Stainless steel end plates
Neoprene gaskets
5.71 in. x 5.87 in. x 2.87 in. (145 mm x 149 mm x 73 mm)
L x W x H includes the 2 integral connectors</td></tr>
<tr><td>Installation</td><td>Can be mounted directly on the power generator set or remotely
Suitable for moist, high shock, vibrating and non-hazardous environments</td></tr>
<tr><td>Fiber Optic Connectors</td><td>1x HFBR-1412TZ
1x HFBR-2412TZ</td></tr>
<tr><td>Mating Plug KIT</td><td>The AX070200 KIT available from Axiomatic includes the following items. (These items may also be available from your local TE Deutsch distributor.)

<table>
<tr><th>TE Deutsch P/N</th><th>Description</th></tr>
<tr><td>DT06-08SA</td><td>Plug, 8 contacts</td></tr>
<tr><td>DRC16-40S</td><td>40-pin plug, no key</td></tr>
<tr><td>0462-201-16141</td><td>48x 16 AWG sockets, solid, 16 to 20 AWG wire, 6mm</td></tr>
<tr><td>114017</td><td>24x sealing plugs, size 12-16 cavities, 12 to 18 AWG</td></tr>
<tr><td>W8S</td><td>Wedgelock</td></tr>
</table>

Note: The sealing plugs are only needed in cases where pins are not used.

A crimping tool from TE Deutsch is required to connect wiring to the sockets, P/N: HDT 48-00 or equivalent (not supplied).</td></tr>
</table>

OUR PRODUCTS

AC/DC Power Supplies

Actuator Controls/Interfaces

Automotive Ethernet Interfaces

Battery Chargers

CAN Controls, Routers, Repeaters

CAN/WiFi, CAN/Bluetooth, Routers

Current/Voltage/PWM Converters

DC/DC Power Converters

Engine Temperature Scanners

Ethernet/CAN Converters, Gateways, Switches

Fan Drive Controllers

Gateways, CAN/Modbus, RS-232

Gyroscopes, Inclinometers

Hydraulic Valve Controllers

Inclinometers, Triaxial

I/O Controls

LVDT Signal Converters

Machine Controls

Modbus, RS-422, RS-485 Controls

Motor Controls, Inverters

Power Supplies, DC/DC, AC/DC

PWM Signal Converters/Isolators

Resolver Signal Conditioners

Service Tools

Signal Conditioners, Converters

Strain Gauge CAN Controls

Surge Suppressors

OUR COMPANY

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

QUALITY DESIGN AND MANUFACTURING

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

WARRANTY, APPLICATION APPROVALS/LIMITATIONS

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

COMPLIANCE

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

SAFE USE

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

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

SERVICE

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