20 CHANNEL THERMOCOUPLE SCANNER WITH CAN 2.0B

USER MANUAL

P/N: AX185000-10

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VERSION HISTORY

Version	Date	Author	Modification
1.00	March 10, 2023	Ilona Korpelainen	Initial Draft
1.01	June 29, 2023	M Ejaz	Marketing review Modified thermocouple input accuracy in Appendix A
1.02	August 1, 2023	M Ejaz Amanda Wilkins	Marketing review Added dimensional drawing Updated approvals
1.03	August 21, 2024	M Ejaz	Removed references to adjustable baud-rate

ACRONYMS

ADC	Analog to digital converter
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.
PropA	Message that uses the Proprietary A PGN for peer-to-peer communication
PropB	Message that uses a Proprietary B PGN for broadcast communication
TP	Transport Protocol
Vps	Voltage Power Supply (a.k.a. BATT+)

TABLE OF CONTENTS

REFERENCES

J1939	Recommended Practice for a Serial Control and Communications Vehicle Network, SAE, April 2011
J1939/21	Data Link Layer, SAE, December 2010
J1939/71	Vehicle Application Layer, SAE, March 2011
J1939/73	Application Layer-Diagnostics, SAE, February 2010
J1939/81	Network Management, SAE, February 2017
UMAX185000-10	User Manual, 20 Channel Thermocouple Scanner with Can 2.0B, Axiomatic Technologies
TDAX185000-10	Technical Datasheet, 20 Channel Thermocouple Scanner Controller with CAN 2.0B Axiomatic Technologies
UMAX07050x	User Manual V 5.16.136, 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 V5.16.136.0 and higher.

1. OVERVIEW OF CONTROLLER

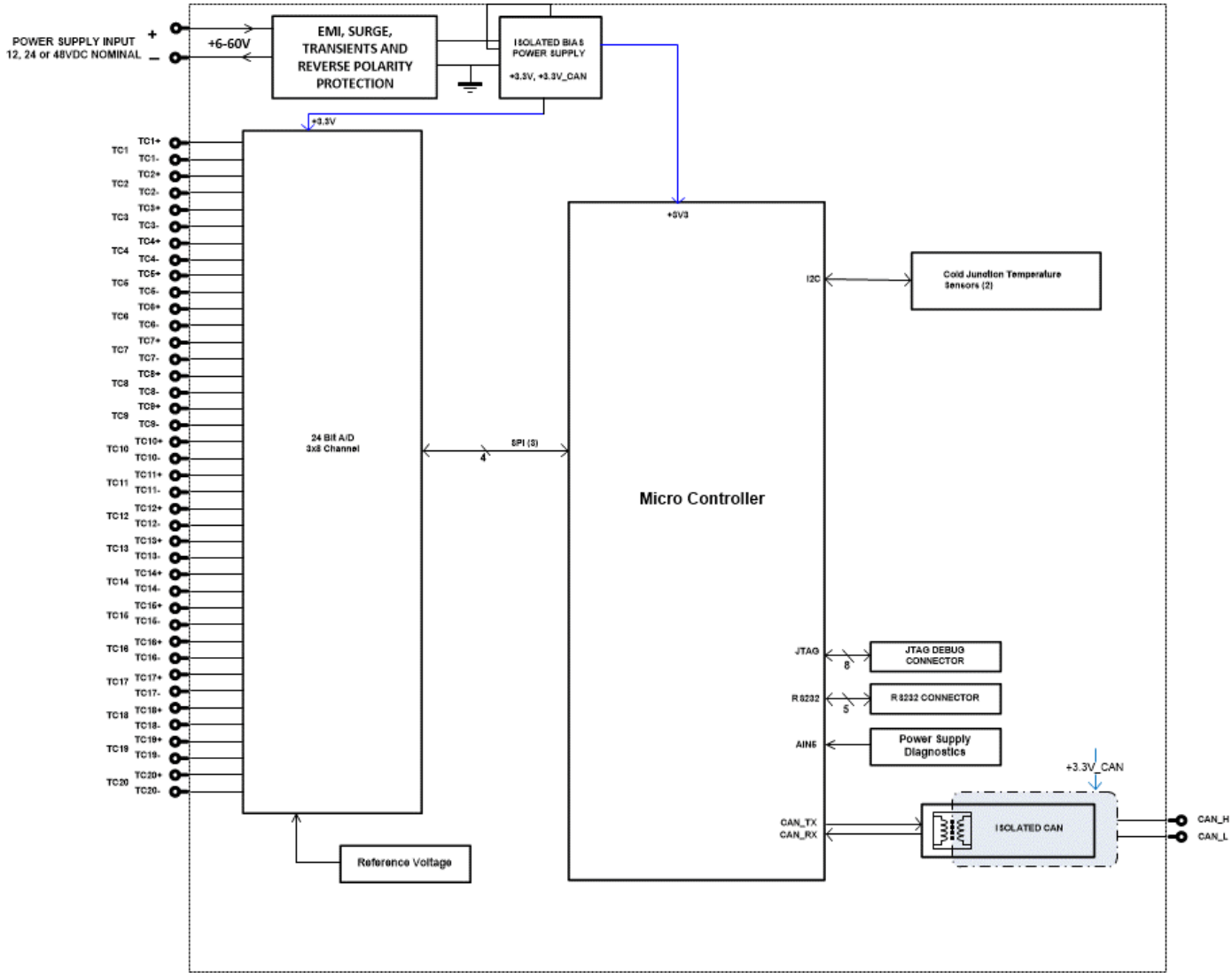


Figure 1 - AX185000-10 Block Diagram

The AX185000-10 supersedes discontinued CA171000 and AXTC20-02. It will interface with a ComAp system using setpoints suitable for the ComAp communication protocol (Refer to Section 4.3, Table 4.0). Customization for use with ComAp communication is discussed in section 3. The 20 Channel Thermocouple Scanner monitors up to 20 thermocouple channels and provides the temperature information over a CAN bus. The channels are independently configurable as Type J, K, B, E, N, R, S or T thermocouples. All 20 channels of temperature data are automatically sent over the CAN bus when power is applied with no additional programming or configuration needed.

A *Windows*-based Axiomatic Electronic Assistant (EA) is used to configure the controller via an USB-CAN (AX070501) device. Configurable properties, EA setpoints, are outlined in chapter 4. Setpoint configuration can be saved in a file which can be used to easily program the same configuration into another 20 Channel Thermocouple Scanner. Throughout this document EA setpoint names are referred to with bolded text in double-quotes and the setpoint option is referred with italicized text in single-quotes. For example, "**Input Sensor Type**" setpoint set to option '*Voltage 0 to 5V*'.

In this document, the configurable properties of the ECU are divided into function blocks, namely TC Input Function Block and Averaging. These function blocks are presented in detail in the next subchapters.

1.1. TC Input Function Blocks

The 20 Channel Thermocouple Scanner has 20 Thermocouple inputs, each provided with two pins in the connector (see section 2.1) for +ve and -ve connections. Thermocouple voltages are measured with three high precision 24-bit ∑-Δ analog-to-digital (ADC) converters. Two high accuracy digital temperature sensors are placed next to thermocouple connectors to provide cold junction compensation. By default, all temperatures are compensated for the cold junction temperature, but it is possible to choose not to use cold junction compensation, by setting "**Use Cold Junction Compensation**" setpoint to '*False'*.

The scanner supports eight common types of thermocouples. Thermocouple type is selected with "**Thermocouple Type**" setpoint. Drop list option for the setpoint are presented in Table 1.

0	*Disabled*
1	*B Type*
2	*E Type*
3	*J Type*
4	*K Type*
5	*N Type*
6	*R Type*
7	*S Type*
8	*T Type*

Table 1 – Thermocouple Type Options

There are two user selectable ADC filter options to reject common line frequency noise. Each provides minimum 120dB rejection for the line frequency and its harmonics. "**ADC Filter Frequency**" setpoint can be found under Miscellaneous setpoint group, and it is used to configure ADC filter for all 20Thermocouple channels.

0	*50Hz rejection*
1	*60Hz rejection*

Table 2 – ADC Filter Frequency Options

Every 4000ms ADC Burnout Current is activated for each Thermocouple channel and Thermocouple voltage is measured to determine if a sensor is present. If near full-scale reading is received from ADC, an open circuit fault is flagged, and error indicator (0x8000) is inserted to the data message instead of measurement data.

The 20 Channel Thermocouple Scanner keeps a log of the last 10 scans of raw ADC measurement data. If the raw data has not changed after 10 scans, the scanner will stop broadcasting the 'frozen' data and insert the error indicator (0x8000) in the data message instead. This is a redundant safety feature and should never occur.

2. INSTALLATION INSTRUCTIONS

2.1. Dimensions and Pinout

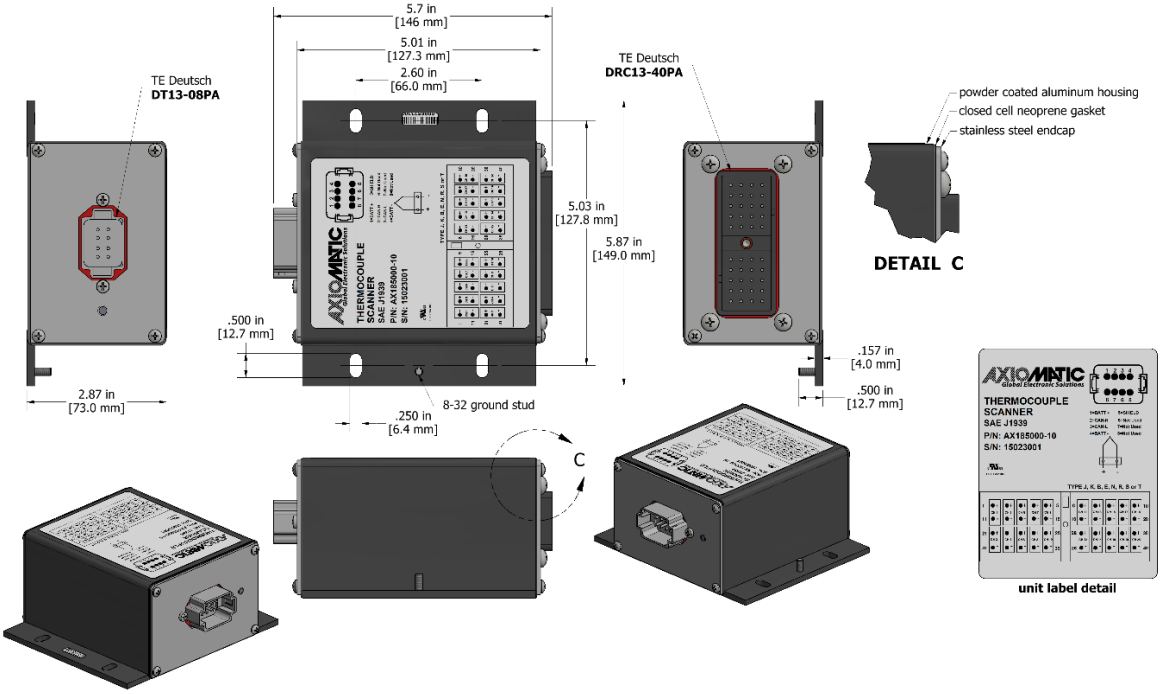
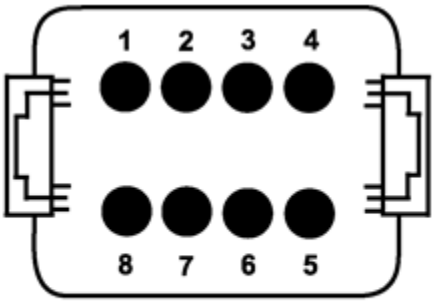


Figure 2 – AX185000-10 Dimensional Drawing

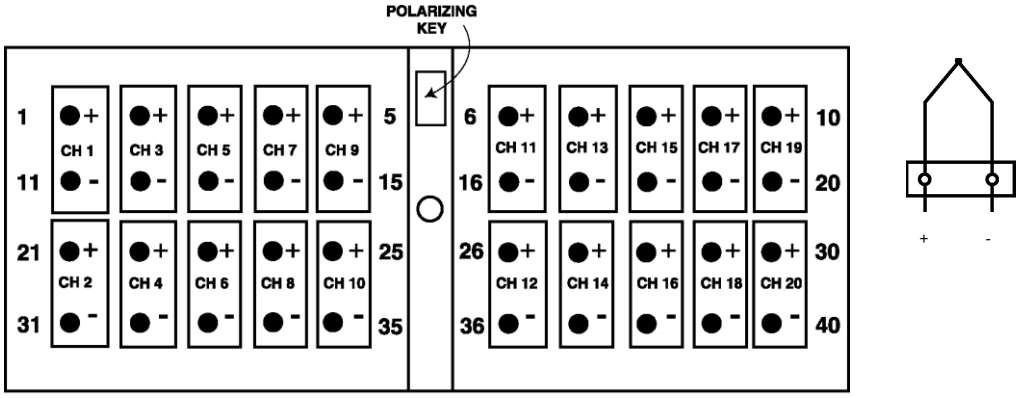


FRONT VIEW
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DT13-08PA

(Mating plug is DT06-08SA with wedgelock W8S and sockets 0462-201-16141.)

Pin #	Function
1	Power+
2	CAN_H
3	CAN_L
4	Power -
5	SHIELD
6	Not Used
7	Not Used
8	Not Used

Figure 3 – AX185000-10 Electrical Pin Out, Power and CAN



FRONT VIEW OF
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DRC13-40PA

Mating Connector Part Number: **Deutsch IPD p/n DRC16-40SE-A or DRC18-40SA or DRC16-40S with sockets 0462-201-16141**

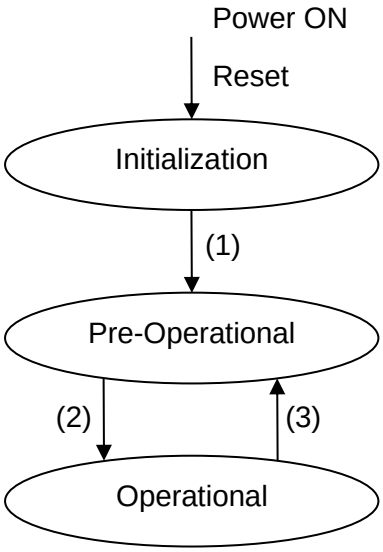
Figure 4 – AX185000-10 Electrical Pin Out, Thermocouples

3. COMAP CUSTOM FEATURES

This controller was designed specifically for interface with ComAp, spol. s.r.o. systems as it replaces legacy products designed for that purpose with the involvement of ComAp. It should not be used with other systems. The communication information in this section has been taken from their specification “IS-CU, IGS-NT CAN1 Communication.”

3.1. Module State Diagram

The TC20 passes through three states, as shown in the figure below.



Initialization
This state is reached after power on or some other reset.

On power-up, the TC20 will remain in the Initialization state for three (3) seconds. This is to prevent erroneous readings from being sent before the data from all 22 channels have been read correctly. The unit will only go into Pre-Operational mode once the preliminary scan of all channels has been completed.

The TC20 notifies all modules on the network of its transition (1) from Initialization to Pre-Operational by sending the “Bootup” message defined in Section 3.2. Prior to sending this message, no data is sent or received from the network.

Pre-Operational
In this state, no data messages are sent, and the TC20 is waiting for a “Start Node” message. Upon receiving this message, the module will transition (2) to the Operational state.

In Pre-Operational state the module can be configured with Electronic Assistant.

In this state, the module sends periodically send a Heartbeat message, defined in Section 3.2.

Operational

In this state, the module is periodically transmitting the Temperature Data messages to the network. Should it receive a “Enter Pre-Operational” message, the TC20 will transition (3) back to the Pre-Operational state where no data messages are sent.

In Operational state the module does not process any other than ComAp messages. To be able to reconfigure the module with Electronic Assistant, the module must be reset with a power cycle.

In this state, the module sends periodically send a Heartbeat message, defined in Section 3.2.

Network Management Messages

In contrast to Initialization, Pre-operational and Operational are not temporary but persistent states. To transition from one to the other, a network management message must be received. These messages are sent only from the IS-CU/IGS-NT, and the TC20 will receive and react to them.

Start Node Message

- standard identifier = 0
- data length = 2
- data: byte1 = 1, byte 2 = module address

Only when the data in byte2 is equal to the TC20’s address will the module receive this message and react to it. Upon receipt of this message, the node will transition to the Operational state and start transmitting temperature data.

Enter Pre-Operational Message

- standard identifier = 0
- data length = 2
- data: byte1 = 128, byte 2 = 0 or module address

After its initialization the IS-CU/IGS-NT sends this message with data byte2 set to 0. All modules would receive this message and go to the Pre-Operational state. In addition, the IS-CU/IGS-NT could also send the message to a specific address, in which case only when the data in byte2 is equal to the TC20’s address will the module receive this message and react to it.

3.2. Error Control Messages

Depending on the module’s state, it will send different Error Control messages to the network.

Bootup Message

- standard identifier = 1792 + module address (0x700 + SA)
- data length = 1
- data: byte1 = 0

After Initialization, the TC20 will send the this message when it transitions to the Pre-Operational state.

Heartbeat Message

- standard identifier = 1792 + module address (0x700 + SA)

- data length = 1
- data: byte1 = module state, 5 = Operational, 127 = Pre-Operational

The TC20 uses this message to inform the other nodes on the network, particularly IS-CU/IGS-NT, of its state. It broadcasts this message periodically in both the Operation and Pre-Operation states. By default, the message is sent every 300ms, but can be changed by the user by configuring "**Heartbeat Transmit Repetition Rate**" setpoint value up to a maximum interval of 500ms.

3.3. Data Messages

The TC20 sends the Temperature Data Messages only in the Operational state. All data messages are transmitted using the Extended Identifier (29-bits) as defined below.

Identifier Construction

Bit 28 = 0
Bits 27 – 21 = Destination Address
Bits 20 – 14 = Source Address
Bits 13 – 7 = Channel
Bits 6 – 0 = 0

Destination Address

The destination address (DA) identifies the module to which the data message is being sent. By default, the TC20 will send its data to the IS-CU/IGS-NT at node address 33. The user can configure the "**Destination Address**" setpoint to any value between 0 to 127 excluding the AIN addressing range, 66 to 75.

Source Address

The source address (SA) identifies the module from which the message is being sent. By default, the TC20 uses node addresses 66 (0x42), 67 (0x43) and 68 (0x44) to send messages, as it is replacing three AIN modules.

The three SA used by the TC20 are always consecutive, and the default start address is 66. This can be changed by the user to any address in the range 66 to 75. If the "**StartAddress**" setpoint is set to 75, the second and third addresses will default to 66 and 67 respectively. If it is set to 74, the third address will default to 66.

Channel

The channel identifies what temperatures are being transmitted.

Channel	Length	Sent From	Meaning
0	8 bytes	IS-CU/IGS-NT	Not applicable in the TC20 module
1	8 bytes	IS-CU/IGS-NT	Not applicable in the TC20 module
2	8 bytes	IS-CU/IGS-NT	Not applicable in the TC20 module
3	8 bytes	TC20 – Address 1	bytes 2-1 = Thermocouple #1 Temperature bytes 4-3 = Thermocouple #2 Temperature bytes 6-5 = Thermocouple #3 Temperature bytes 8-7 = Thermocouple #4 Temperature
4	8 bytes	TC20 – Address 1	bytes 2-1 = Thermocouple #5 Temperature bytes 4-3 = Thermocouple #6 Temperature bytes 6-5 = Thermocouple #7 Temperature bytes 8-7 = Thermocouple #8 Temperature
3	8 bytes	TC20 – Address 2	bytes 2-1 = Thermocouple #9 Temperature bytes 4-3 = Thermocouple #10 Temperature bytes 6-5 = Thermocouple #11 Temperature bytes 8-7 = Thermocouple #12 Temperature
4	8 bytes	TC20 – Address 2	bytes 2-1 = Thermocouple #13 Temperature

			bytes 4-3 = Thermocouple #14 Temperature bytes 6-5 = Thermocouple #15 Temperature bytes 8-7 = Thermocouple #16 Temperature
3	8 bytes	TC20 – Address 3	bytes 2-1 = Thermocouple #17 Temperature bytes 4-3 = Thermocouple #18 Temperature bytes 6-5 = Thermocouple #19 Temperature bytes 8-7 = Thermocouple #20 Temperature
4	8 bytes	TC20 – Address 3	bytes 2-1 = Average of Inputs on Bank 1 (1 to 10) bytes 4-3 = Average of Inputs on Bank 2 (11 to 20) bytes 6-5 = Average of all Active Thermocouples bytes 8-7 = Measured Cold Junction Temperature

Data is sent using Intel Little Endian notation, where the least significant byte is sent first.

All temperatures are sent as an integer with 1ºC/bit resolution. Error data (such as flagging an open circuit) is sent as 0x8000. Channels that are not used (Thermocouple Type = Disabled) have the data stuffed as 0xFFFF.

In the Operational state, data is automatically sent once per second by default (1000ms). To change the update rate of the temperature transmissions, the user can set the "**Data Transmit Repetition Rate**" setpoint to any value between 100ms to 60000ms.

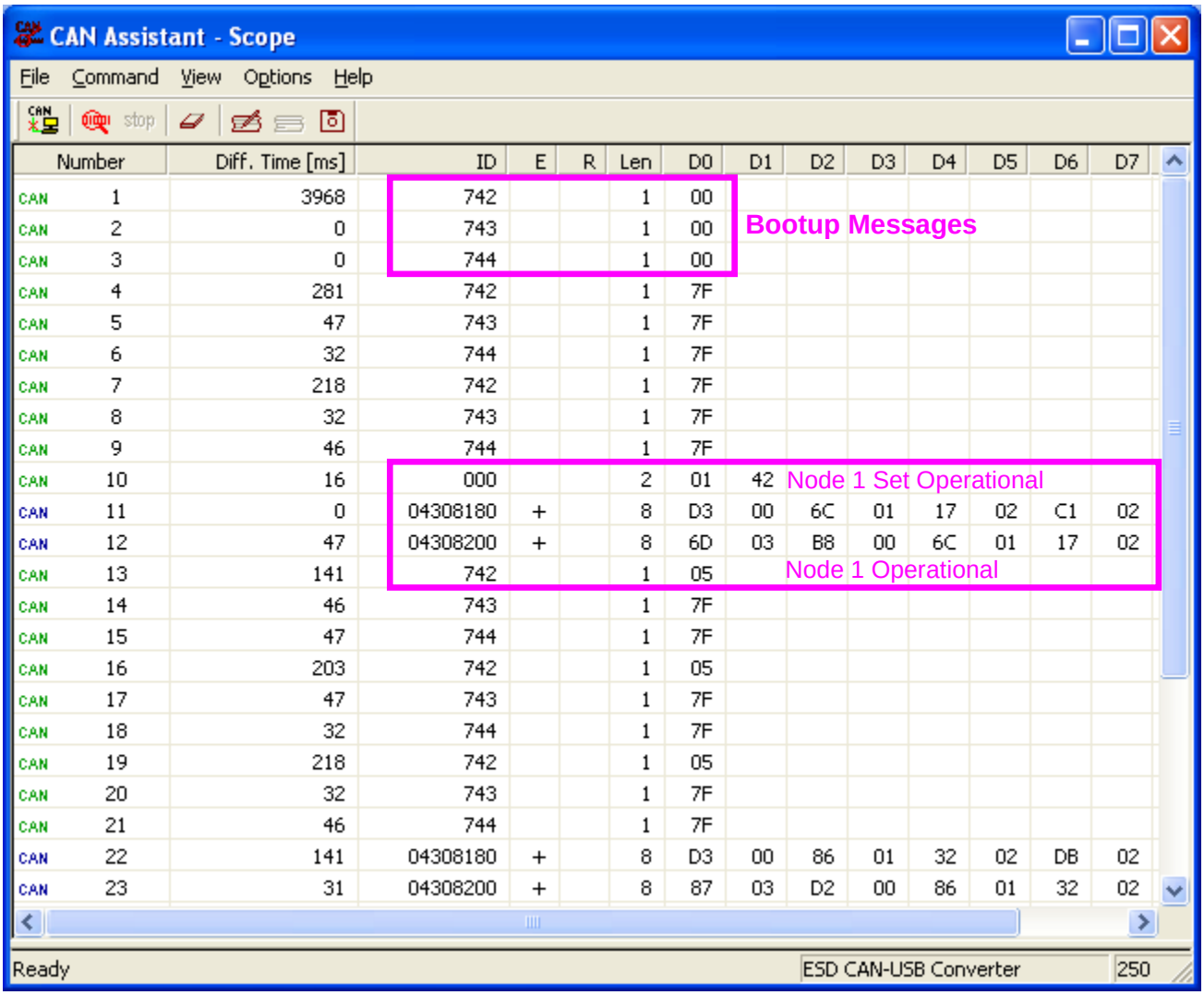
Since the TC20 can send up to 6 data messages when all channels are active, there is by default a 50ms delay between each message. The same delay period is also used between the Heartbeat messages that each node will send. The user can change this delay by setting the "**Inter Message Delay**" setpoint to any value between 10 to 250ms.

Warning: The combined message delay (6xD) must not be set longer than the "Data Transmit Repetition Rate" or the TC20 will not transmit data in the expected manner.

3.4. Replacing AIN Modules

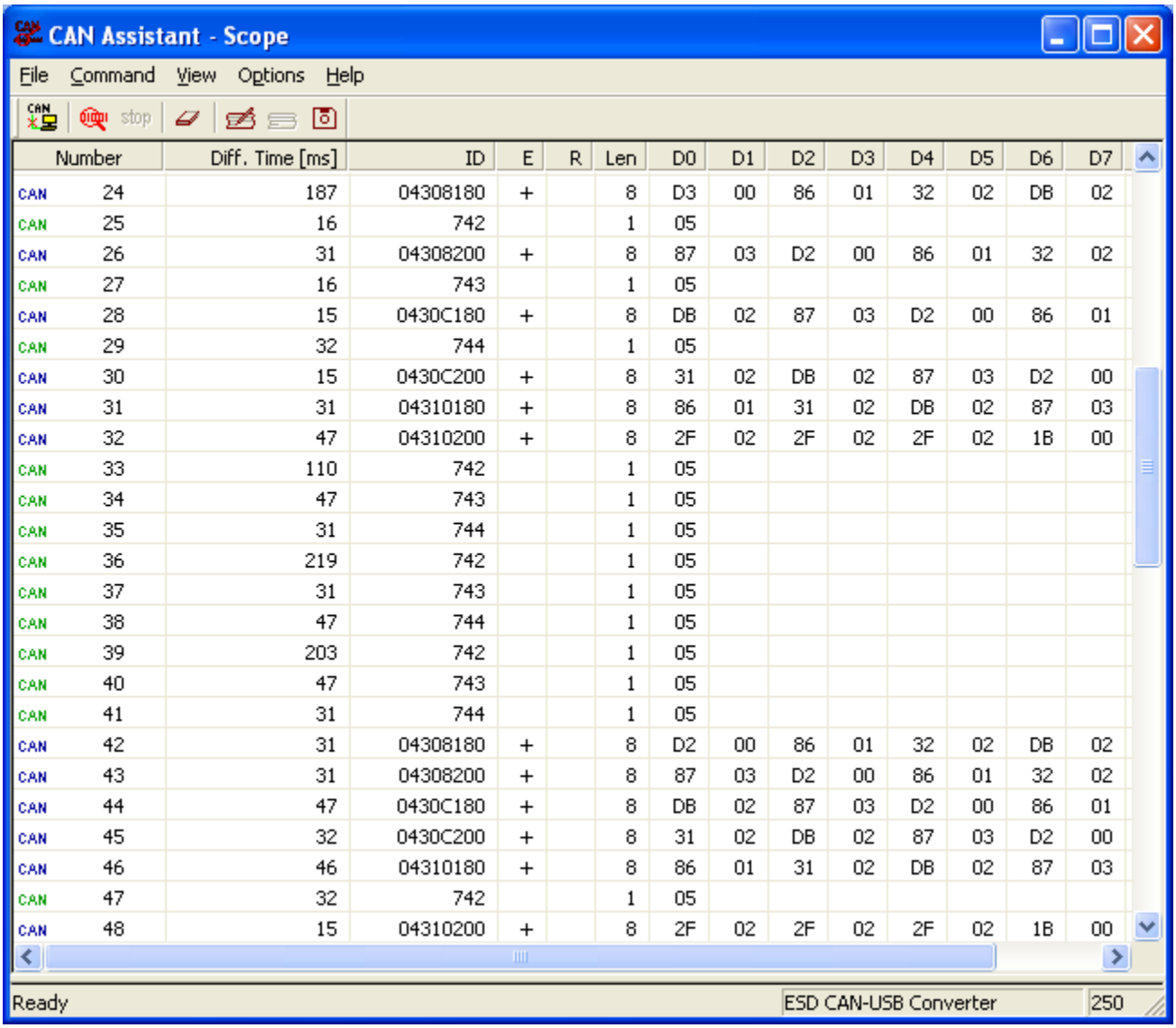
Since the TC20 is designed to replace three AIN modules, it has three independent state machines as described in Sections 3.1 and 3.3.

This means that the TC20 will actually send three Bootup and Heartbeat messages from different node address, as shown in the examples below. The time interval between each Heartbeat message would be the same "**Inter Message Delay**" period used between the Data message transmissions.



	Number	Diff. Time [ms]	ID	E	R	Len	D0	D1	D2	D3	D4	D5	D6	D7
CAN	1	3968	742			1	00							
CAN	2	0	743			1	00							
CAN	3	0	744			1	00							
CAN	4	281	742			1	7F							
CAN	5	47	743			1	7F							
CAN	6	32	744			1	7F							
CAN	7	218	742			1	7F							
CAN	8	32	743			1	7F							
CAN	9	46	744			1	7F							
CAN	10	16	000			2	01	42						
CAN	11	0	04308180	+		8	D3	00	6C	01	17	02	C1	02
CAN	12	47	04308200	+		8	6D	03	B8	00	6C	01	17	02
CAN	13	141	742			1	05							
CAN	14	46	743			1	7F							
CAN	15	47	744			1	7F							
CAN	16	203	742			1	05							
CAN	17	47	743			1	7F							
CAN	18	32	744			1	7F							
CAN	19	218	742			1	05							
CAN	20	32	743			1	7F							
CAN	21	46	744			1	7F							
CAN	22	141	04308180	+		8	D3	00	86	01	32	02	DB	02
CAN	23	31	04308200	+		8	87	03	D2	00	86	01	32	02

Example 1 – State Machine 1 Operational, Node 2 and 3 Pre-Operational



Example 2 – All Three State Machines Operational

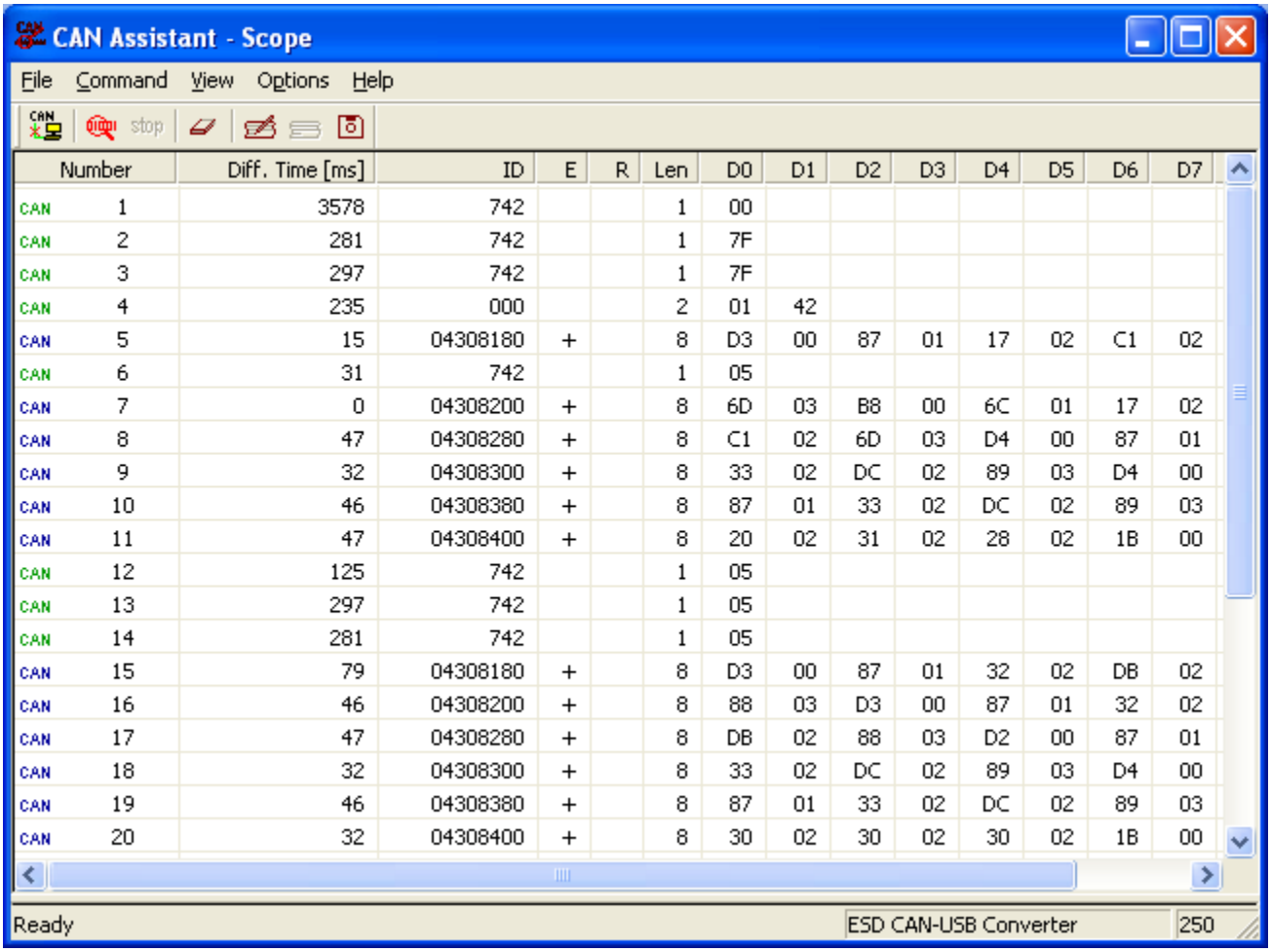
Alternatively, it may be preferred to have the TC20 use only one State Machine, in which case the user would set the parameter "**Simulate Three Modules**" to FALSE – One Module.

In this case, only one Heartbeat message would be sent by the module, and all data would be sent from the same source address. Here, data would also be sent on channels 5 through 8 as shown in the table below.

Channel	Length	Sent From	Meaning
3	8 bytes	TC20 – Address 1	bytes 2-1 = Thermocouple #1 Temperature bytes 4-3 = Thermocouple #2 Temperature bytes 6-5 = Thermocouple #3 Temperature bytes 8-7 = Thermocouple #4 Temperature
4	8 bytes	TC20 – Address 1	bytes 2-1 = Thermocouple #5 Temperature bytes 4-3 = Thermocouple #6 Temperature bytes 6-5 = Thermocouple #7 Temperature bytes 8-7 = Thermocouple #8 Temperature

5	8 bytes	TC20 – Address 1	bytes 2-1 = Thermocouple #9 Temperature bytes 4-3 = Thermocouple #10 Temperature bytes 6-5 = Thermocouple #11 Temperature bytes 8-7 = Thermocouple #12 Temperature
6	8 bytes	TC20 – Address 1	bytes 2-1 = Thermocouple #13 Temperature bytes 4-3 = Thermocouple #14 Temperature bytes 6-5 = Thermocouple #15 Temperature bytes 8-7 = Thermocouple #16 Temperature
7	8 bytes	TC20 – Address 1	bytes 2-1 = Thermocouple #17 Temperature bytes 4-3 = Thermocouple #18 Temperature bytes 6-5 = Thermocouple #19 Temperature bytes 8-7 = Thermocouple #20 Temperature
8	8 bytes	TC20 – Address 1	bytes 2-1 = Average of Inputs on Bank 1 (1 to 10) bytes 4-3 = Average of Inputs on Bank 2 (11 to 20) bytes 6-5 = Average of all Active Thermocouples bytes 8-7 = Measured Cold Junction Temperature

An example of how the TC20 behaves when only one State Machine is supported is shown below. Notice how the Extended IDs of the data messages have changed from the earlier examples.



Number	Diff. Time [ms]	ID	E	R	Len	D0	D1	D2	D3	D4	D5	D6	D7
CAN 1	3578	742			1	00							
CAN 2	281	742			1	7F							
CAN 3	297	742			1	7F							
CAN 4	235	000			2	01	42						
CAN 5	15	04308180	+		8	D3	00	87	01	17	02	C1	02
CAN 6	31	742			1	05							
CAN 7	0	04308200	+		8	6D	03	B8	00	6C	01	17	02
CAN 8	47	04308280	+		8	C1	02	6D	03	D4	00	87	01
CAN 9	32	04308300	+		8	33	02	DC	02	89	03	D4	00
CAN 10	46	04308380	+		8	87	01	33	02	DC	02	89	03
CAN 11	47	04308400	+		8	20	02	31	02	28	02	1B	00
CAN 12	125	742			1	05							
CAN 13	297	742			1	05							
CAN 14	281	742			1	05							
CAN 15	79	04308180	+		8	D3	00	87	01	32	02	DB	02
CAN 16	46	04308200	+		8	88	03	D3	00	87	01	32	02
CAN 17	47	04308280	+		8	DB	02	88	03	D2	00	87	01
CAN 18	32	04308300	+		8	33	02	DC	02	89	03	D4	00
CAN 19	46	04308380	+		8	87	01	33	02	DC	02	89	03
CAN 20	32	04308400	+		8	30	02	30	02	30	02	1B	00

Example 3 – Only One State Machine Active

3.5. Averaging Feature

Averaging block calculates average temperature of the Thermocouple channels. The average value of all active channels in Bank 1 (thermocouple channels 1 to 10), the average value of all active channels in Bank 2(thermocouple channels 11 to 20), and the average value of all active channels are calculated.

By default, the averaging information and measured Cold Junction Temperature are included in the data message as shown in section 3.3. Averaging information can be excluded from the data message by setting value of the "**Averaging Enabled**" setpoint to '*False*'. The setpoint can be found under Miscellaneous setpoint group as shown in section 4.4.

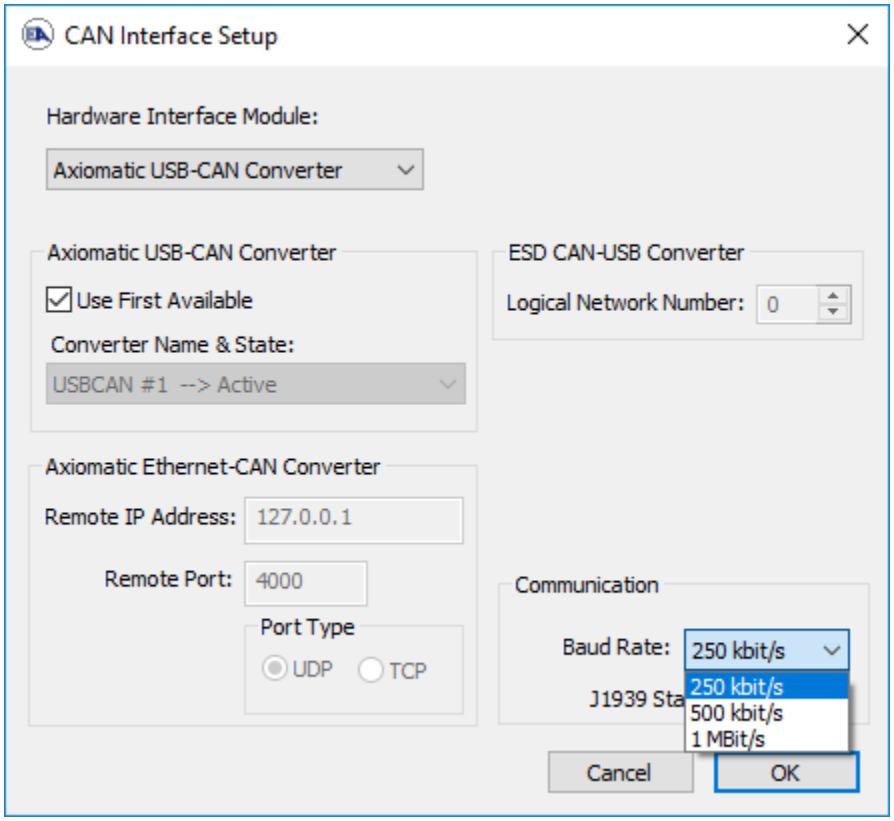
As with regular channel temperature data, these temperatures are sent as an integer with 1ºC/bit.

4. ECU SETPOINTS ACCESSED WITH ELECTRONIC ASSISTANT

This section describes in detail each setpoint, and their default and ranges. Default values presented in tables are values used when setpoint in question is active. Many of the setpoints are dependent on other setpoints and they may not be active by default. Associated Figures show screen capture of initial operation, however some of the setpoints are not in default condition as they are set differently to activate more setpoints for the image. The setpoints are divided into setpoint groups as they are shown in EA. For more information on how each setpoint is used by the 20 Channel Thermocouple Scanner controller, refer to the relevant section in this user manual.

4.1. Accessing the ECU Using EA

ECU with P/N AX185000-10 does not need any specific setup for EA. The CAN Interface Setup can be found from “Options” menu in EA.



4.2. J1939 Network Parameters

"**ECU Instance Number**" and "**ECU Address**" setpoints are solely to configure communication with EA.

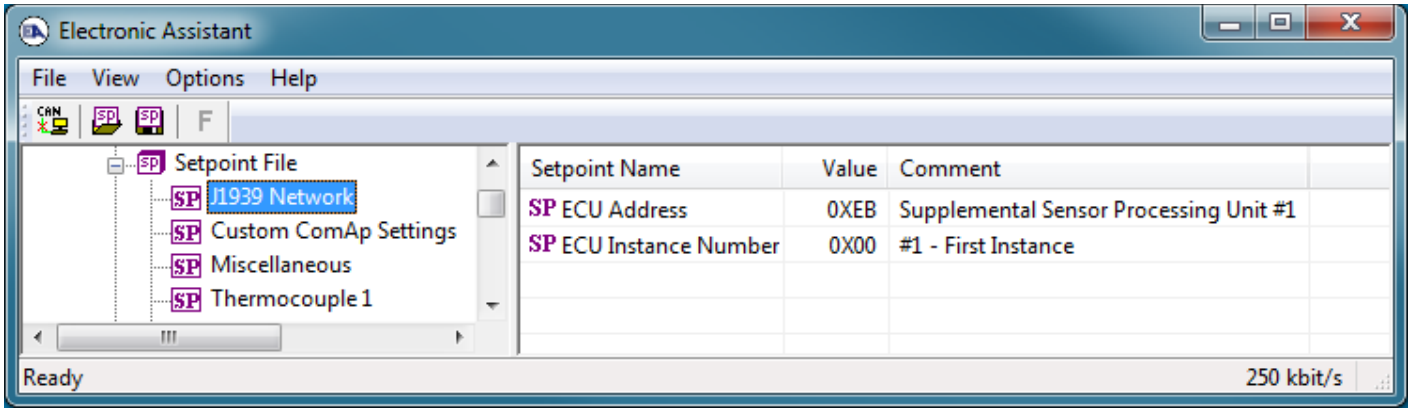


Figure 5 – Screen Capture of J1939 Setpoints

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 3 – J1939 Network Setpoints

The "**ECU Address**" is not to be confused with "**Start Address**" and "**Destination Address**" defined for ComAp communication. These setpoint cannot be programmed through a setpoint file and can only be changed manually.

4.3. Custom ComAp

These setpoints are used to configure ComAp communication protocol messages.

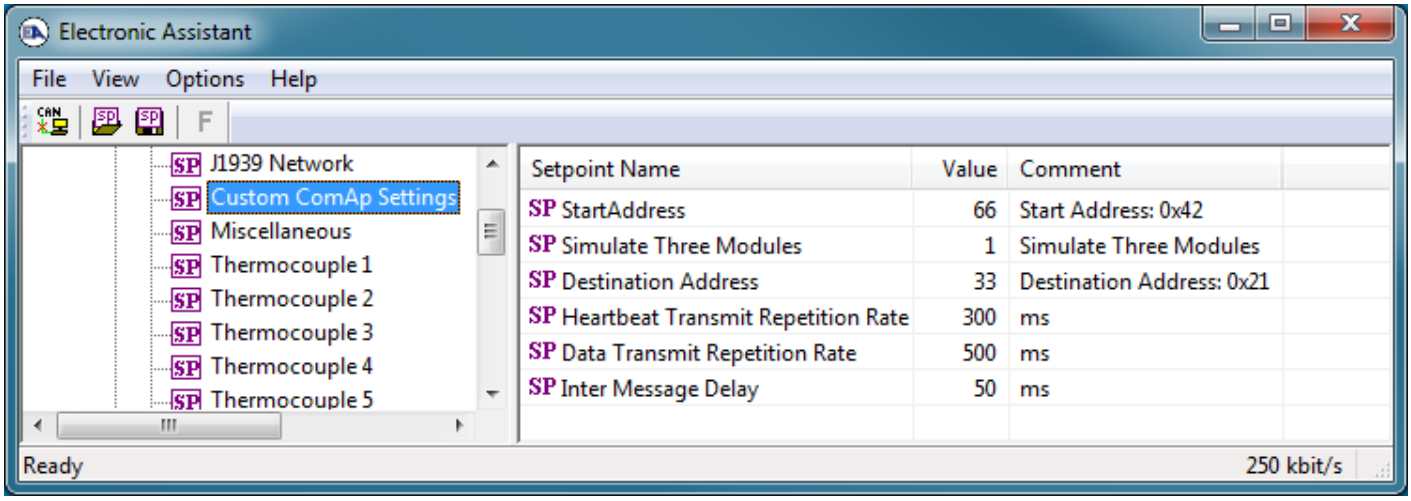


Figure 6 – Screen Capture of Custom ComAp Settings Setpoints

Name	Range	Default	Notes
Start Address	66 to 75	66 (0x42)	
Simulate Three Modules	False / True	True -Simulate Three Modules	
Destination Address	0 to 125 (excluding 66 to 75)	33 (0x21)	
Heartbeat Transmit Repetition Rate	10 to 500ms	300ms	
Data Transmit Repetition Rate	100 to 60000ms	500ms	
Inter Message Delay	10 to 250ms	50ms	

Table 4 – Custom ComAp Settings Setpoints

4.4. Miscellaneous Setpoints

ADC Filter Frequency setpoint can be found under Miscellaneous Setpoints setpoint group. This setpoint is used to select appropriate ADC filter for thermocouple channels to reject line frequency noise as discussed in Section 1.1.

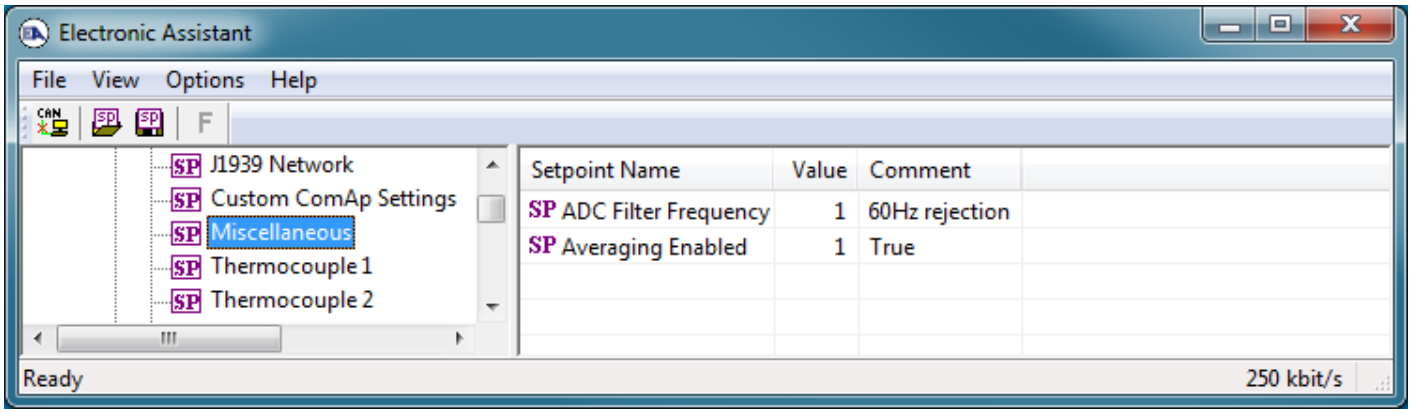


Figure 7 – Screen Capture of Universal Input Setpoints

Name	Range	Default	Notes
ADC Filter Frequency	Drop List	60Hz rejection	See Table 2
Averaging Enabled	True / False	True	See Section 3.3 and 3.5

Table 5 – Miscellaneous Setpoints

4.5. TC Input Setpoints

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

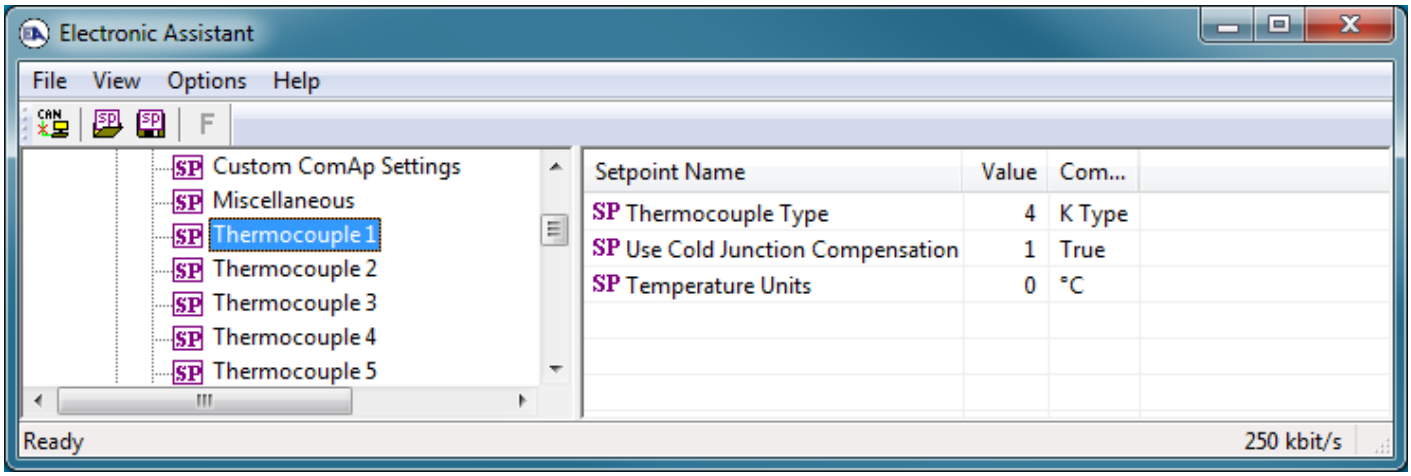


Figure 8 – Screen Capture of TC Input Setpoints

Name	Range	Default	Notes
Temperature Suspect Parameter Number	Drop List	Different for each	See
Thermocouple Type	Drop List	K type	See Table 1
Temperature Units	Drop List	°C	

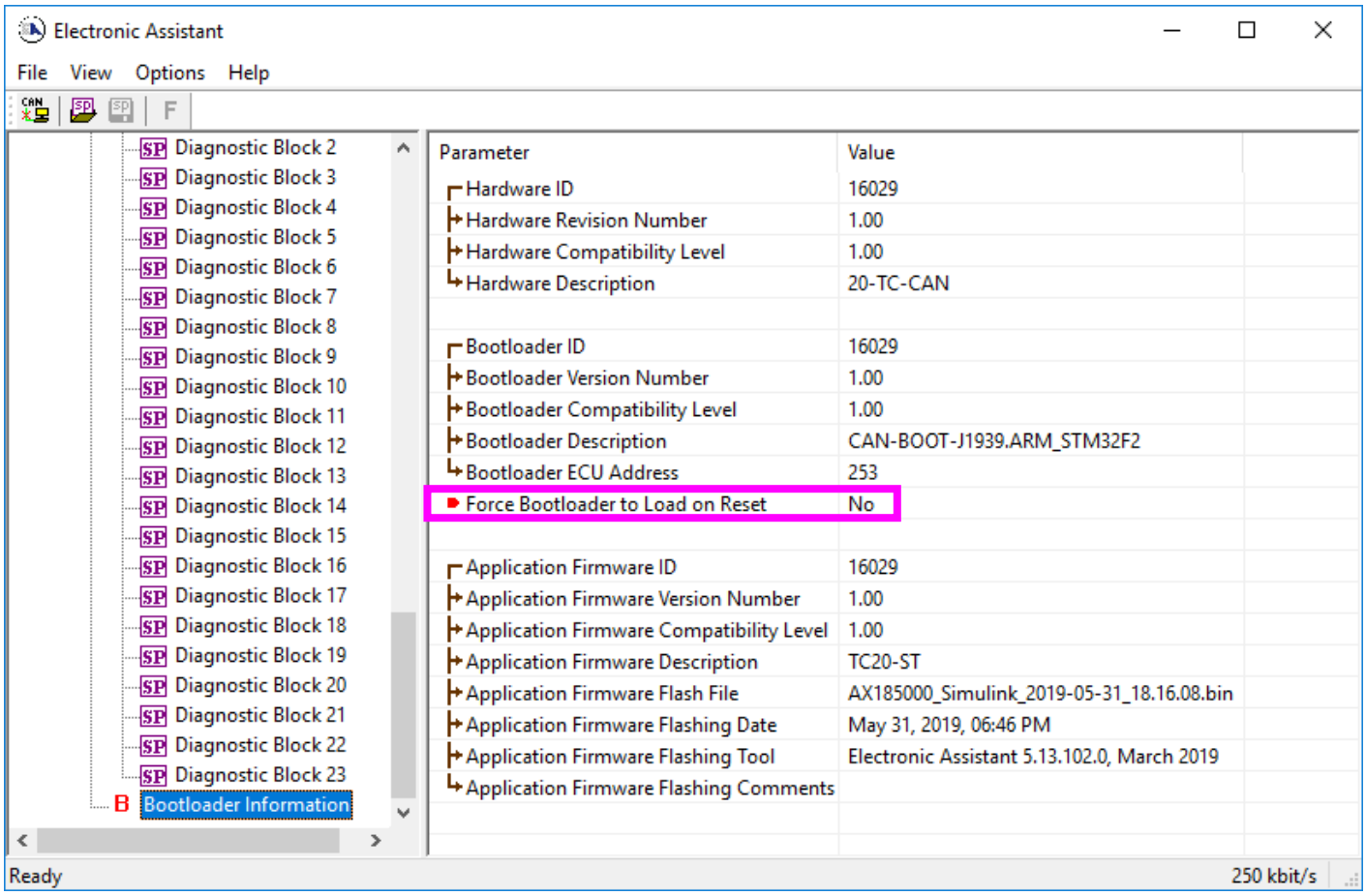
Table 6 – TC Input Setpoints

5. REFLASHING OVER CAN WITH EA BOOTLOADER

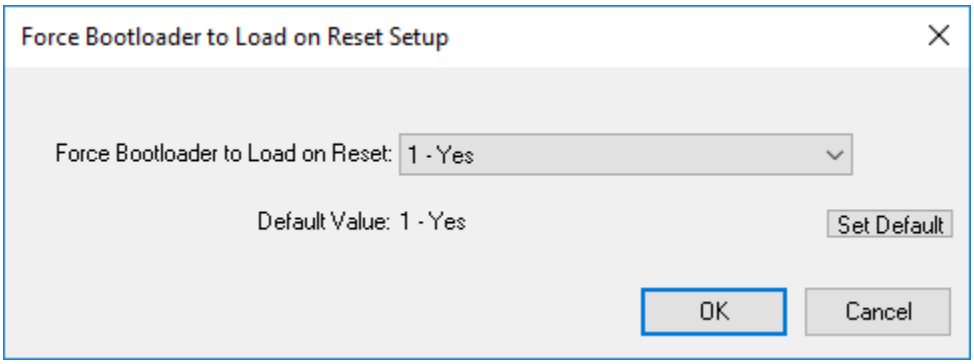
The AX185000-10 can be upgraded with new application firmware using the **Bootloader Information** section. This section details the simple step-by-step instructions to upload new firmware provided by Axiomatic onto the unit via CAN, without requiring it to be disconnected from the J1939 network.

Note: To upgrade the firmware use the latest version of Axiomatic Electronic Assistant.

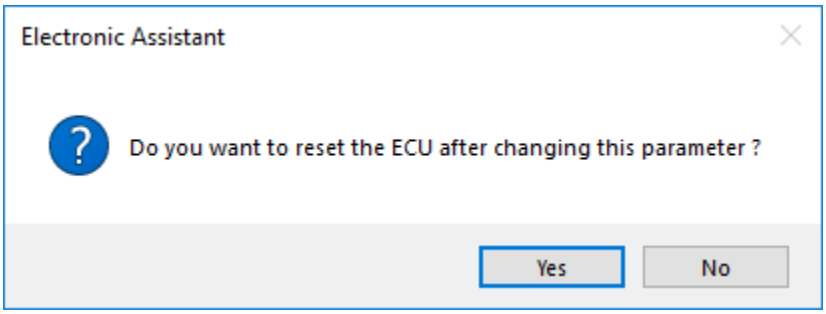
1. When EA first connects to the ECU, the **Bootloader Information** section will display the following information.



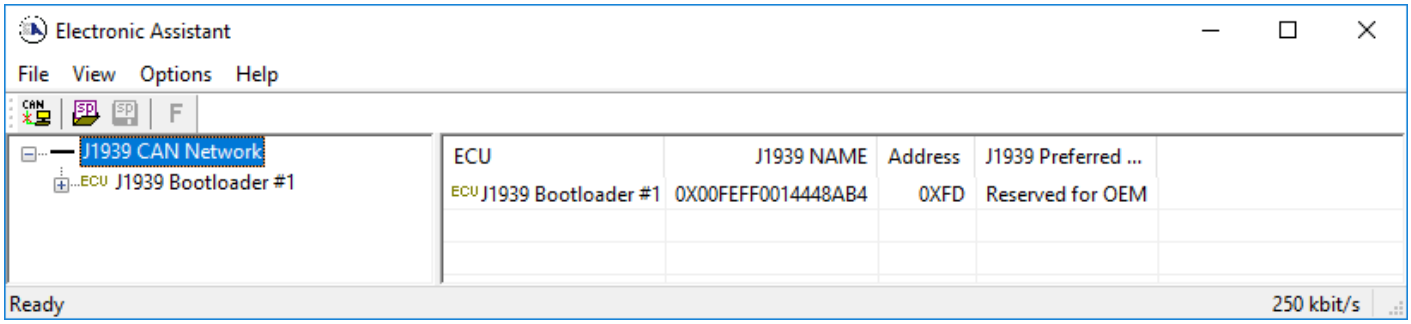
2. To use the bootloader to upgrade the firmware running on the ECU, change the variable **"Force Bootloader To Load on Reset**" to *Yes.*

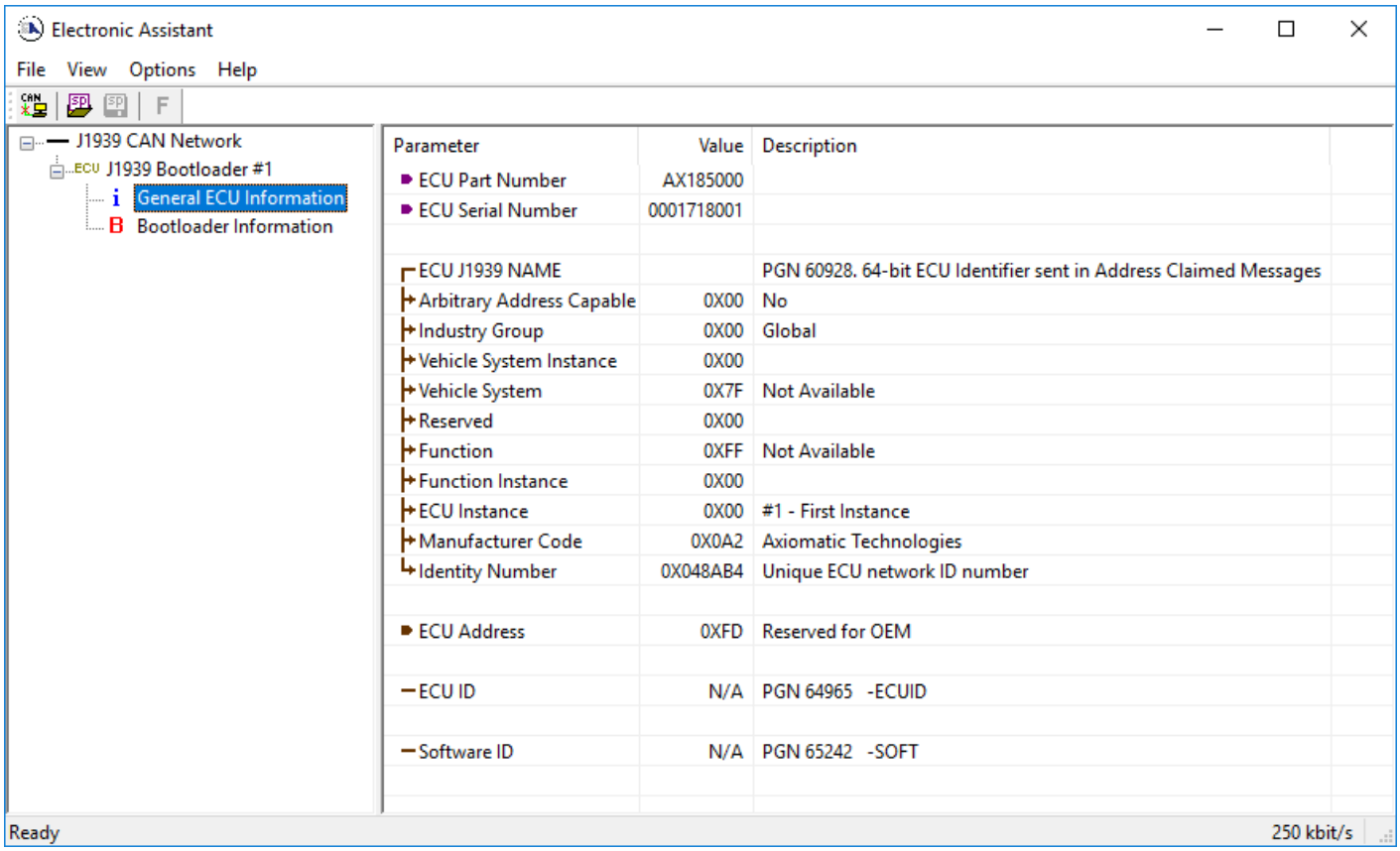


3. When the prompt box asks if you want to reset the ECU, select *Yes*.



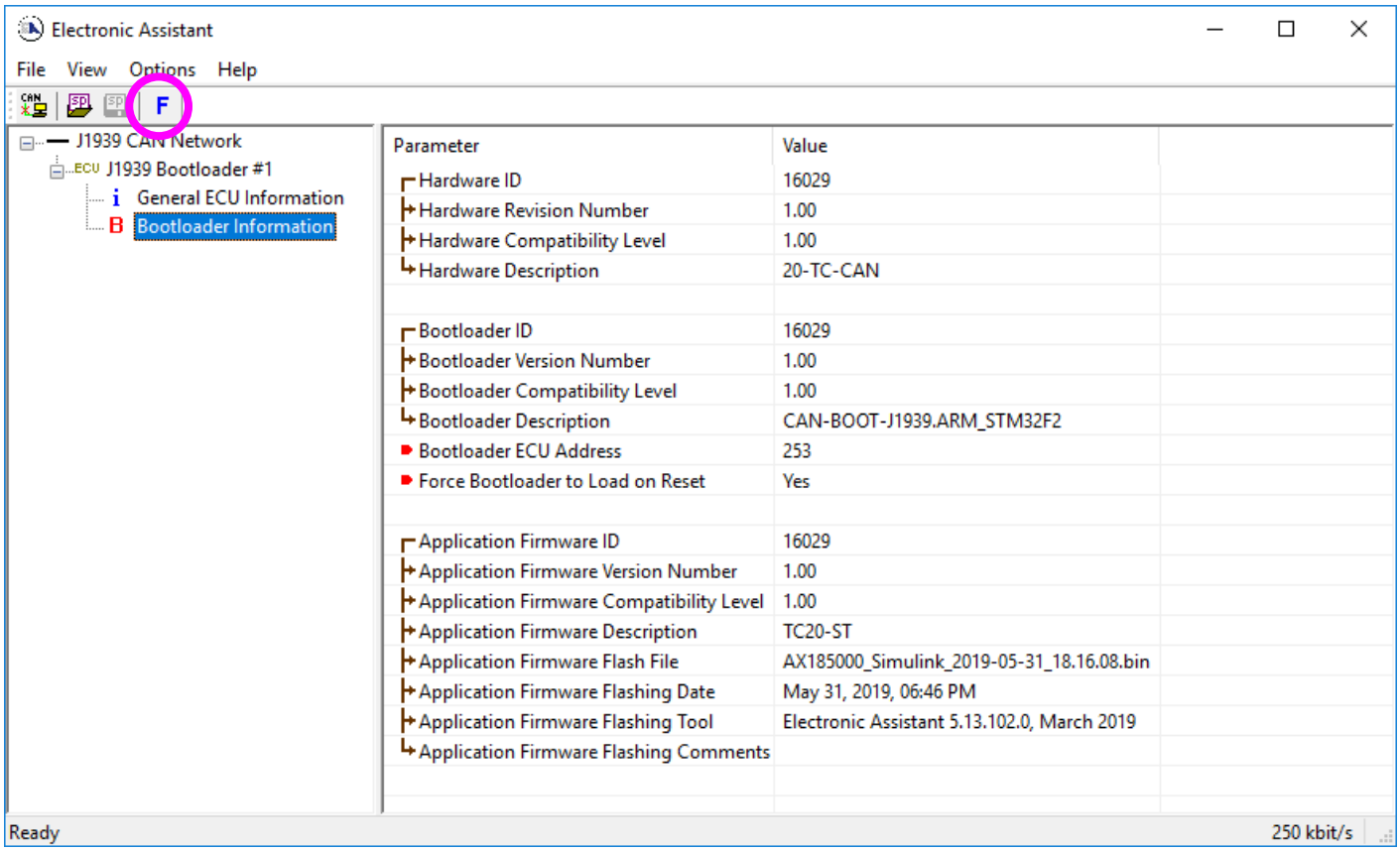
4. Upon reset, the ECU will no longer show up on the J1939 network as an AX185000-10 but rather as **J1939 Bootloader #1**.





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.

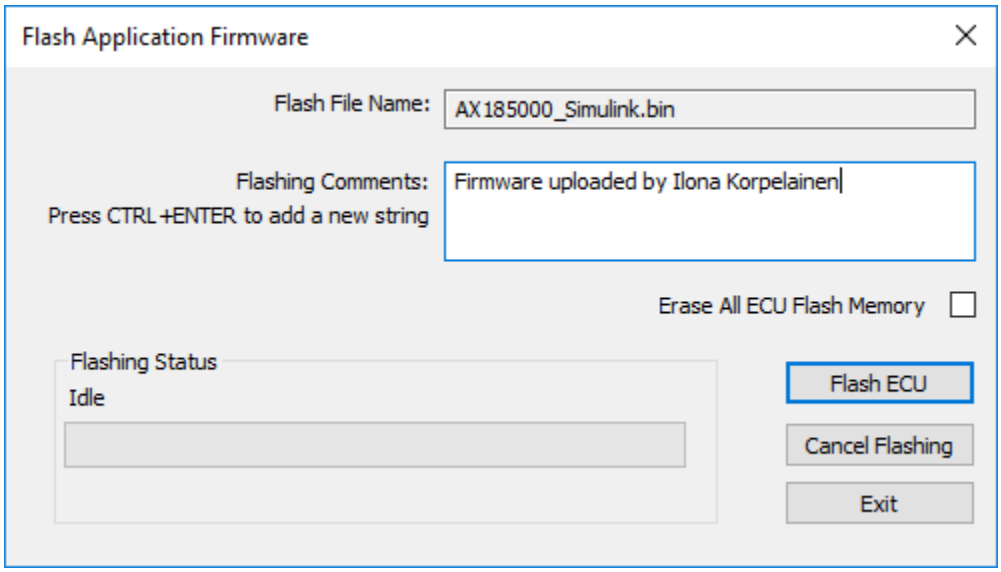
5. When the **Bootloader Information** section is selected, the same information is shown as when it was running the AX185000-10 firmware, but in this case the **F**lashing feature has been enabled.



6. Select the **F**lashing button and navigate to where you had saved the **AX185000-10_Simulink.bin** file sent from Axiomatic. (Note: only binary (.bin) files can be flashed using the EA tool.)

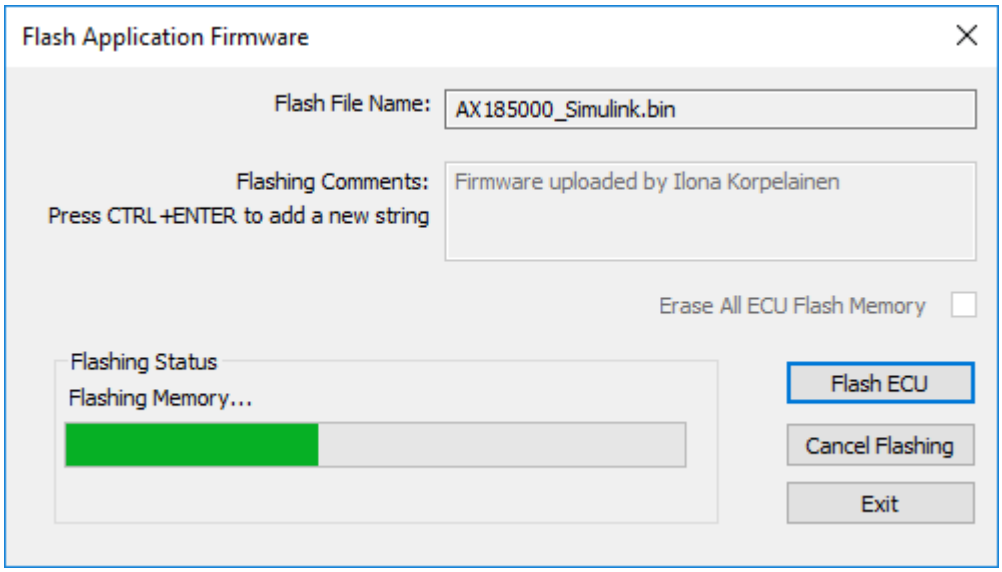
7. Once the Flash Application Firmware window opens, you can enter comments such as “Firmware upgraded by [Name]” if you so desire. This is not required, and you can leave the field blank if you do not want to use it.

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

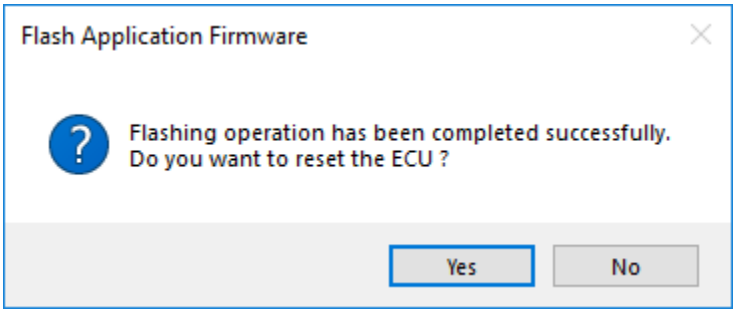


WARNING: Do not check the “Erase All ECU Flash Memory” box unless instructed to do so by your Axiomatic contact. Selecting this will erase ALL data stored in non-volatile flash including the calibration from Axiomatic factory testing. It will also erase any configuration of the setpoints that might have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

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



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 AX185000-10 application will start running, and the ECU will be identified as such by EA. Otherwise, the next time the ECU is power-cycled, the AX185000-10 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 - TECHNICAL SPECIFICATION

Technical Specifications

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

Input

Power Supply Input	12 or 24 VDC nominal (9 to 60 VDC power supply range)
Quiescent Current	40 mA @ 12 VDC; 20 mA @ 24 VDC typical
Protection	Reverse polarity protection is provided. Power supply input section protects against transient surges and short circuits and is isolated from thermocouple inputs
Thermocouple Types	Up to 20 channels, independently configurable for B, E, J, K, N, R, S, or T
Thermocouple Inputs	The device reads voltage (mV) signals from the supported Thermocouple types. B = 0 to 13.82 mV E = -9.835 to 76.373 mV J = -8.095 to 69.553 mV K = -6.458 to 54.886 mV N = -4.345 to 47.513 mV R = -0.226 to 21.101 mV S = -0.236 to 18.693 mV T = -6.258 to 20.872 mV Temperatures are configured to indicate the SAE J1939 SPN to be transmitted by that temperature input. Resolution: 0.001°C Accuracy: • ±1°C typical with cold junction compensation at ambient temperature (except types J, E, K, N) • Type J: ±1°C up to 600°C and ±3°C beyond 600°C (typical with cold junction compensation) • Type E: ±1°C up to 450°C and ±3°C beyond 450°C (typical with cold junction compensation) • Type K: ±1°C up to 850°C and ±3°C beyond 850°C (typical with cold junction compensation) • Type N: ±1°C up to 950°C and ±3°C beyond 950°C (typical with cold junction compensation)
Scan Rate	Maximum sweep time: 1.5 seconds
Common Mode Readings	Input range: ±2.5 V maximum Rejection: 120 db (maximum) at 2.5 Vp-p (50-60 Hz)
Thermal Drift	4 ppm/°C of span (maximum)
Isolation	Digital isolation is 500 VDC from input to ground. Three-way isolation is provided for the CAN line, inputs, and power supply.
Averaging	The average temperature of all the active channels can be sent on a data message.
Protection	Open circuit detection Frozen data detection

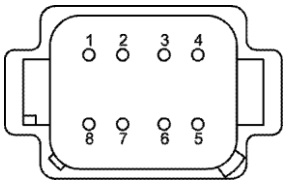
Communication

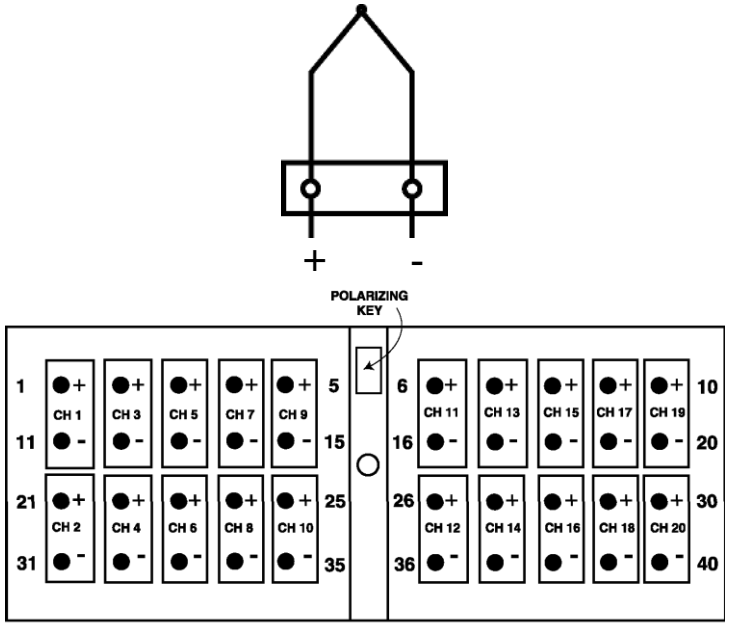
CAN	1 CAN port (2.0B, SAE J1939) 250 kbit/s baud-rate Digital isolation is provided for the CAN line.
Network Termination	According to the CAN standard, it is necessary to terminate the network with external termination resistors. The resistors are 120 Ω, 0.25 W minimum, metal film or similar type. They should be placed between CAN_H and CAN_L terminals at both ends of the network.

General Specifications

Microcontroller	STM32F205VG, 32-bit, 1 MB flash memory
Control Logic	User programmable functionality with the Axiomatic Electronic Assistant (EA) • Node address is auto configurable as per J1939-81 and/or via customer configuration. • Monitored parameters and diagnostics are user selectable from a drop-down list in the EA. • Monitored parameters and diagnostics are read-only over the network. • Units are pre-configured with default values at the factory. Refer to the user manual. • All parameter locations have default values that do not conflict. • Module is fully functional during configuration and communications. • Parameter values and diagnostic error codes are retained when the modules are de-energized. • Configurable ECU Instance in the NAME to allow for multiple ECU's on the same network

SAE J1939 Profile	For J1939 compliance (SAE, Recommended Practice for a Serial Control and Communications Vehicle Network, October 2007), all modules comply with the applicable portions of the following. • SAE J1939-21, Dec 2006, Data Link Layer • SAE J1939-71, Sep 2013, Application Layer • SAE J1939-73, Feb 2010, Application Layer – Diagnostic • SAE J1939-81, March 2017, Network Management *Customer specific proprietary extensions can also be included in the SAE J1939 profile on request.*
User Interface	Axiomatic Electronic Assistant, P/Ns: **AX070502** or **AX070506K** Updates for the EA are found on www.axiomatic.com
UL and cUL Compliance	Standard for Controllers for Use in Power Production, CAN/ULC 6200, 1st edition
CE/ UKCA Compliance	CE/ UKCA marking 2004/108/EC (EMC Directive) 2011/65/EU (RoHS Directive)
Vibration	7.32 Grms (random)
Operating Temperature	-40°C to 85ºC (-40ºF to 185ºF)
Storage Temperature	-50°C to 120°C (-58°F to 248°F)
Humidity	Protected against 95% humidity non-condensing, 30ºC to 60ºC
Weight	2.2 lbs. (1 kg)
Protection	IP67
Enclosure and Dimensions	Rugged aluminum housing, stainless steel end plates, neoprene gaskets 145.30 x 149.00 x 73.00 mm (5.72 x 5.86 x 2.87”) L x W x H Connectors, TE Deutsch P/N: 1 8-pin DT13-08PA, 1 40-pin DRC13-40PA It can be mounted directly on the power generator set or remotely.

<table>
<tr>
<td>Electrical Connections</td>
<td>
<u>Power and CAN:</u>
1 8-pin TE Deutsch connector, P/N: DT13-08PA


<table>
<tr><th>Pin #</th><th>Function</th></tr>
<tr><td>1</td><td>Power+</td></tr>
<tr><td>2</td><td>CAN_H</td></tr>
<tr><td>3</td><td>CAN_L</td></tr>
<tr><td>4</td><td>Power -</td></tr>
<tr><td>5</td><td>SHIELD</td></tr>
<tr><td>6</td><td>Not Used</td></tr>
<tr><td>7</td><td>Not Used</td></tr>
<tr><td>8</td><td>Not Used</td></tr>
</table>
<u>Thermocouples:</u>
Type J, K, B, E, N, R, S, or T
1 40-pin TE Deutsch connector, P/N: DRC13-40PA


FRONT VIEW OF
MODULE MOUNTED CONNECTOR
DEUTSCH P/N: DRC13-40PA
</td>
</tr>
<tr>
<td>Mating Connectors</td>
<td>
Mating Plug KIT P/N: AX070200 (This kit includes 1 plug DT06-08SA, 1 plug DRC16-40S, 1 wedgelock W8S, 48 contact sockets 0462-201-16141, and 24 sealing plugs 114017.)
These items are also available from a local TE Deutsch distributor. A crimping tool from TE Deutsch is required to connect wiring to the sockets, P/N: HDT 48-00 or equivalent (not supplied).

<u>Power and CAN:</u>
TE Deutsch connector, P/N: DT06-08SA, wedgelock W8S and sockets 0462-201-16141

<u>Thermocouples:</u>
TE Deutsch connector, P/N: DRC16-40SE-A, or DRC18-40SA, or DRC16-40S with sockets 0462-201-16141
</td>
</tr>
<tr>
<td>Mounting</td>
<td>It can be mounted directly on the power generator set or remotely.</td>
</tr>
</table>