10 Inputs, 1 Analog & 8 Relay Outputs Controller

SAE J1939

USER MANUAL

P/N: AX031855

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ACRONYMS

ACK	Positive Acknowledgement
CSR	CAN Status Report
DIDAO	Discrete-Input-Discrete/Analog-Output
DM	Diagnostic Message (from SAE J1939 standard)
DTC	Diagnostic Trouble Code
FMI	Failure Mode Identifier
OC	Occurrence Count
EA	Axiomatic Electronic Assistant (Service Tool for Axiomatic ECUs)
ECU	Electronic Control Unit (from SAE J1939 standard)
MAP	Memory Access Protocol
NAK	Negative Acknowledgement
PDU1	A format for messages that are to be sent to a destination address, either specific or global
PDU2	A format used to send information that has been labeled using the Group Extension technique and does not contain a destination address.
PGN	Parameter Group Number (from SAE J1939 standard)
PropB	Message that uses a Proprietary B PGN
SPN	Suspect Parameter Number (from SAE J1939 standard)

Note:

An Axiomatic Electronic Assistant KIT may be ordered as P/N: AX070502 or AX070506K

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1. GENERAL INFORMATION

1.1. Introduction to Features

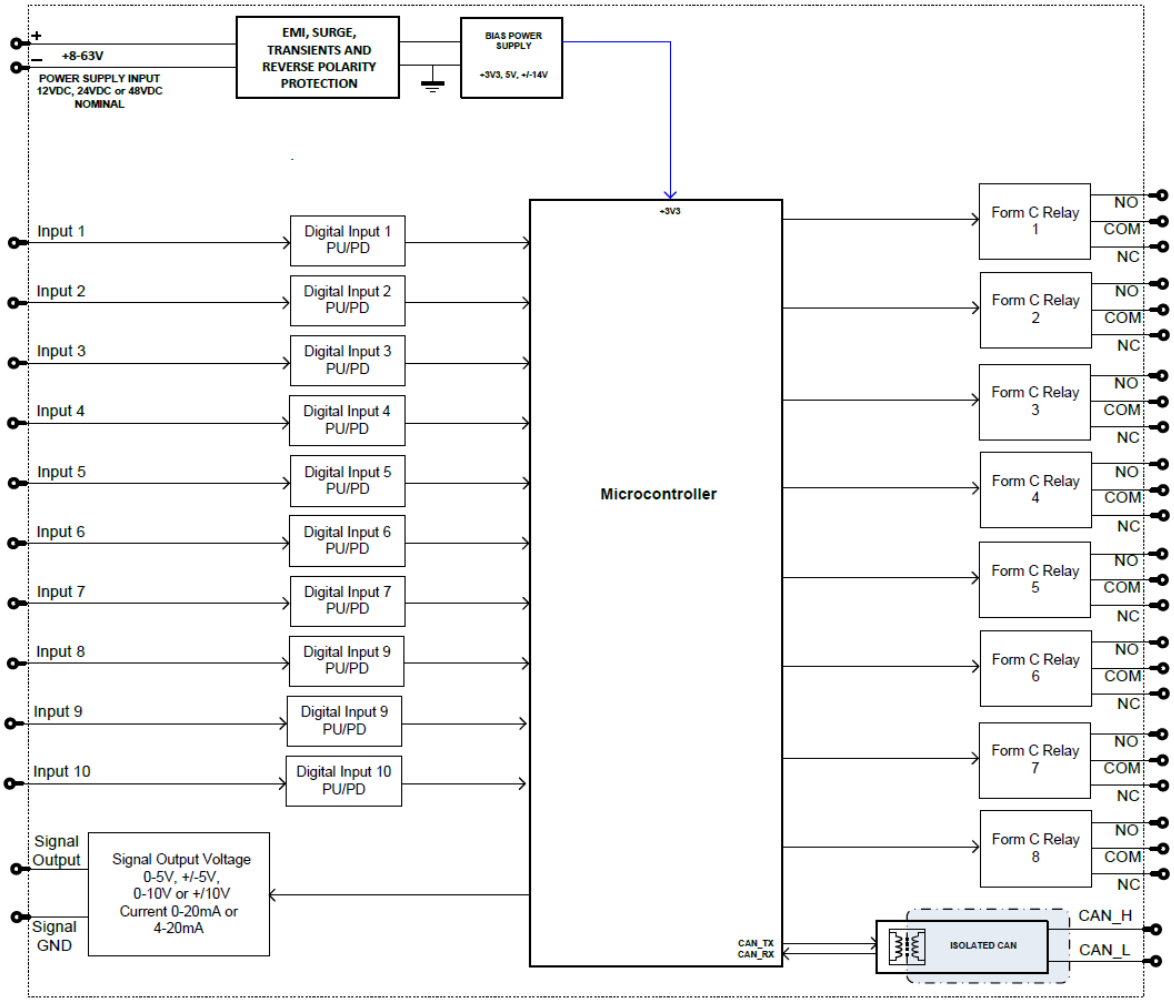


Figure 1: Hardware Functional Block Diagram

The Discrete Input – Discrete / Analog Output controller (DIDAO) is designed to provide a simple interface between J1939 CAN network and discrete and analog electronic devices in a power generator set or industrial environment. The hardware of the DIDAO supports 10 discrete inputs and 8 normally-open/normally-closed relay outputs, and 1 analog output.

The DIDAO is a versatile controller with several setpoints that will allow the user to configure it according to their application. The tool used to configure the unit is the Axiomatic Electronic Assistant. The Axiomatic EA communicates with the DIDAO over the J1939 CAN bus and uses Memory Access Protocol (MAP) to read/write each setpoint. Once the DIDAO has been setup as desired, the setpoints can be saved to a file, and flashed into other DIDAOs over the CAN bus using the Axiomatic EA.

Depending on how the controller is configured, the DIDAO can have its relay and analog outputs respond to Diagnostic Trouble Codes, J1939 CAN messages, discrete inputs, or have them all disabled.

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

A front panel bi-colour LED indicator allows the user to observe the current state of DIDAO and easily identify a normal operating condition and situations when there is a network error or absence of network traffic.

If an error, power glitch or other emergency cases occurs on the network, the DIDAO will self-recover immediately after the normal condition is restored.

1.2. J1939 Network – Diagnostic Broadcast

The DIDAO broadcasts diagnostic messages, which are triggered by the internal function blocks onto the CAN bus network. However, in some applications this broadcast may not be required and so the DIDAO gives the user the option to disable or enable this feature. Section 3.1 and 3.14 shows the configuration of this feature by using the Axiomatic Electronic Assistant tool.

1.3. Internal Data Sources

Several function blocks within the DIDAO utilize a combination of setpoints labeled **Source** and **Number** to either command/control or broadcast data. Table 1 lists the different sources available along with the index range for each source.

Table 1: Control Sources

Value	Meaning	Range
0	Source Not Used	[0]
1	Digital Input	[1…12]
2	Digital Relay Output	[1…8]
3	Analog Output	[1]
4	Power Supply Voltage Fault State	[0]
5	Temperature Fault State	[0]
6	Diagnostic Trouble Code	[1…30]
7	CAN Receive Message	[1…10]
8	Conditional Block	[1…10]
9	Constant Data	[1…10]
10	CAN Status Report	[1…8]
11	Power Supply Voltage	[0]
12	Temperature	[0]

1.4. Digital Input Function Blocks

The 10 digital inputs of the DIDAO controller have a fixed 5kOhm pull-up resistor. The signals going into the DIDAO controller are interpreted as 0 or 1. The turn ON-signal (1) is reached at 3.75V input level while the turn OFF-signal (0) is reached at 0.8V input level. The discrete inputs can be used as control sources for relay outputs and/or can be used to trigger Diagnostic Trouble Codes in the J1939 network.

The sub sections below explain in more detail the functionality and available setpoints/parameters of the discrete inputs.

1.4.1. Digital Input Functionality

The **Active High/Low** parameter allows the user to select how the controller responds to the behaviour of the digital input. Table 1 shows the different Active High/Low options with the default being highlighted.

Table 2: Active High/Low

Value	Meaning
0	Active High
1	Active Low

The inputs of the DIDAO have a fixed 5kOhm pull-up resistor. Given that by default, the inputs are configured to *Active High*, an ON response by the DIDAO is achieved when the input is grounded.

1.4.2. Debounce Time

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

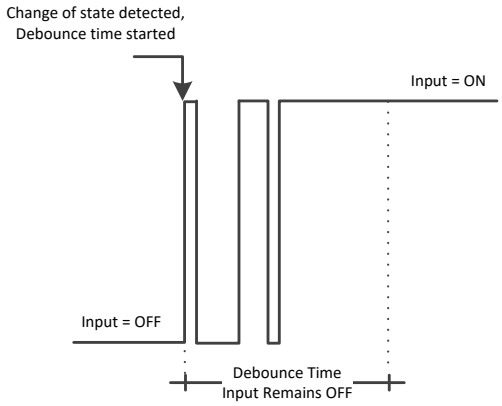


Figure 2: Digital Input Debounce Time

1.4.3. Digital Input Type

The **Digital Input Type** parameter allows for flexibility in the response of the input. Table 2 shows the options available for this parameter.

Table 3: Digital Input Types

Value	Meaning
0	Normal Logic
1	Inverse Logic
2	Latched Logic

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

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

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

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

1.4.4. Digital Input Diagnostic Trouble Code Trigger

The DIDAO controller allows for Diagnostic Trouble Codes (DTCs) to be sent by the controller on the J1939 network upon an ON-signal detection.

Event Generates a DTC in DM1 parameter determines whether or not a configured DTC is sent on the network upon an ON-signal detection. Table 3 shows the different options for this parameter.

Table 4: Event Generates a DTC in DM1

Value	Meaning
0	False
1	True

By default, no digital input sends a DTC on the network when an ON signal is detected. If **Event Generates a DTC in DM1** is set to *TRUE,* the user has access to a full configuration of the DTC parameters. When **Event Cleared Only by DM11** parameter is set to *FALSE,* the DTC is cleared when the controller no longer detects an ON signal at its respective digital input. However, when **Event Cleared Only by DM11** is *TRUE,* the DTC will remain active after the controller no longer detects an ON signal at its respective digital input until a DM11 message is sent to the controller. Upon reception of a DM11 message, if the controller is detecting an ON signal at its respective digital input, the DTC **will not** be cleared. If, however, the controller no longer detects an ON signal at its respective digital input upon reception of a DM11 message, the DTC will be cleared but the occurrence count **will** remain the same. If desired to clear the occurrence count, it is necessary for a DM3 message to be sent to the controller.

Table 4 shows the available options for **Lamp Set by Event in DM1** that can be configured.

Table 5: Lamp Set by Event in DM11

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

Table 5 below shows the available options for the **Failure Mode Identifiers** (FMI) used in the DTC.

Table 6: FMI for Event used in DTC

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

When the DIDAO controller has detected an ON signal at the digital input, which has been configured to send a DTC, the parameter **Delay Before Sending DM1** determines how long the controller will wait in milliseconds before sending a DTC in a DM1 message. If the digital input has turned OFF before **Delay Before Sending DM1** the DTC will not become active and will not be sent on the network. If the controller is sending a DM1 message and the state of the digital input turns OFF, the error will be cleared after the configured time in milliseconds of the parameter **Delay Before Clearing DM1**.

1.5. Relay Output Function Blocks

There are 8 relay outputs available in the DIDAO controller which are 2Amp rated. The following sub sections will explain in more detail the functionalities and available setpoints/parameters.

1.5.1. Relay Output Functionality

All 8 relay outputs have 2 states: *Normally Open* and *Normally Closed*. Each relay output has 3 pins associated with it: Normally Closed (NC), Normally Open (NO), and Common (C). The **Relay Output Type** parameter allows for flexibility in the response of the output. Table 6 shows the options available for this parameter.

Table 7: Relay Output Type

Value	Meaning
0	Output Not Implemented
1	Normal Logic
2	Inverse Logic
3	Latched Logic
4	Inverse Latched Logic
5	Toggle Logic

By default, *Normal Logic* response is used for the relay outputs.

In *Normal Logic* response, the Common pin is connected to the Normally Closed pin if the source of the respective relay output is triggered ON, the Common pin is connected to the Normally Open pin.

In the case of *Inverse Logic* response, the Common pin is connected to the Normally Open pin when the source of the respective relay output is triggered ON. When the source of the respective relay output is triggered OFF, the Common pin is connected to the Normally Closed pin.

In the case of *Latched Logic* response, the Common pin is toggled between Normally Closed and Normally Open pins every time the source of the respective relay output goes from OFF to ON. The opposite behavior applies to the *Inverse Latched Logic*. If the output switches from ON to OFF, the output state changes.

The *Toggle Logic* response lets the relay output toggle between Normally closed and Normally Open pins for a configured frequency. The time for switching from one state to the other state is set by the **Toggle Frequency** which is by default 500ms.

1.5.2. Relay Output Control/Enable/Override/Unlatch Sources

The relay outputs can be configured to be commanded and/or enabled by the sources listed in Table 1. This table also displays the number associated with the control sources which can be selected.

The selected control source in the **Control Source** parameter is the main commanding source of the relay output based on **the Relay Output Type** parameter. A delay can be set for both output states. In case the output state should turn low after a certain amount of time, the parameter **Turn OFF Delay** can be set. Whereas the **Turn ON Delay** can be configured to set a delay before switching from the OFF-state to ON-state. Both delays are configurable in milliseconds.

1.5.3. Relay Output Enable

The **Enable Source** will determine whether or not the relay output will be commanded by the **Control Source**. There are six different **Enable Responses** in which the enable signal can be used. These responses are listed in Table 8, where the default value is highlighted.

Table 8: Enable Response

Value	Meaning
0	Enable When ON
1	Enable When OFF
2	Disable When ON
3	Disable When OFF
4	Enable When ON Else Keep State
5	Enable When OFF Else Keep State

When the **Enable Response** is set to *Enable When ON* or *Disable When OFF,* the relay output will be commanded according to the signal of the **Control Source/Number** and the **Relay Output Type** only when the signal of the **Enable Source/Number** is ON. Otherwise, the relay output is commanded to the OFF state (**Relay Output Type** selected).

Similarly, when the **Enable Response** is set to *Enable When OFF* or *Disable When ON*, the relay output will be commanded according to the **Control Source/Control Number** and the **Relay Output Type** only when the signal of the **Enable Source/Enable Number** is OFF. Otherwise, the relay output is commanded to the OFF state (**Relay Output Type** selected).

In case the **Enable Response** is *Enable When ON Else Keep State*, the relay output will be commanded according to the signal of the **Control Source/Number** and the **Relay Output Type** only when the signal of the **Enable Source/Number** is ON. If the Enable Source is OFF, the relay output will keep the previous state.

Likewise, when the **Enable Response** is configured to *Enable When OFF Else Keep State*, the relay output will be commanded according to the **Control Source/Number** and the Relay Output Type only when the **Enable Source/Number** is OFF. Otherwise, the relay output holds the previous state.

A time delay for both states (ON, OFF) can be set by setting the **Enable Response Delay** parameter to true. The values of these time delays can be set with the parameters **Turn OFF Delay** and **Turn ON Delay**. In this case, the delays are valid for the enable state and the control state.

1.5.4. Relay Output Override

The **Override Source** will determine whether or not the relay output will be commanded by the **Control Source**. This Source has a higher priority than the Enable Source.

There are two different **Override Responses** in which the Override signal can be used. These responses are listed in Table 9, where the default value is highlighted.

Table 9: Override Responses

Value	Meaning
0	Override When OFF
1	Override When ON

When the **Override Response** is configured to *Override When ON*, the relay output will be commanded according to the signal of the **Control Source/Number** by the **Override State**. If the Override Response is set to Override When OFF, the relay output will be commanded according to the signal of the Control Source/Number by the Override State. Table 10 shows the two possible states for the **Override Response**.

Table 10: Override State

Value	Meaning
0	Override State OFF
1	Override State ON

In the case of **Override State OFF**, the relay output switches to normally open. If **Override State ON** is configured, the relay output changes to normally closed.

1.5.5. Relay Output Unlatch

This Source can only be configured if the Output Type is set to **Latched Logic or Inverse Latched Logic**. If the state of the Unlatch Source is normally closed it turns the output state OFF in case the Output Type is set to **Latched Logic**. If the Unlatch Source state turns normally open afterwards, the output state stays OFF independent of the Output state before. The reverse behavior is valid for the **Inverse Latched Logic**.

The unlatch logic can be modified by **Unlatch Only by Unlatch Source**. If this parameter is set to True, the output state can only be unlatched by triggering the unlatch source. Otherwise, the output's state stays ON whether the control source is triggered or not, in case Output Type Latched Logic is selected.

The parameter **Output Response upon Unlatch Removal** can be set to Latched and Immediate. By setting this parameter to Latched, the output state in Latched Logic will be normally open after the unlatch source got triggered and switched back to normally open. By setting this parameter to Immediate, however, the output state changes back to the state when the unlatch source was triggered after the unlatch source is normally open again. For instance, the output type is set to latched and the output state is normally closed. If the unlatch source is triggered, the output turns OFF. The output turns ON again after the unlatch source becomes normally open.

1.5.6. Digital Output Diagnostic Trouble Code Trigger

The DIDAO controller allows for Diagnostic Trouble Codes (DTCs) to be used as a trigger for digital outputs. Refer to subchapter 1.4.4 for details on Diagnostic Trouble Codes.

The principle of the digital output's diagnostic trouble code is the same as for the digital inputs. That is why this chapter refers to subchapter 1.4.4.

1.6. Analog Output Function Block

There is a single analog output available in the DIDAO controller. The following sub-sections will explain in more detail the functionality and parameters available to control this output.

1.6.1. Analog Output Functionality

The type of analog output set by the DIDAO is determined by the **Output Type** parameter. It's important to select this type first before configuring other setpoints for the output, because depending on the type selected the other setpoints will be enabled or disabled and will have different interpretations. Table 11 outlines the possible output types selectable for the output.

Table 11: Output Types

Input Types	Value	Min Range	Max Range	Units
Output Not Implemented	0	-	-	-
Voltage Output 0 to 5 V	1	0	5	V
Voltage Output 0 to 10 V	2	0	10	V
Voltage Output -5 to 5 V	3	-5	5	V
Voltage Output -10 to 10 V	4	-10	10	V
Current Output 4 to 20 mA	5	4	20	mA
Current Output 0 to 20 mA	6	0	20	mA
Current Output 0 to 24 mA	7	0	24	mA

1.6.2. Analog Output Control/Enable/Override

The analog output goes through a series of data sources to determine what the final output will be. Output data will follow this order of precedence if all sources are active; Override > Enable > Control. The **Control Source** sets the baseline value for the output data and must be set to provide any output data. The data from the source will be normalized and calculated to appear in the range of the set **Minimum Range** and **Maximum Range**. While the control source is actively commanding the output, the **Ramp Up Time** and **Ramp Down Time** parameters set the amount of time it will take to ramp through the whole range. Additionally, the **Delay Time** setpoint will set a delay before the output is commanded by the control.

If the **Enable Source** is selected, the set **Enable Response** will determine the output if the condition is matched. The enable control will have higher priority than the standard control. Table 12 below lists the possible responses, each of which has either Shut Off, Ramp Off or Keep Last Value behaviour. If the response is set to Shut Off, the output will be immediately disabled when the source meets the response condition. When Ramp Off behaviour is selected, the source satisfying the response condition will cause the output to ramp down until its off using the **Ramp Down** setpoint. Selecting a response using Keep Last Value behaviour will result in the output staying fixed at the last value set by the **Control Source** before the **Enable Source** met the response condition.

Table 12: Enable Response

Value	Meaning
0	Enable When ON Else Shut Off
1	Enable When ON Else Ramp Off
2	Enable When ON Else Keep Last Value
3	Enable When OFF Else Shut Off
4	Enable When OFF Else Ramp Off
5	Enable When OFF Else Keep Last Value

The **Override Source** has the highest priority of all sources, and if it matches the logic set by the **Override Response** will control the analog output with the **Override Value**.

The available override responses are listed below in Table 13.

Table 13: Override Responses

Value	Meaning
0	Override When OFF
1	Override When ON

1.6.3. Analog Output Diagnostics

The diagnostic functionality for the analog output is currently not implemented.

1.7. Diagnostics

1.7.1. General Diagnostics

The diagnostic messages of the DIDAO controller can be enabled or disabled by the setpoint **Disable All Diagnostics Checking**. In case there is an empty DM1 message required, **Send empty DM1 message** can be enabled. Both Setpoints are Disabled by default.

1.7.2. Power Supply – Temperature – CAN – Diagnostics

By using the setpoint **Power Supply Diagnostics**, an undervoltage and/or overvoltage error of the DIDAO controller can be detected in case the setpoint **Fault Detection is Enabled** is set to true. The **Undervoltage Threshold** and the **Overvoltage Threshold** can be set in range of 8 to 36 Volts by the **Power Supply Diagnostics**. To clear these errors, the Setpoint **Hysteresis to Clear Voltage Fault** can be configured. The undervoltage error clears, if the voltage reaches the defined clear voltage value plus the undervoltage threshold. This principle is also valid for the overvoltage. In this case, the clear voltage value will be subtracted of the overvoltage threshold. When the power supply reaches one of these values, the error will be cleared if **Event Cleared Only by DM11** is set to False.

An overheating can be detected with the **Temperature Diagnostics**. The settings can be enabled by the Setpoint **Fault Detection is Enabled**. If it's set to true, an error will be detected when the temperature reaches a value equal or higher than the configured **Over Temperature Threshold**. The detected error will be cleared if the temperature value is equal or smaller than the over temperature threshold subtracted by the **Hysteresis to Clear Temperature Fault**.

Both diagnostics, Power Supply and Temperature, have a parameter to disable all outputs. In case all outputs should be disabled when an overvoltage or undervoltage is measured, the parameter **Power Fault Disables Outputs** must be set to true. Whereas the parameter **Over Temperature Shutdown** disables the outputs when the unit is overheating.

In the **CAN Diagnostics**, an error will be detected when a CAN receive timeout appears. The error will be cleared if a new CAN receive message occurs.

By default, none of the Diagnostics sends a DTC on the network when one of the errors above is detected. If **Event Generates a DTC in DM1** is set to *TRUE,* the user has access to a full configuration of the DTC parameters. When **Event Cleared Only by DM11** parameter is set to *False,* the DTC is cleared when the controller no longer detects an error message at its respective diagnostic. However, when **Event Cleared Only by DM11** is *True,* the DTC will remain active after the controller no longer detects an error at its respective diagnostic until a DM11 message is sent to the controller. Upon reception of a DM11 message, if the controller is detecting an error at its respective diagnostic, the DTC **will not** be cleared. If, however, the controller no longer detects an error at its respective diagnostic upon reception of a DM11 message, the DTC will be cleared but the occurrence count **will** remain the same. If desired to clear the occurrence count, it is necessary for a DM3 message to be sent to the controller.

The setting for the for **Lamp Set by Event in DM1** and **Failure Mode Identifiers** (FMI) are the same as for the Digital Inputs and Outputs. Therefore Table 4: Lamp Set by Event in DM11 and Table 5: FMI for Event used in DTC are also valid for the discussed parameters in this subchapter.

1.7.3. Diagnostic Trouble Code (DTC) React

The DTC React function block will allow a received DTC sent from another ECU on a DM1 message to be used as an input source to control and/or enable/disable any output signal. Up to thirty (30) SPN/FMI combinations can be selected.

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

By setting the parameter **Enable Specific Source Address** to true, a source address between 1 and 253 can be set with **Specific Source Address That Sends.**

1.8. CAN Receive Function Block

The DIDAO controller supports up to 16 unique fully configurable CAN Receive Messages. The CAN Receive function block is designed to take any SPN from the J1939 network and use it as a **Control/Unlatch/Enable/Override Source** for any relay outputs or CAN transmits.

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

Once a message has been enabled, a Lost Communication fault will be flagged if that message is not received within the **Receive Message Timeout** period if this has been set to 10ms or higher. This will trigger a Lost Communication event, and the output data of the CAN Receive message will be set to 0. To avoid timeouts (if set to 10ms or higher) on a heavily saturated network, it is recommended to set the period at least three times longer than the expected update rate. To disable the timeout feature, simply set this value to zero, in which case the received message will never timeout and will never trigger a Lost Communication event.

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

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

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 level types. These values are in whatever units the incoming data is **after** the resolution and offset are applied to the CAN Receive signal.

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

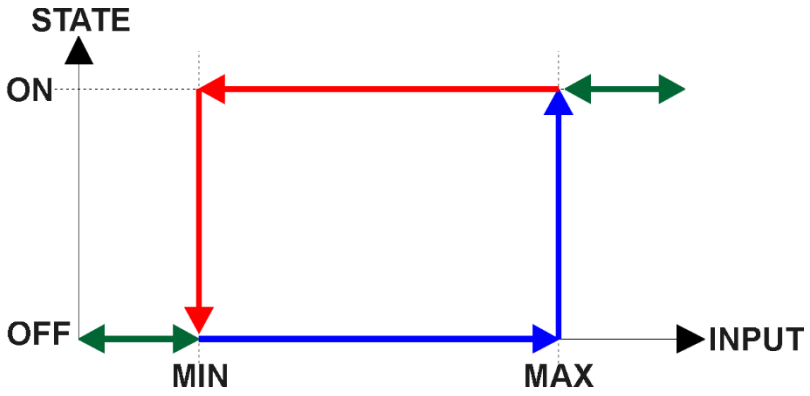


Figure 3: CAN Receive Message to Digital Output State

1.9. CAN Transmit Function Block

The DIDAO controller provides up to 12 fully configurable CAN Transmit messages. Each block has a configurable **Transmit PGN** while the first three CAN Transmit messages have by default a **PGN** of 0xFF00. The fourth down to the 12th CAN Transmit Block have different PGNs by default. Thereby, the fourth starts with a PGN of 0xFF01 counting down to the 12th CAN Transmit Block, which has a PGN of 0xFF09.

A pre-defined CAN Transmit message is used to transmit the Digital Input and Digital Output states of the DIDAO controller to the J1939 network. The Digital Input and output states are 1-bit size long occupying the first 3 bytes of the CAN Transmit message. Section 2.3 shows the default values of this message.

The CAN transmit message is always enabled and the **Transmit Repetition Rate** defines to which time in milliseconds the CAN transmit message is repeated. The CAN message will not transmit on the J1939 network in case all CAN transmits have the same PGN and the **Transmit Repetition Rate** of the first CAN transmit is set to zero.

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

Enabling the **Override Source Address**, the **Source Address** of the J1939 Identifier can be changed to any value between 0…255.

The **Transmit Data Size**, **Transmit Data Index in Array (LSB)**, **Transmit Bit Index in Byte (LSB), Transmit Data Resolution**, and **Transmit Data Offset** can all be used to map any SPN supported message by the J1939 standard from any **Data Source/Number** of the Transmit Function Block. Table 15 exhibits the possible Sources for the CAN Transmits.

In case the source **CAN Status Reports** is selected, the minimum **Transmit Data Size** must be one Byte. Otherwise, data loss cannot be excluded. The same is valid for the sources **Global VPS** and **Global Temperature**.

1.10. CAN Status Reports

The DIDAO controller provides CAN Status Report messages to merge more than one state in a CAN Transmit message. Each CAN Status Report provides eight Control Sources, Control Numbers, and Bit Locations. This way, it is possible to create a one-byte message with up to 8 status bits. The Bit Location of each status bit is configurable between Bit Location 1 and Bit Location 8. Any Bit Location which is not set to a Source will be set to zero. Table 16 shows the Control Sources of the CAN Status Reports with their Control Number ranges.

The Sources Digital Input and Digital Output are set as default for the three CAN Status Reports. Thereby, the first CAN Status Report has the first 8 Digital Input States, while the second one has the last four Inputs states and the first four Output states. The third CAN Status Report message merges the last four states of the Digital Outputs while Bit Location 5 to 8 are empty.

1.11. Conditional Block

The Conditional Block compares up to four different input sources with different logical or relational operators. The result of each block can therefore only be true (1) or false (0). Figure 4 demonstrates the connections between all parameters.

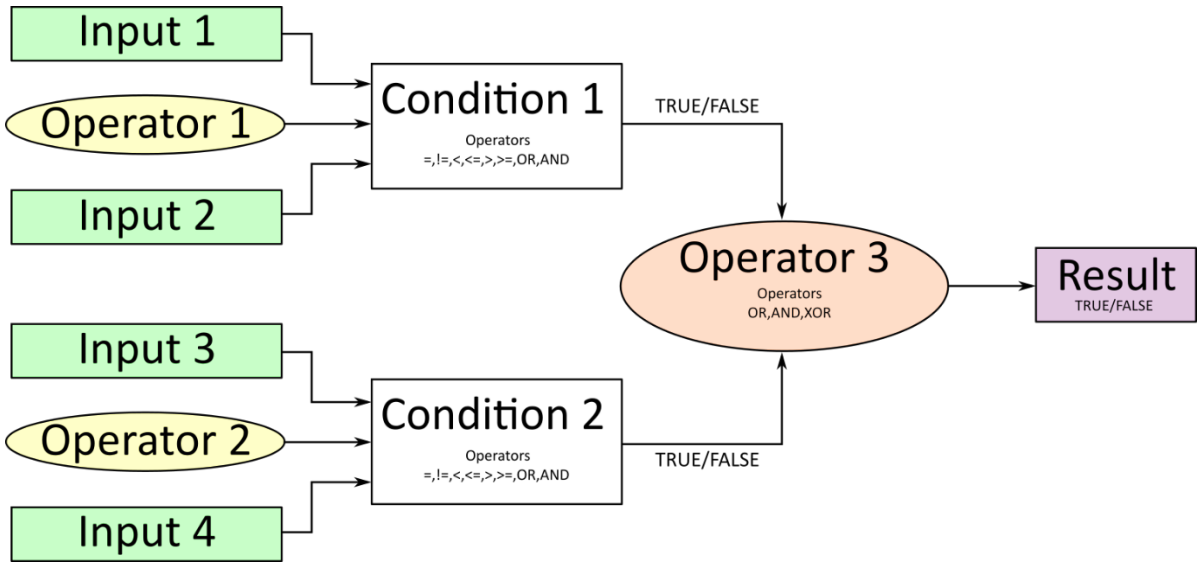


Figure 4: Conditional Block Diagram

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

The value of Input 1 to Input 4 depends on the configured control source and control number.

All Inputs are set to Digital Input one to four as an input source by default. The value of each source will then be compared to each other with an operator of Table 14. If no source is selected, the output value of an Input will be zero.

Table 14: Input Operator Options

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

Operator 1 and Operator 2 are configured to AND by default. The table above cannot be used for comparing the conditions because they can only be compared with logical operators, which are listed in Table 15.

Table 15: Condition Operator Options

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

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

2. OVERVIEW OF J1939 FEATURES

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

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

2.1. Introduction To Supported Messages

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

From J1939-21 - Data Link Layer

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

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

From J1939-73 - Diagnostics

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

From J1939-81 - Network Management

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

Commanded Address 65240 ($00FED8)

From J1939-71 – Vehicle Application Layer

- Software Identification 65242 ($00FEDA)

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

2.2. J1939 Name, Address and Software ID

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

2.2.1. J1939 Name

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

Arbitrary Address Capable	Yes
Industry Group	0, Global
Vehicle System Instance	0
Vehicle System	0, Non-specific system
Function	124, Axiomatic I/O Controller
Function Instance	1, Axiomatic AXDIDAO128, 10 Digital Input, 8 Relay Output, 1 Analog Output Controller
ECU Instance	0, First Instance
Manufacture Code	162, Axiomatic Technologies Corporation
Identity Number	Variable, uniquely assigned during factory programming for each ECU

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

2.2.2. ECU Address

The default value of this setpoint is 128 (0x80), which is the preferred starting address for self-configurable ECUs as set by the SAE in J1939 tables B3 to B7. The Axiomatic EA 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 DIDAO will continue select the next highest address until it finds one that it can claim. See J1939/81 for more details about address claiming.

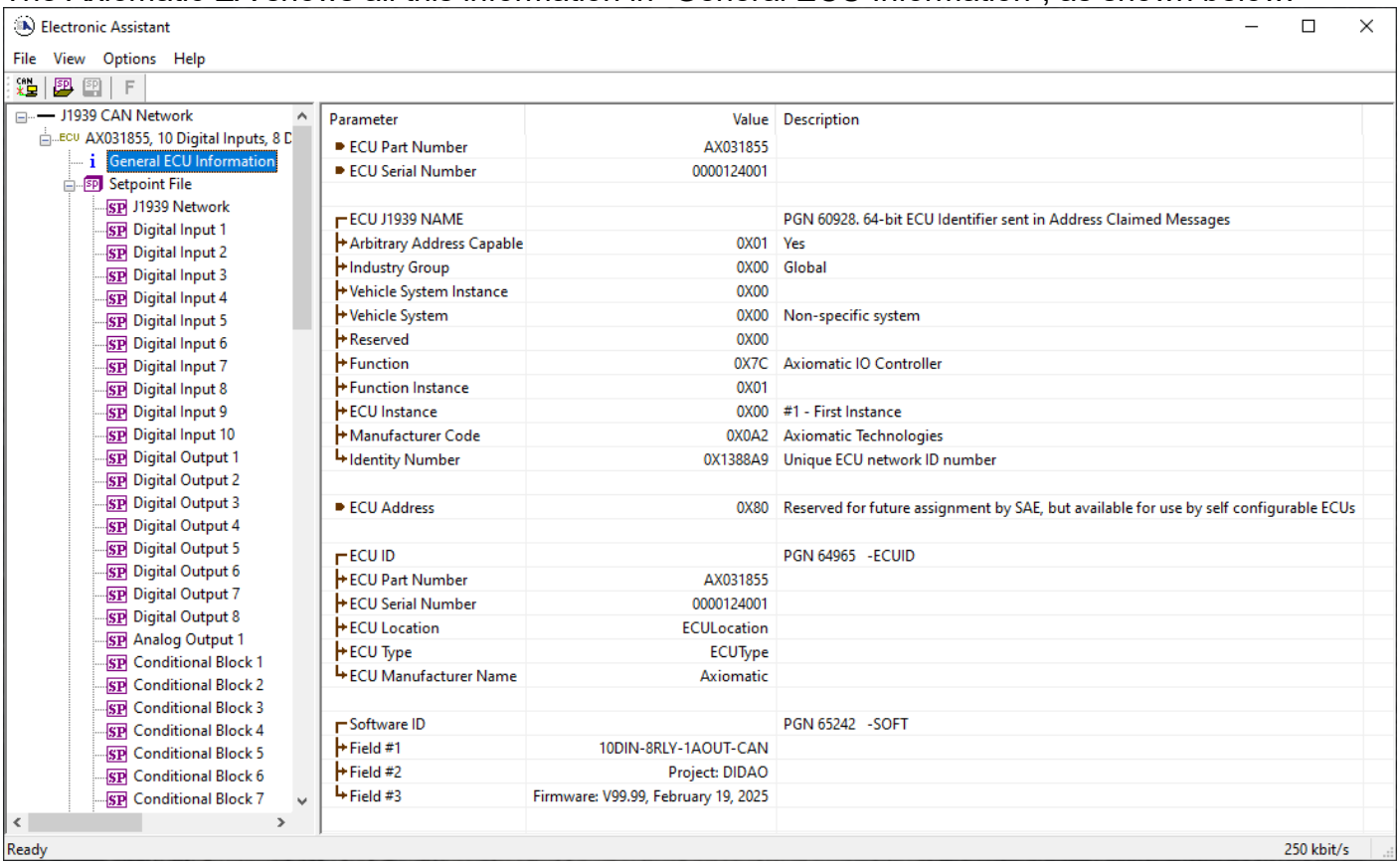
2.2.3. Software Identifier

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

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

(Version)*

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



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

2.3. CAN Transmit Message Default

This section outlines the **default** settings of the DIDAO CAN transmission. Recall, however, that this is a programmable function block, such that all these SPNs can be sent on different PGNs if so desired.

In all the messages shown below, not all the transmitted values have an SPN assigned to them, as this ECU only uses the SPNs for diagnostic trouble codes.

The “Digital Input and Relay Output State Feedback” has the following default configuration.

PGN 65280 Digital Input and Relay Output State Feedback

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

Start Position	Length	Parameter Name
1.1	1 bit	Digital Input 1 State
1.2	1 bit	Digital Input 2 State
1.3	1 bit	Digital Input 3 State
1.4	1 bit	Digital Input 4 State
1.5	1 bit	Digital Input 5 State
1.6	1 bit	Digital Input 6 State
1.7	1 bit	Digital Input 7 State
1.8	1 bit	Digital Input 8 State
2.1	1 bit	Digital Input 9 State
2.2	1 bit	Digital Input 10 State
2.3	1 bit	Digital Input 11 State
2.4	1 bit	Digital Input 12 State
2.5	1 bit	Relay Output 1 State
2.6	1 bit	Relay Output 2 State
2.7	1 bit	Relay Output 3 State
2.8	1 bit	Relay Output 4 State
3.1	1 bit	Relay Output 5 State
3.2	1 bit	Relay Output 6 State
3.3	1 bit	Relay Output 7 State
3.4	1 bit	Relay Output 8 State
3.5	1 bit	Empty
3.6	1 bit	Empty
3.7	1 bit	Empty
3.8	1 bit	Empty

3. ECU SETPOINTS ACCESSED WITH THE 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 DIDAO controller, refer to the relevant section of the User Manual.

3.1. J1939 Network Setpoints

The J1939 Network setpoints deal with the setpoints such as *ECU Instance Number* and *ECU Address*. Figure 5 and Table 16 below will explain these setpoints and their ranges.

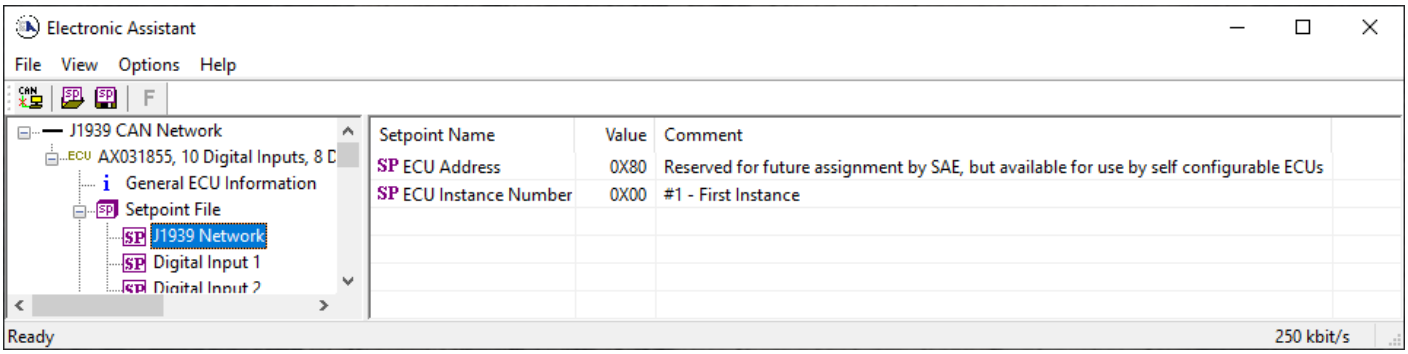


Figure 5: Screen Capture of J1939 Network Setpoints

Table 16: Default J1939 Network Setpoints

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

3.2. Digital Input Setpoints

The Digital Input setpoints are defined in Section 1.3. Refer to that section for detailed information on how these setpoints are used. The screen capture below in Figure 7 displays the available setpoints for each of the Digital Inputs. Table 17 below highlights the allowable ranges for each setpoint.

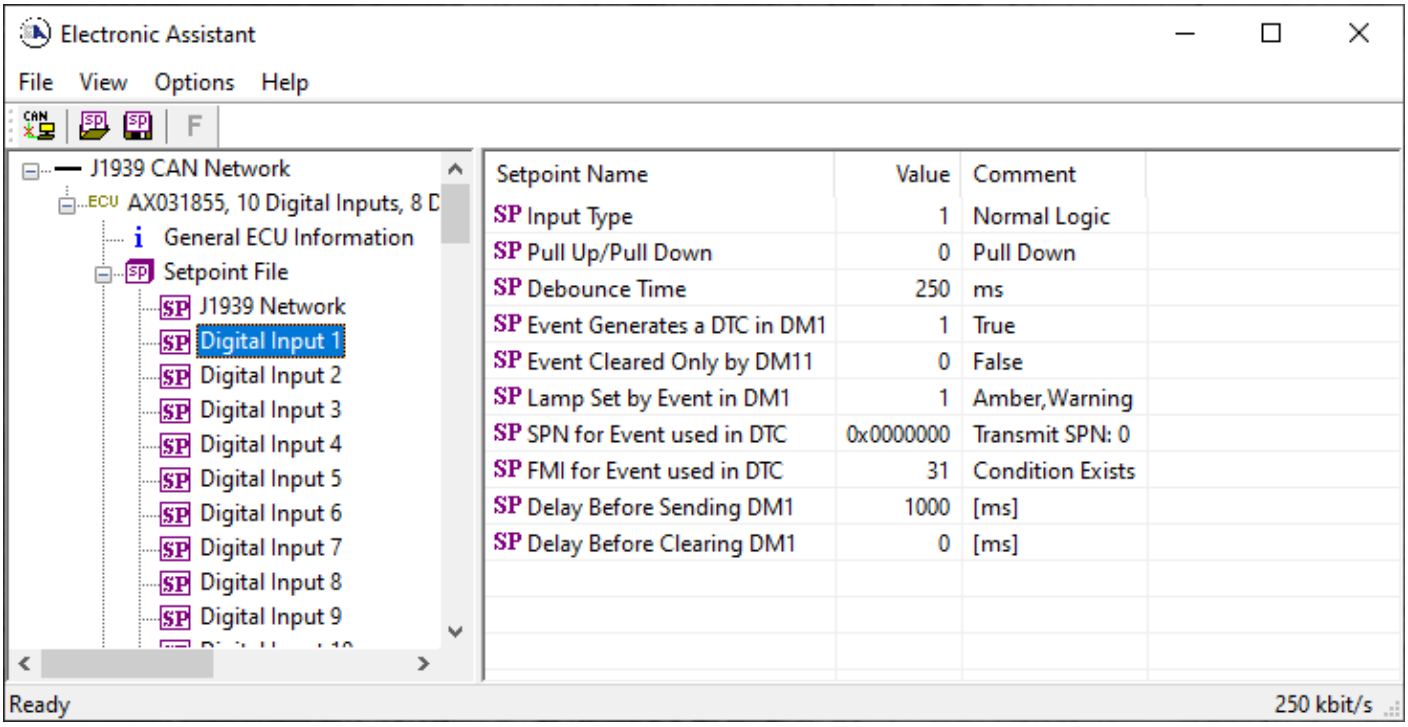


Figure 6: Screen Capture of Digital Input Setpoints

Table 17: Default Digital Input Setpoints

Name	Range	Default	Notes
Input Type	Drop List	Normal Logic	
Pull Up/Pull Down	Drop List	Pull Down	
Debounce Time	0…65,000	250	Units in [milliseconds]
Event Generates a DTC in DM1	Drop List	False	Default changed to *True* for illustration purposes. When *False*, the Digital Input will not trigger a fault on a DM1
Event Cleared Only by DM11	Drop List	False	When set to *True*, only DM11 messages will clear the fault if the input is no longer active. Refer to subsection 1.4.4
Lamp Set by Event in DM1	Drop List	Protect	Refer to Table 5
SPN for Event used in DTC	0…524,287	0	
FMI for Event used in DTC	Drop List	Condition Exists	Refer to Table 6
Delay Before Sending DM1	0…84,600,000	1000	If digital input remains ON after this time, a DTC will be sent on a DM1
Delay Before Clearing DM1	0…84,600,000	0	If digital output OFF after this time, a DTC will not be sent on a DM1 message anymore.

3.3. Relay Output Setpoints

The Relay Output setpoints are defined in Section 1.5. Refer to that section for detailed information on how these setpoints are used. The screen capture below in Figure 8 displays the available setpoints for each of the Digital Outputs. The table below highlights the allowable ranges for each setpoint.

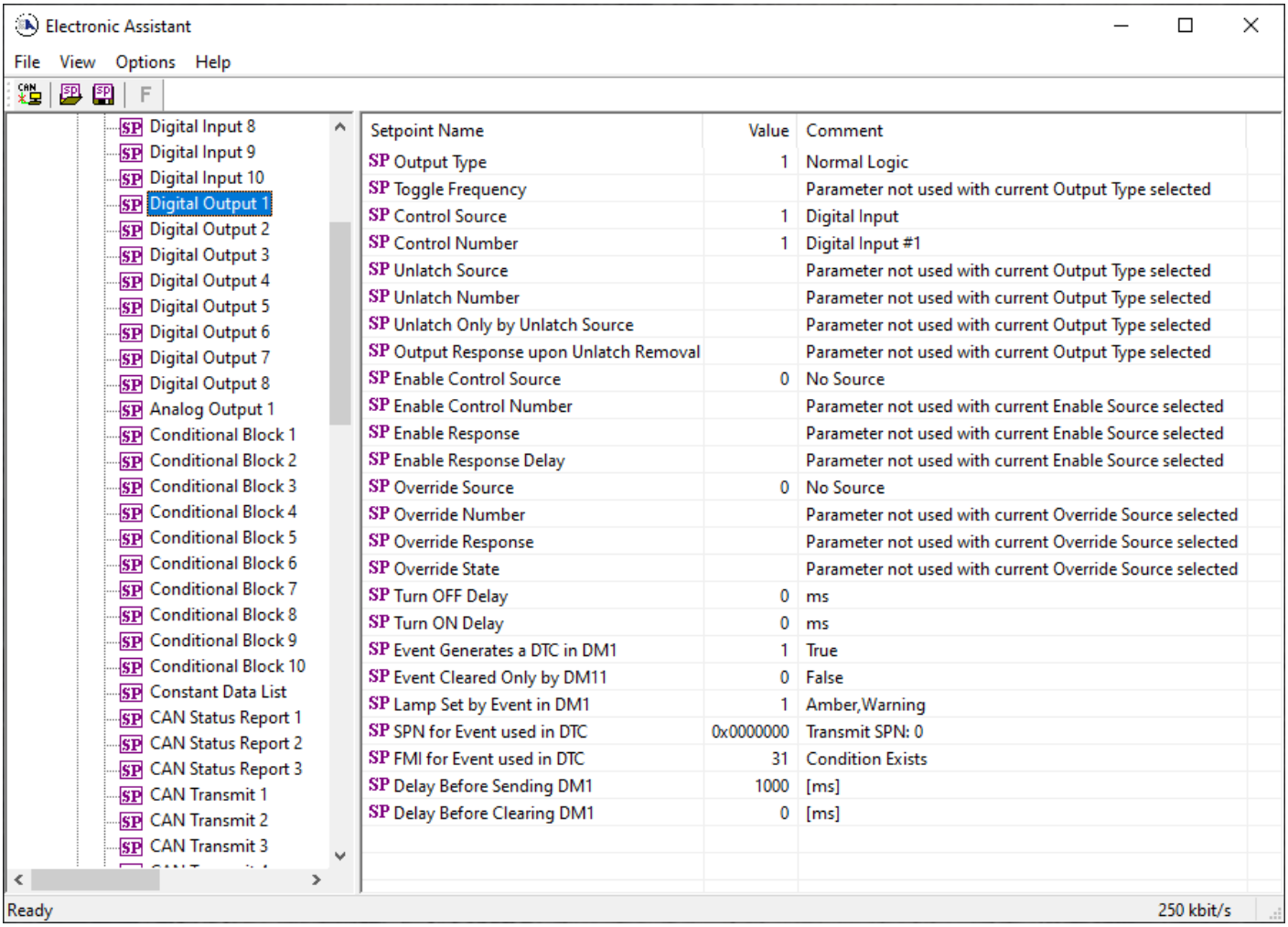


Figure 7: Screen Capture of Relay Output Setpoints

Table 18: Default Output Relay Setpoints

Name	Range	Default	Notes
Output Type	Drop List	Normal Logic	Refer to Table 7
Toggle Frequency	0…65,000	0	Units in [milliseconds]
Control Source	Drop List	Digital Input	Refer to Table 1
Control Number	Depends on Source Selected	-	Refer to Table 1
Unlatch Source	Drop List	Source Not Used	Refer to Table 1
Unlatch Number	Depends on Source Selected	-	Refer to Table 1
Unlatch Only by Unlatch Source	Drop List	False	
Output Response upon Unlatch Removal	Drop List	Latched	
Enable Source	Drop List	Source Not Used	Refer to Table 1
Enable Number	Depends on Source Selected	-	Refer to Table 1
Enable Response	Drop List	Enable When ON	Refer to Table 8
Enable Response Delay	Drop List	False	
Override Source	Drop List	Source not Used	Refer to Table 1
Override Number	Depends on Source Selected	-	Refer to Table 1
Override Response	Drop List	Enable When ON	Refer to Table 9
Override State	Drop List	False	Refer to Table 10
Turn OFF Delay	0…84,600,000	0	
Turn ON Delay	0…84,600,000	0	
Event Generates a DTC in DM1	Drop List	False	Default changed to *True* for illustration purposes. When *False*, the Digital Output will not trigger a fault on a DM1
Event Cleared Only by DM11	Drop List	False	When set to *True*, only DM11 messages will clear the fault if the output is no longer active. Refer to subsection 1.4.4
Lamp Set by Event in DM1	Drop List	Protect	Refer to Table 5
SPN for Event used in DTC	0…524,287	0	
FMI for Event used in DTC	Drop List	Condition Exists	Refer to Table 6
Delay Before Sending DM1	0…84,600,000	1,000	If digital output remains ON after this time, a DTC will be sent on a DM1.
Delay Before Clearing DM1	0…84,600,000	0	If digital output OFF after this time, a DTC will not be sent on a DM1 message anymore.

3.4. Analog Output

The Analog Output setpoints are defined in Section 1.6. Refer to that section for detailed information on how these setpoints are used. The screen capture below in Figure 8 displays the available setpoints for the Analog Output. The table below highlights the allowable ranges for each setpoint.

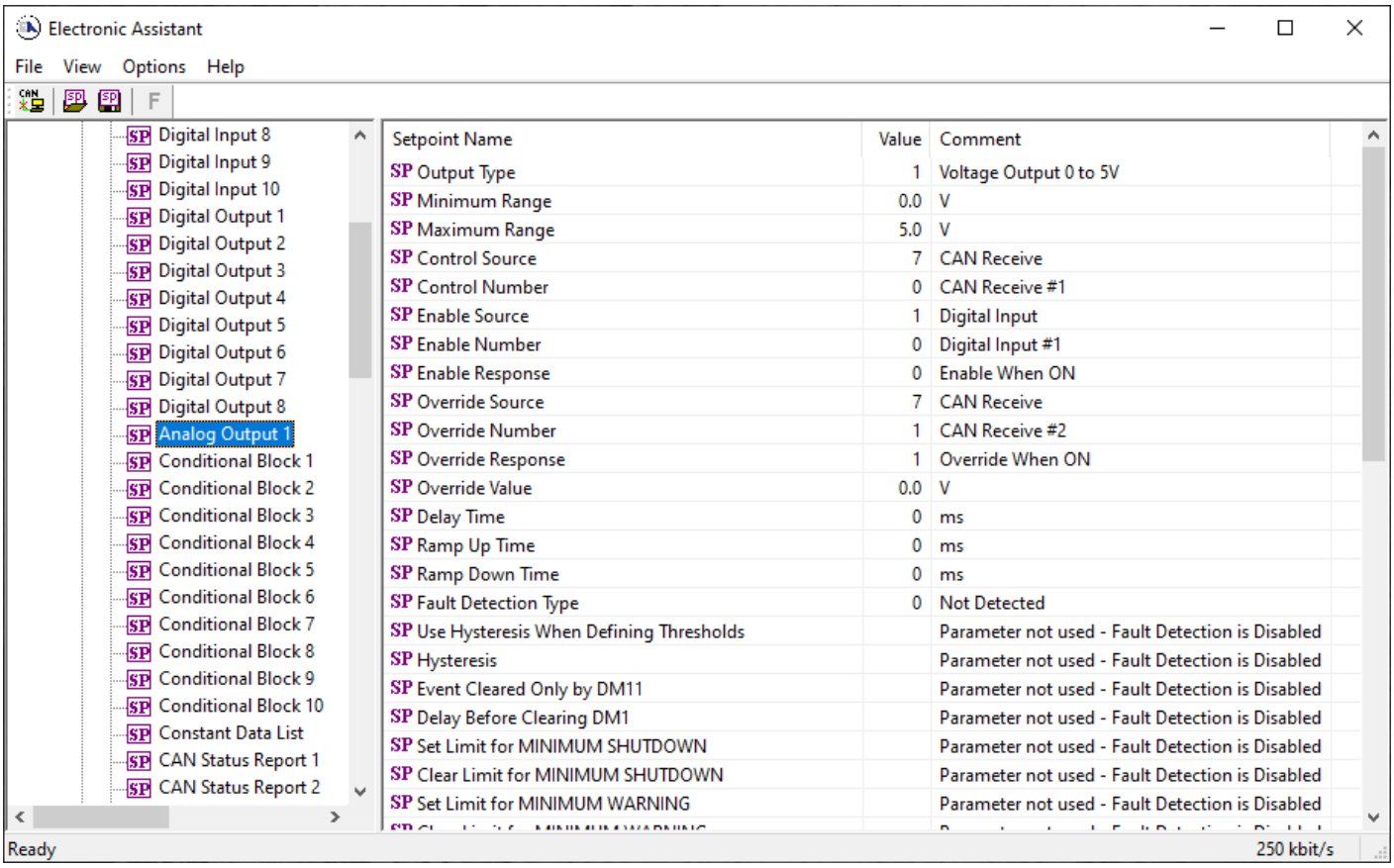


Figure 8: Screen Capture of Analog Output Setpoints

Table 19: Default Output Relay Setpoints

Name	Range	Default	Notes
Output Type	Drop List	Normal Logic	Default changed to *Latched Logic* for illustration purposes. Refer to Table 7
Minimum Range	Depends on Type Selected	-	Refer to Table 11
Maximum Range	Depends on Type Selected	-	Refer to Table 11
Control Source	Drop List	Digital Input	Refer to Table 1
Control Number	Depends on Source Selected	-	Refer to Table 1
Enable Source	Drop List	Source Not Used	Refer to Table 1
Enable Number	Depends on Source Selected	-	Refer to Table 1
Enable Response	Drop List	Enable When ON	Refer to Table 8
Override Source	Drop List	Source not Used	Refer to Table 1
Override Number	Depends on Source Selected	-	Refer to Table 1
Override Response	Drop List	Enable When ON	Refer to Table 9
Override Value	Depends on Type Selected	-	Refer to Table 10
Delay Time	0…65,000 ms	0	Refer to Section 1.6.1
Ramp Up Time	0…65,000 ms	0	Refer to Section 1.6.1
Ramp Down Time	0…65,000 ms	0	Refer to Section 1.6.1
Fault Detection Type	Drop List	0	Refer to Section 1.6.3
Use Hysteresis When Defining Thresholds	Drop List	False	
Hysteresis			
Event Cleared Only by DM11	Drop List	False	
Delay Before Clearing DM1	0…84,600,000	0	
Set Limit for MINIMUM SHUTDOWN	Depends on Type Selected	-	
Clear Limit for MINIMUM SHUTDOWN	Depends on Type Selected	-	
Set Limit for MINIMUM WARNING	Depends on Type Selected	-	
Clear Limit for MINIMUM WARNING	Depends on Type Selected	-	
Set Limit for MAXIMUM WARNING	Depends on Type Selected	-	
Clear Limit for MAXIMUM WARNING	Depends on Type Selected	-	
Set Limit for MAXIMUM SHUTDOWN	Depends on Type Selected	-	
Clear Limit for MAXIMUM SHUTDOWN	Depends on Type Selected	-	
MINIMUM SHUTDOWN, Event Generates a DTC in DM1	Drop List	False	
MINIMUM SHUTDOWN, Lamp Set by Event	Drop List	Protect	Refer to Table 5
MINIMUM SHUTDOWN, SPN for Event	0…524,287	0	
MINIMUM SHUTDOWN, FMI for Event	Drop List	Condition Exists	Refer to Table 6
MINIMUM SHUTDOWN, Delay Before Event is Flagged	0…84,600,000	1,000	
MINIMUM WARNING, Event Generates a DTC in DM1	Drop List	False	
MINIMUM WARNING, Lamp Set by Event	Drop List	Protect	Refer to Table 5

MINIMUM WARNING, SPN for Event	0…524,287	0	
MINIMUM WARNING, FMI for Event	Drop List	Condition Exists	Refer to Table 6
MINIMUM WARNING, Delay Before Event is Flagged	0…84,600,000	1,000	
MAXIMUM WARNING, Event Generates a DTC in DM1	Drop List	False	
MAXIMUM WARNING, Lamp Set by Event	Drop List	Protect	Refer to Table 5
MAXIMUM WARNING, SPN for Event	0…524,287	0	
MAXIMUM WARNING, FMI for Event	Drop List	Condition Exists	Refer to Table 6
MAXIMUM WARNING, Delay Before Event is Flagged	0…84,600,000	1,000	
MAXIMUM SHUTDOWN, Event Generates a DTC in DM1	Drop List	False	
MAXIMUM SHUTDOWN, Lamp Set by Event	Drop List	Protect	Refer to Table 5
MAXIMUM SHUTDOWN, SPN for Event	0…524,287	0	
MAXIMUM SHUTDOWN, FMI for Event	Drop List	Condition Exists	Refer to Table 6
MAXIMUM SHUTDOWN, Delay Before Event is Flagged	0…84,600,000	1,000	

3.5. Conditional Block

The Conditional Block setpoints are defined in Section 1.11. Refer to that section for detailed information on how these setpoints are used. The screen capture in Figure 9 displays the available setpoints for each of the Conditional Blocks. The table below the screen capture highlights the allowable ranges for each setpoint.

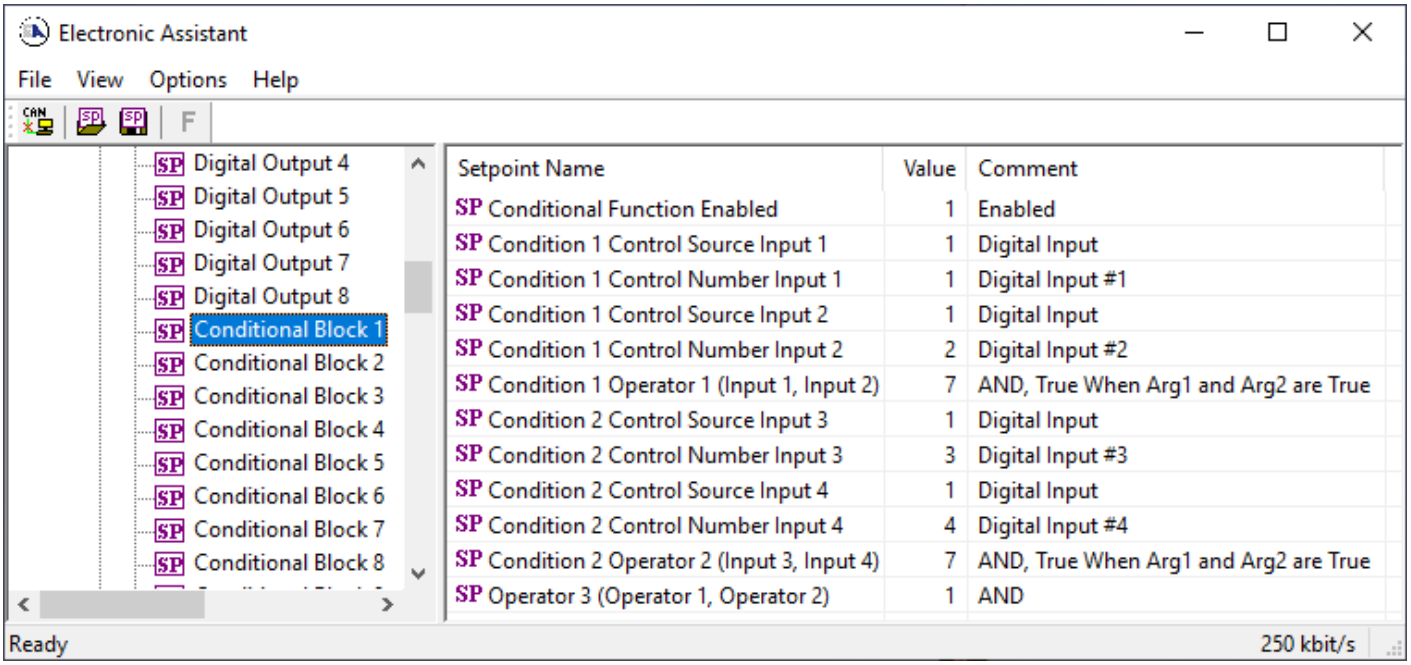


Figure 9: Screen Capture of Conditional Block Setpoints

Table 20: Default Conditional Block Setpoints

Name	Range	Default	Notes
Conditional Function Enabled	Drop List	Disabled	Default changed to *Enabled* for illustration purposes.
Condition 1 Control Source Input 1	Drop List	Digital Input	Refer to Table 1
Condition 1 Control Number Input 1	Depends on Source Selected	1	Refer to Table 1
Condition 1 Control Source Input 2	Drop List	Digital Input	Refer to Table 1
Condition 1 Control Number Input 2	Depends on Source Selected	1	Refer to Table 1
Condition 1 Operator 1(Input 1, Input 2)	0…7	7	Refer to Table 14
Condition 2 Control Source Input 3	Drop List	Digital Input	Refer to Table 1
Condition 2 Control Number Input 3	Depends on Source Selected	1	Refer to Table 1
Condition 2 Control Source Input 4	Drop List	Digital Input	Refer to Table 1
Condition 2 Control Number Input 4	Depends on Source Selected	1	Refer to Table 1
Condition 2 Operator 2(Input 3, Input 4)	0…7	7	Refer to Table 14
Operator 3 (Condition 1, Condition 2)	0…2	1	Refer to Table 15

3.6. Constant Data List Setpoints

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

The first two constants are fixed values of 0 (False) and 1 (True) for use in binary logic. The remaining 8 constants are fully user configurable to any value between +/- 1,000,000. The default values are displayed in the screen capture below.

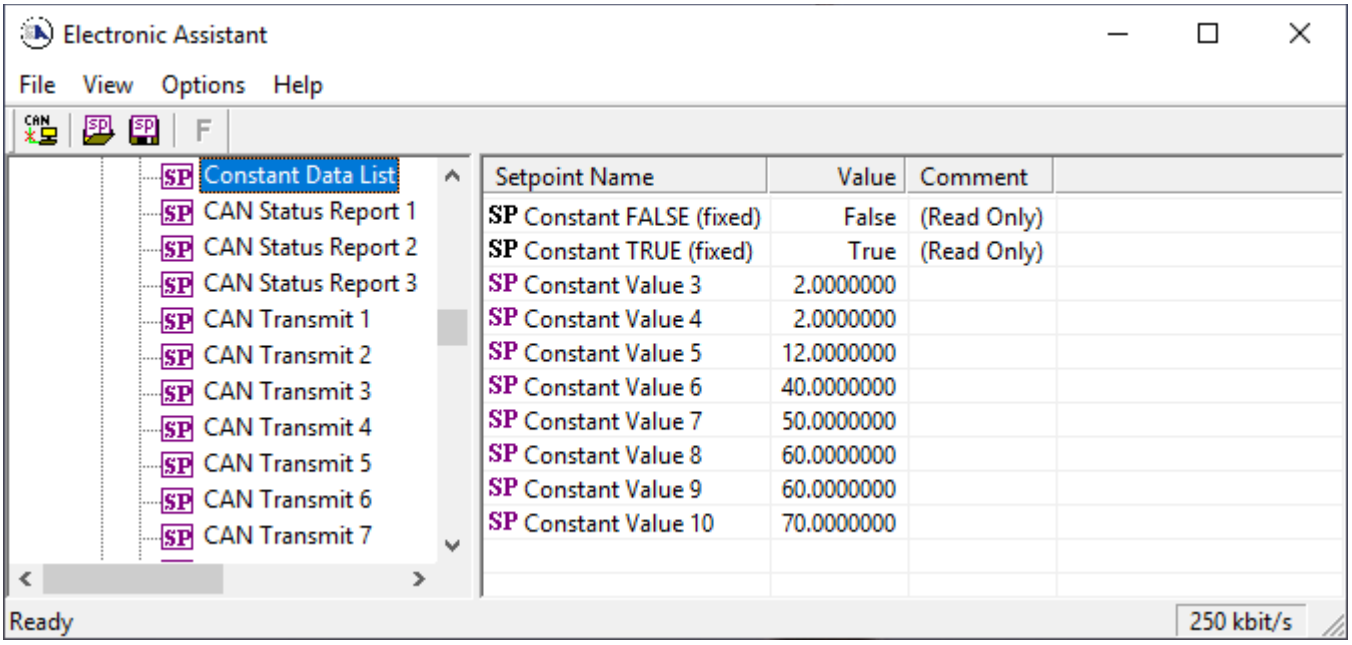


Figure 10: Screen Capture of Constant Data Setpoints

3.7. CAN Status Report Setpoints

The Relay Output setpoints are defined in Section 1.5. Refer to that section for detailed information on how these setpoints are used. The screen capture in Figure 11 displays the available setpoints for each of the CAN Status Reports (CSR). Table 21 below highlights the allowable ranges for each setpoint.

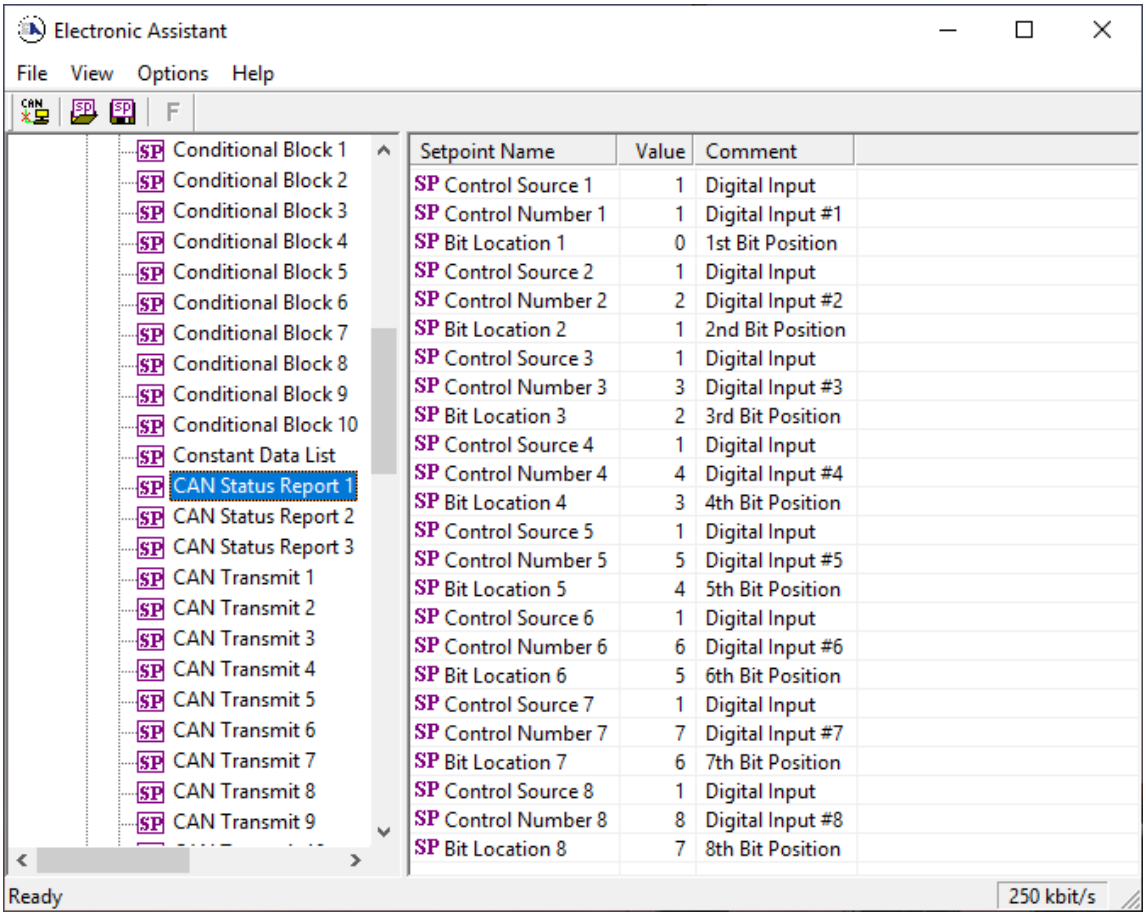


Figure 11: Screen Capture of Default CAN Status Reports

Table 21: Default CAN Status Report (CSR) Setpoints

Name	Range	Default CSR 1	Default CSR 2	Default CSR 3	Notes
Control Source 1	Drop List	Digital Input	Digital Input	Digital Output	Refer to Table 1
Control Number 1	Depends on Source Selected	1	9	5	Refer to Table 1
Bit Location 1	[1...8]	0	0	0	
Control Source 2	Drop List	Digital Input	Digital Input	Digital Output	Refer to Table 1
Control Number 2	Depends on Source Selected	2	10	6	Refer to Table 1
Bit Location 2	[1...8]	1	1	1	
Control Source 3	Drop List	Digital Input	Digital Input	Digital Output	Refer to Table 1
Control Number 3	Depends on Source Selected	3	11	7	Refer to Table 1
Bit Location 3	[1...8]	2	2	2	
Control Source 4	Drop List	Digital Input	Digital Input	Digital Output	Refer to Table 1
Control Number 4	Depends on Source Selected	4	12	8	Refer to Table 1
Bit Location 4	[1...8]	3	3	3	
Control Source 5	Drop List	Digital Input	Digital Output	No Source	Refer to Table 1
Control Number 5	Depends on Source Selected	5	1	-	Refer to Table 1
Bit Location 5	[1...8]	4	4	-	
Control Source 6	Drop List	Digital Input	Digital Output	No Source	Refer to Table 1
Control Number 6	Depends on Source Selected	6	2	-	Refer to Table 1
Bit Location 6	[1...8]	5	5	-	
Control Source 7	Drop List	Digital Input	Digital Output	No Source	Refer to Table 1
Control Number 7	Depends on Source Selected	7	3	-	Refer to Table 1
Bit Location 7	[1...8]	6	6	-	
Control Source 8	Drop List	Digital Input	Digital Output	No Source	Refer to Table 1
Control Number 8	Depends on Source Selected	8	4	-	Refer to Table 1
Bit Location 8	[1...8]	7	7	-	

3.8. CAN Transmit Setpoints

The CAN Transmit setpoints are defined in Section 1.9. Refer to that section for detailed information on how these setpoints are used. The screen capture below in Figure 12 displays the available setpoints for the CAN Transmit setpoints. Table 22 below highlights the allowable ranges for the first CAN Transmit setpoint.

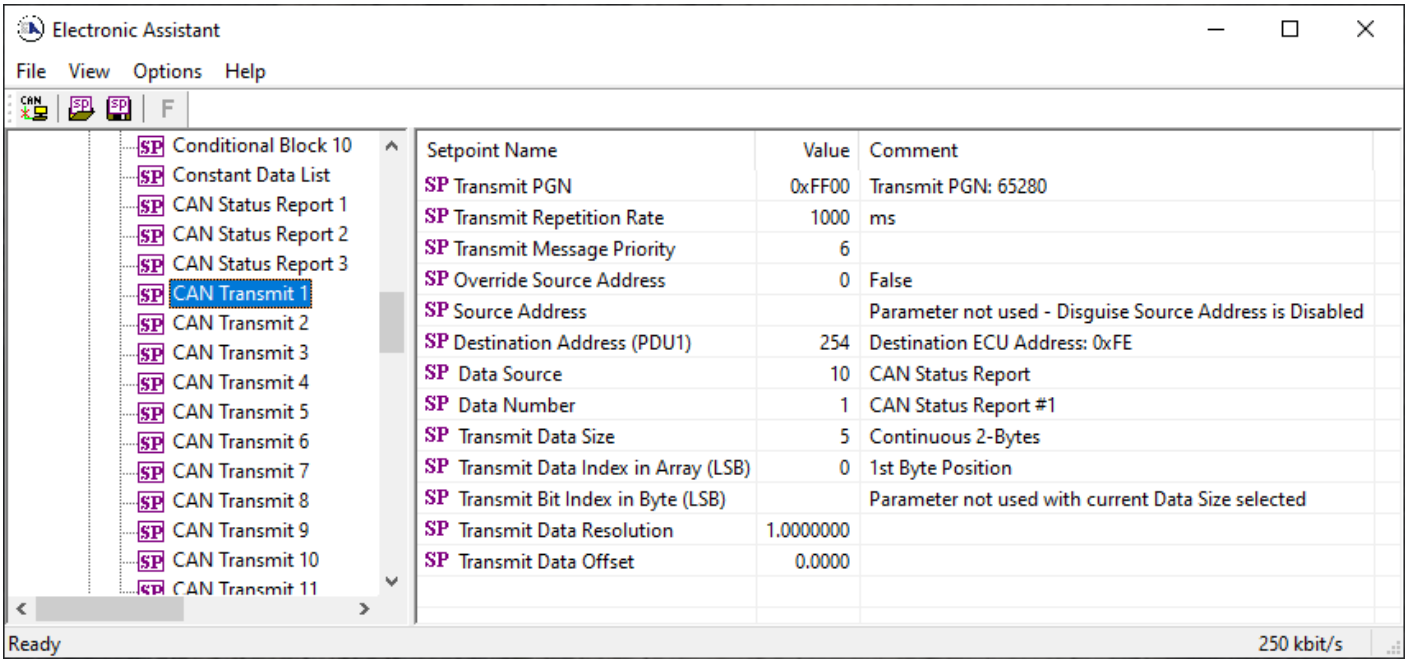


Figure 12: Screen Capture of Default CAN Transmit Setpoints

Table 22: Default CAN Transmit Setpoints

Name	Range	Default	Notes
Transmit Message PGN	0…65,535	65,280	Refer to Section 1.9
Transmit Message Repetition Rate	0…60,000	1000	Refer to Section 1.9
Transmit Message Priority	0...7	6	Refer to Section 1.9
Override Source Address	Drop List	False	
Source Address	0...255	-	Refer to Section 1.9
Destination Address (PDU1)	0...255	254	Refer to Section 1.9
Data Source	Drop List	CAN Status Report	Refer to Table 1
Data Number	Depends on Source Selected	1	Refer to Table 1
Transmit Data Size	Drop List	65,280	Refer to Section 1.9
Transmit Data Index in Array (LSB)	Depends on Source Selected	0	Refer to Section 1.9
Transmit Bit Index in Byte (LSB)	Depends on Source Selected	65,280	Refer to Section 1.9
Transmit Data Resolution	-100,000...100,000	1	Refer to Section 1.9
Transmit Data Offset	-100,000...100,000	0	Refer to Section 1.9

3.9. CAN Receive Setpoints

The CAN Receive setpoints are defined in Section 1.8 Refer to that section for detailed information on how these setpoints are used. The screen capture below in Figure 13 displays the available setpoints for the CAN Receive setpoints. Table 23 below highlights the allowable ranges for each setpoint.

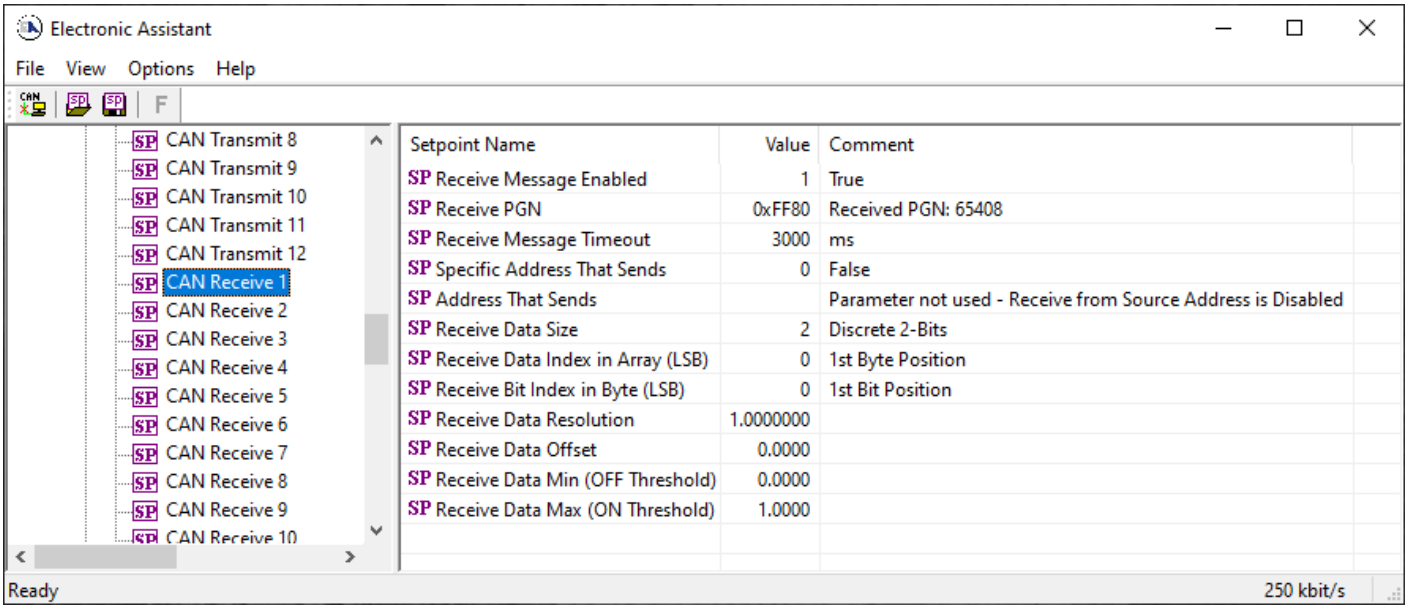


Figure 13: Screen Capture of Default CAN Receive Setpoints

Table 23: Default CAN Receive Setpoints

Name	Range	Default	Notes
Receive Message Enabled	Drop List	False	Default changed to *True* for illustration purposes. Refer to Section 1.8
Receive PGN	0…65,535	65280	Refer to Section 1.8
Receive Message Timeout	0...60,000	3000	Refer to Section 1.8
Specific Address That Sends	Drop List	False	Refer to Section 1.8
Address That Sends	0…255	255	Not Used by Default
Receive Data Size	Drop List	Discrete 2-Bit	0 = Not Used (disabled) 1 = Discrete 1-Bit 2 = Discrete 2-Bits 3 = Discrete 4-Bits 4 = 1-Byte Continuous 5 = 2-Bytes Continuous 6 = 4-Bytes Continuous
Receive Data Index in Array (LSB)	0…7	0	Refer to Section 1.8
Receive Bit Index in Byte (LSB)	0…7	0	Refer to Section 1.8
Receive Data Resolution	-0xFFFFFFFF…0xFFFFFFFF	1.0	Refer to Section 1.8
Receive Data Offset	-0xFFFFFFFF…0xFFFFFFFF	0.0	Refer to Section 1.8
Receive Data Min (OFF Threshold)	-0xFFFFFFFF…Data Max	0.0	Refer to Section 1.8
Receive Data Max (ON Threshold)	Data Min…0xFFFFFFFF	1.0	Refer to Section 1.8

3.10. DTC React Setpoints

The DTC React setpoints are defined in subsection 1.7.1. Refer to that subsection for detailed information on how these setpoints are used. The screen capture below in Figure 14 displays the available setpoints for the DTC React setpoints. Table 24 below highlights the allowable ranges for each setpoint.

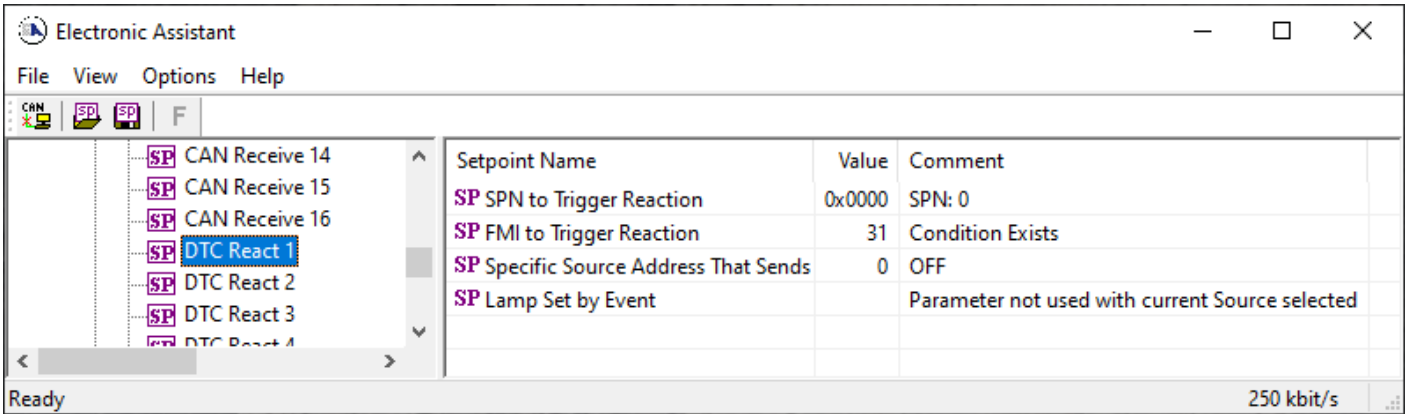


Figure 14: Screen Capture of Default DTC React Setpoints

Table 24: Default DTC React Setpoints

Name	Range	Default	Notes
SPN to Trigger Reaction #1	0...524,287	0	Refer to Section 1.7.1
FMI to Trigger Reaction #1	Drop List	Condition Exists	Refer to Section 1.7.1
Enable Specific Source Address	Drop List	False	Refer to Section 1.7.1
Specific Source Address That Sends	1-253	-	Refer to Section 1.7.1

3.11. Power Supply Diagnostics

The Power Supply Diagnostic setpoints are defined in subsection 1.7.2. Refer to that subsection for detailed information on how these setpoints are used. The screen capture below in Figure 15 displays the available setpoints for the Power Supply Diagnostic setpoints. Table 25 below highlights the allowable ranges for each setpoint.

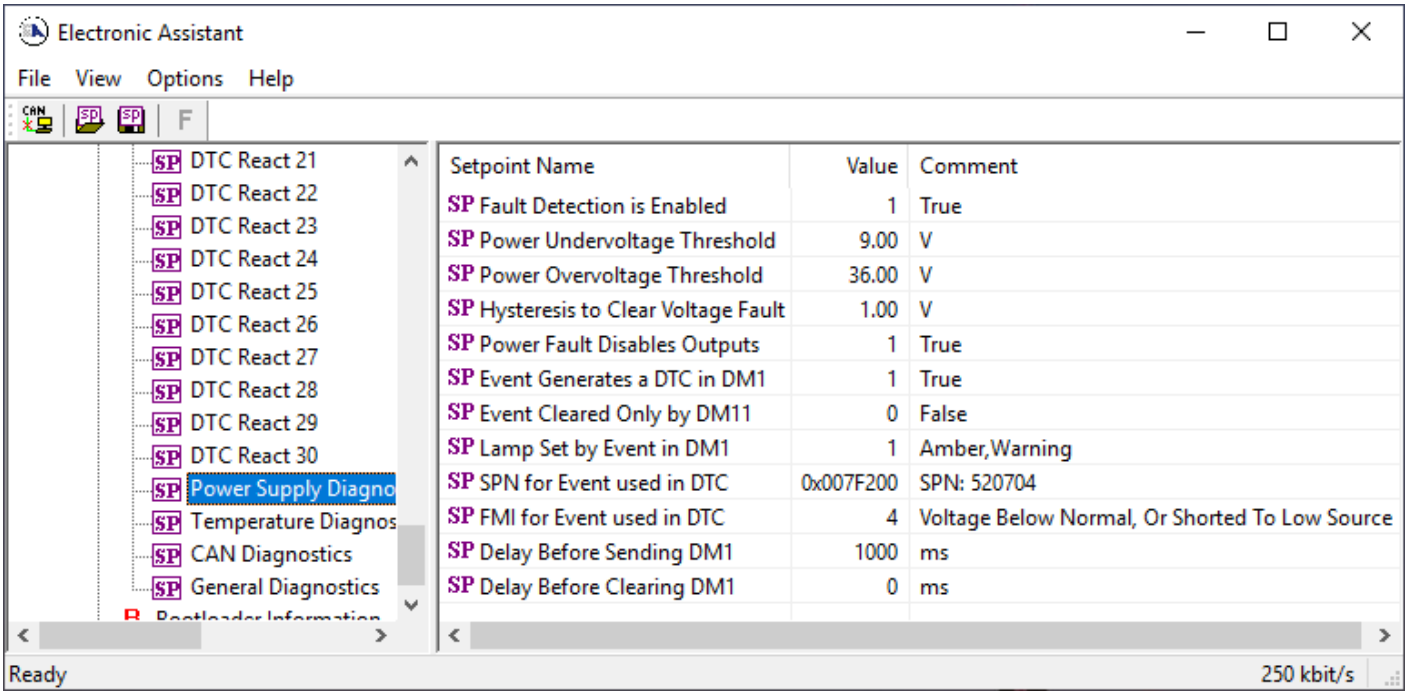


Figure 15: Screen Capture of Default Power Supply Diagnostic Setpoints

Table 25: Default Power Supply Diagnostic Setpoints

Name	Range	Default	Notes
Fault Detection is Enabled	Drop List	True	Refer to Subsection 1.7.2
Power Undervoltage Threshold	8…Power Overvoltage Threshold	9	Units in [volts]
Power Overvoltage Threshold	Power Undervoltage Threshold...36	36	Units in [volts]
Hysteresis to Clear Voltage Fault	0.01…30	1.00	Units in [volts]
Power Fault Disables Outputs	Drop List	True	Refer to Subsection 1.7.2
Event Generates a DTC in DM1	Drop List	False	Default changed to *True* for illustration purposes, Refer to Subsection 1.7.2
Event Cleared Only by DM11	Drop List	False	Refer to Subsection 1.7.2
Lamp Set by Event in DM1	Drop List	Amber, Warning	Refer to Table 5
SPN for Event used in DTC	0...524,287	520704	Refer to Subsection 1.7.2
FMI for Event used in DTC	Drop List	Voltage Below Normal, Or Shorted to Low Source	Refer to Table 6
Delay Before Sending DM1	0…84,600,000	1000	Units in [milliseconds]
Delay Before Clearing DM1	0…84,600,000	0	If digital output OFF after this time, a DTC will not be sent on a DM1 message anymore.

3.12. Temperature Diagnostics

The Temperature Diagnostic setpoints are defined in subsection 1.7.2. Refer to that subsection for detailed information on how these setpoints are used. The screen capture below in Figure 16 displays the available setpoints for the Temperature Diagnostic setpoints. Table 26 below highlights the allowable ranges for each setpoint.

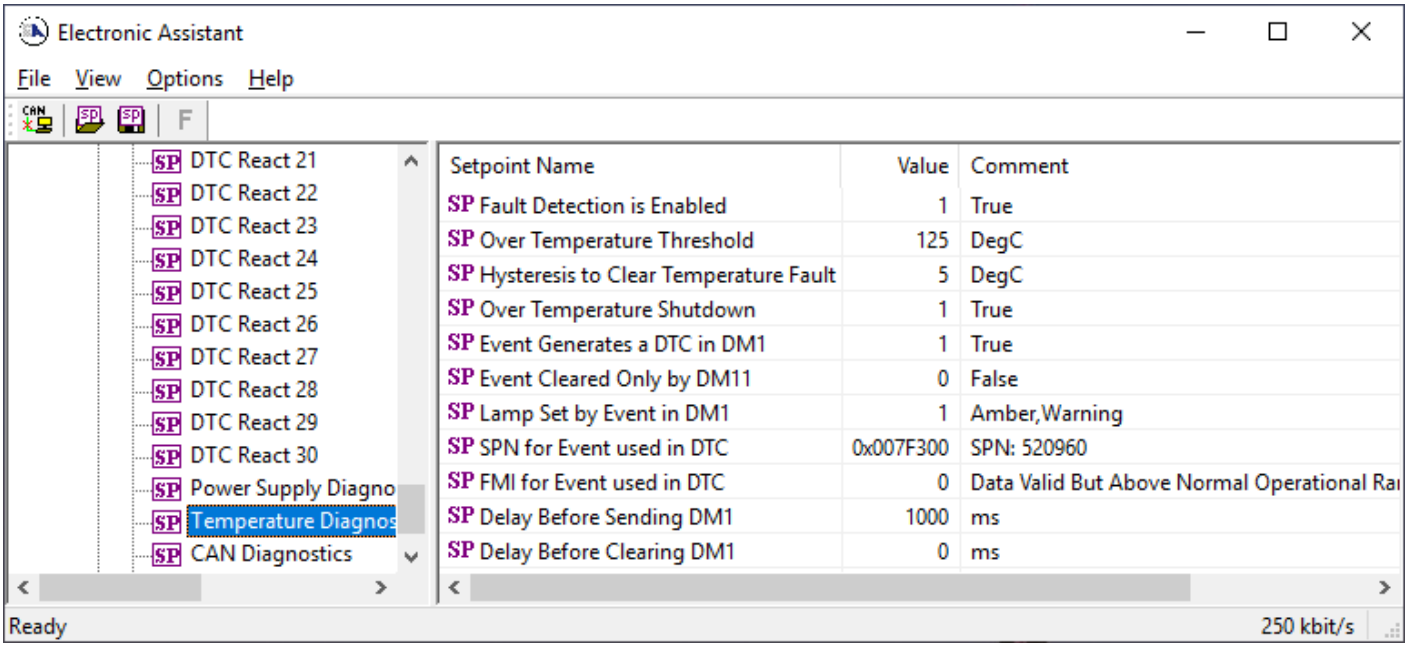


Figure 16: Screen Capture of Default Temperature Diagnostic Setpoints

Table 26: Default Temperature Diagnostic Setpoints

Name	Range	Default	Notes
Fault Detection is Enabled	Drop List	True	Refer to Subsection 1.7.2
Over Temperature Threshold	50…150	125	Units in [degree in C]
Hysteresis to Clear Voltage Fault	1.00…50	5.00	Units in [degree in C]
Over Temperature Shutdown	Drop List	True	Refer to Subsection 1.7.2
Event Generates a DTC in DM1	Drop List	False	Default changed to *True* for illustration purposes, Refer to Subsection 1.7.2
Event Cleared Only by DM11	Drop List	False	Refer to Subsection 1.7.2
Lamp Set by Event in DM1	Drop List	Amber, Warning	Refer to Table 5
SPN for Event used in DTC	0...524,287	520,960	Refer to Subsection 1.7.2
FMI for Event used in DTC	Drop List	Data Valid But Above Normal Operational Range – Most Severe Level	Refer to Table 6
Delay Before Sending DM1	0…84,600,000	1,000	Units in [milliseconds]
Delay Before Clearing DM1	0…84,600,000	0	If digital output OFF after this time, a DTC will not be sent on a DM1 message anymore.

3.13. CAN Diagnostics

The CAN Diagnostic setpoints are defined in subsection 1.7.2. Refer to that subsection for detailed information on how these setpoints are used. The screen capture below in Figure 17 displays the available setpoints for the Temperature Diagnostic setpoints. Table 27 below highlights the allowable ranges for each setpoint.

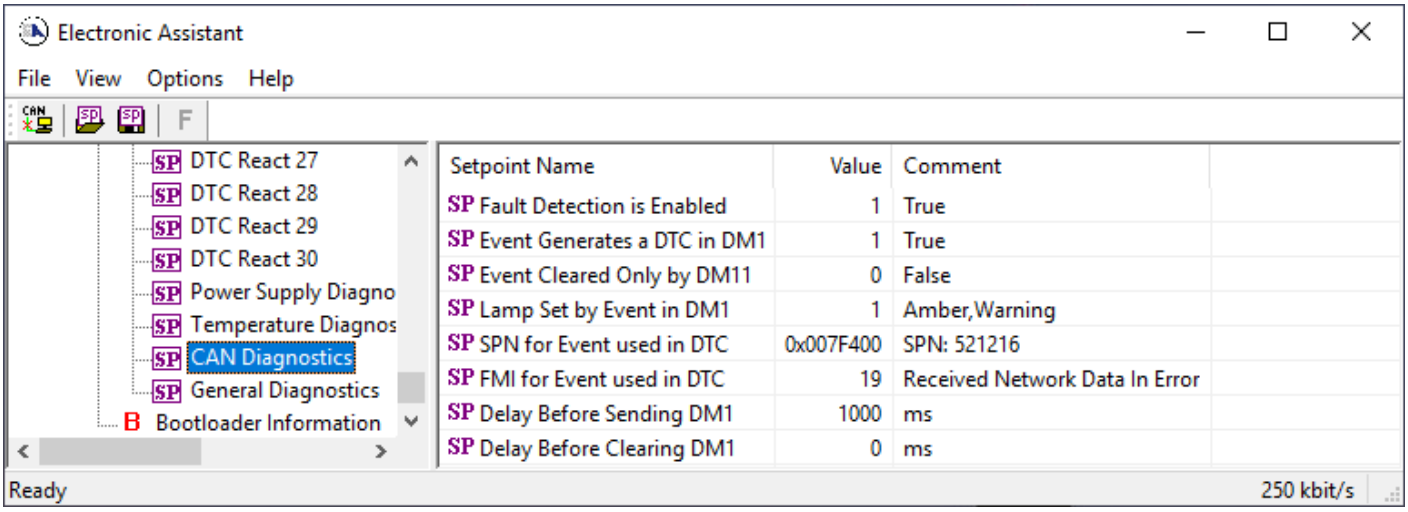


Figure 17: Screen Capture of Default CAN Diagnostic Setpoints

Table 27: Default CAN Diagnostic Setpoints

Name	Range	Default	Notes
Fault Detection is Enabled	Drop List	True	Refer to Subsection 1.7.2
Event Generates a DTC in DM1	Drop List	False	Default changed to *True* for illustration purposes, Refer to Subsection 1.7.2
Event Cleared Only by DM11	Drop List	False	Refer to Subsection 1.5.2
Lamp Set by Event in DM1	Drop List	Amber, Warning	Refer to Table 5
SPN for Event used in DTC	0...524,287	521,216	Refer to Subsection 1.7.2
FMI for Event used in DTC	Drop List	Voltage Below Normal, Or Shorted to Low Source	Refer to Table 6
Delay Before Sending DM1	0…84,600,000	1,000	Units in [milliseconds]
Delay Before Clearing DM1	0…84,600,000	0	If digital output OFF after this time, a DTC will not be sent on a DM1 message anymore.

3.14. General Diagnostics

The General Diagnostic setpoints are defined in subsection 1.7.1. Refer to that subsection for detailed information on how these setpoints are used. The screen capture below in Figure 18 displays the available setpoints for the Temperature Diagnostic setpoints. Table 28 below highlights the allowable ranges for each setpoint.

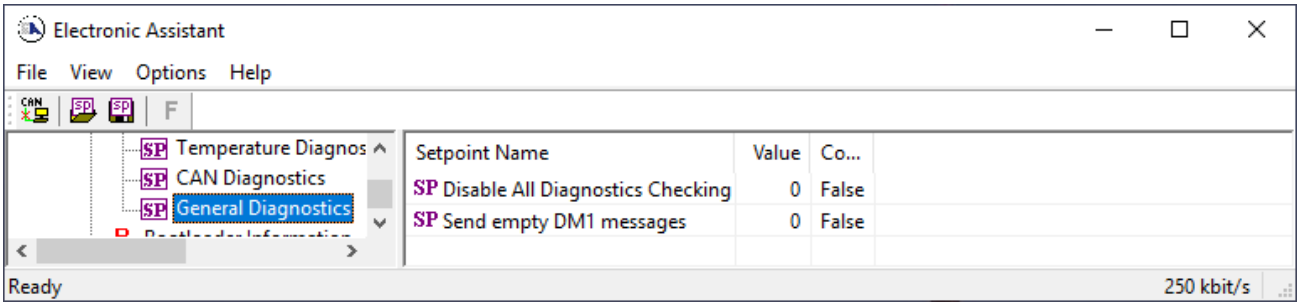


Figure 18: Screen Capture of Default General Diagnostic Setpoints

Table 28: Default General Diagnostic Setpoints

Name	Range	Default	Notes
Disable All Diagnostic Checking	Drop List	False	Refer to Subsection 1.7.1
Send empty DM1 messages	Drop List	False	Refer to Subsection 1.7.1

4. Reflashing over CAN with the Axiomatic Electronic Assistant Bootloader

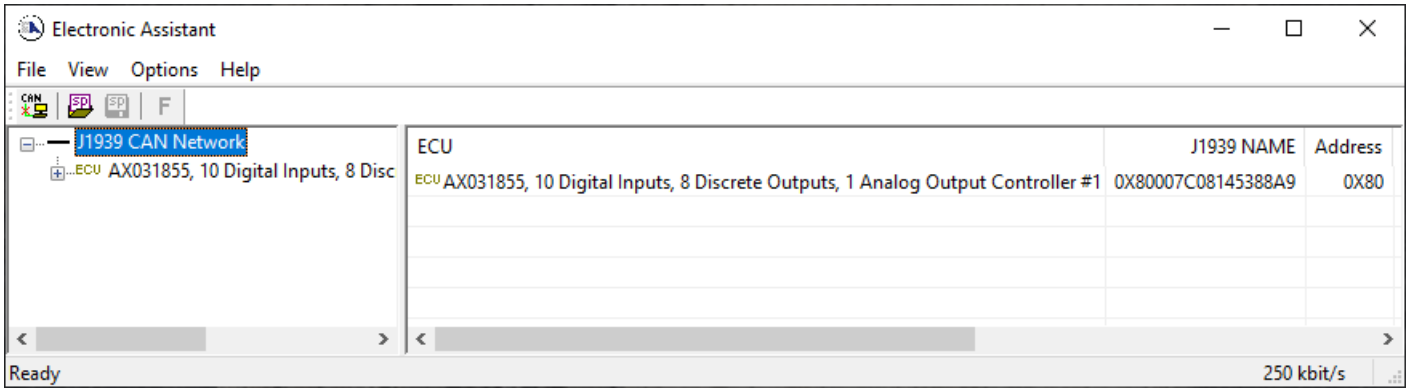
This chapter describes a procedure of re-programming an application firmware in CANJ1939 in the field.

4.1. Prerequisites

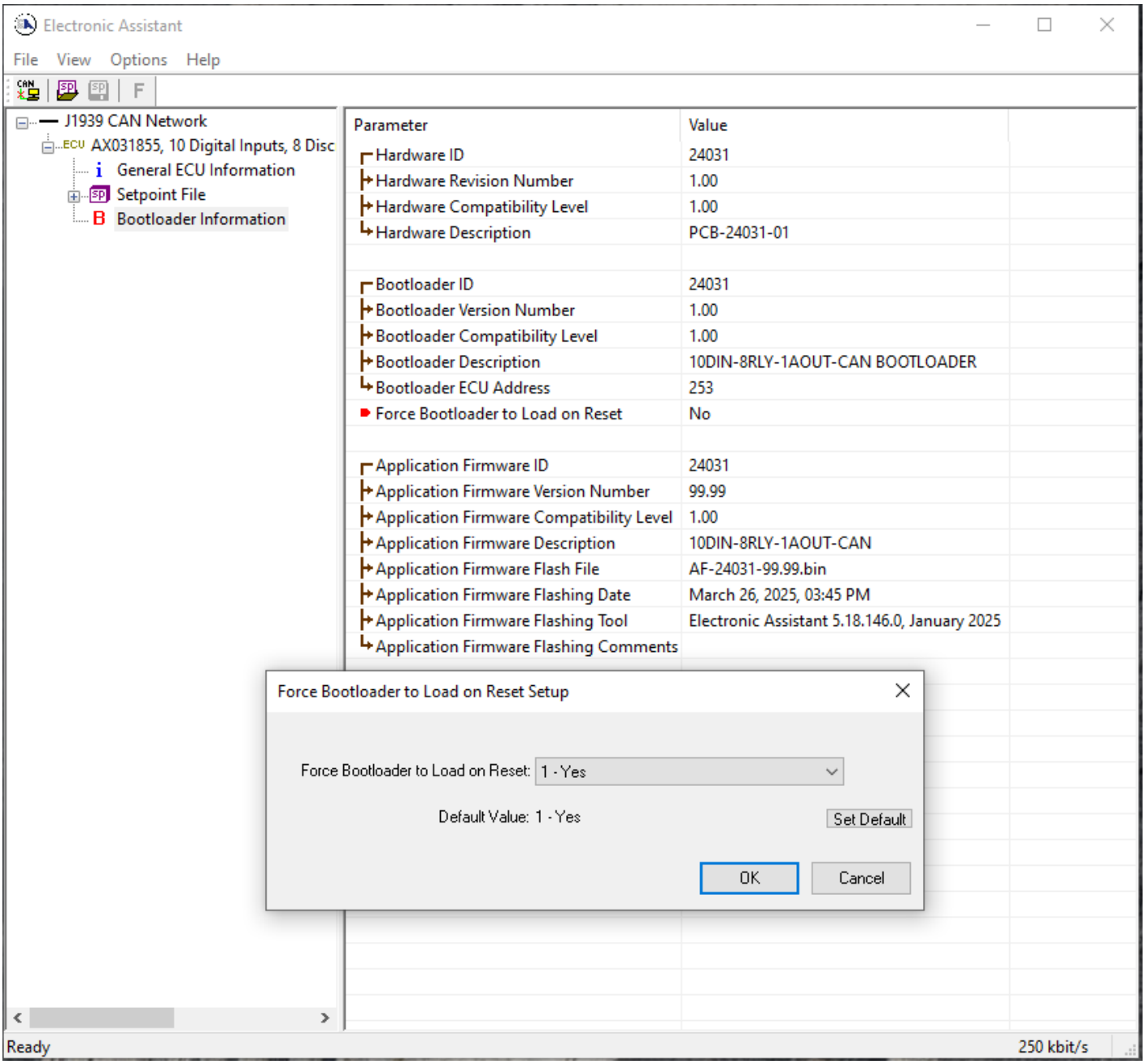
- A personal computer with a USB port running Windows operating system.
- A flash file for P24031 DIDAO. It should have the following name: AF-24031-x.xx-sss.bin, where x.xx – firmware version number, and sss are file comments information purposes.
- Axiomatic Electronic Assistant (EA) software.
- Axiomatic CAN Assistant – Scope software, P/N: AX070501SCO.
- Axiomatic USB-CAN Converter, P/N: AX070501. It should be connected to the USB port of the personal computer.
- Power supply to power the controllers.
- Wire harness to connect the controllers to the power supply and to the CAN port of the Axiomatic USB-CAN converter with proper termination resistance.

4.2. Re-flashing Procedure

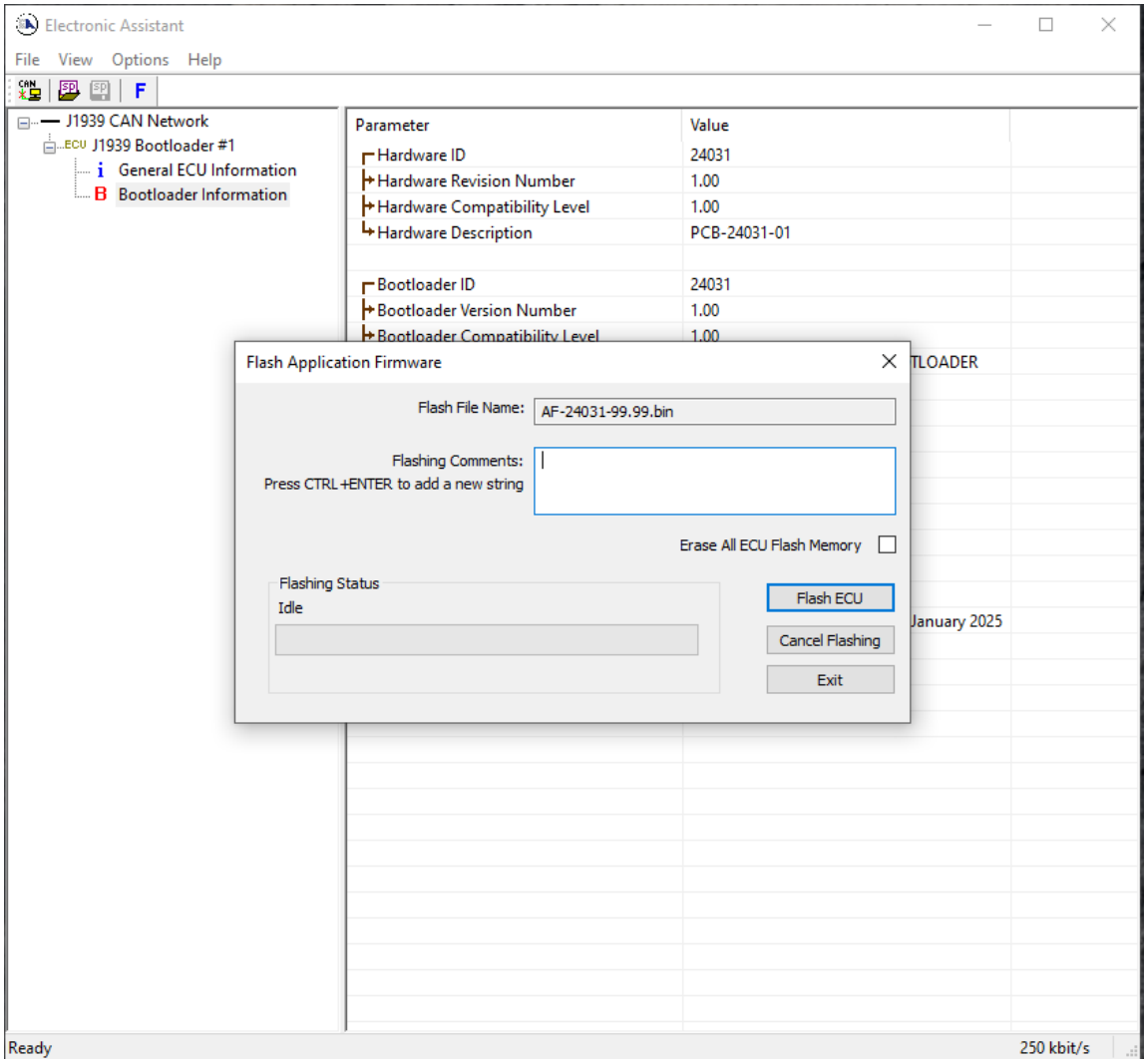
1. Connect DIDAO to the power supply and Axiomatic USB-CAN converter.
2. Open CAN port and start monitoring the CAN bus in CAN Assistant – Scope. Make sure that the baud rate is set to 250 kBit/s.
3. Power-up the controller.
4. Run the Axiomatic Electronic Assistant (EA) software and connect to the CAN port. The user should see the following screen:



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

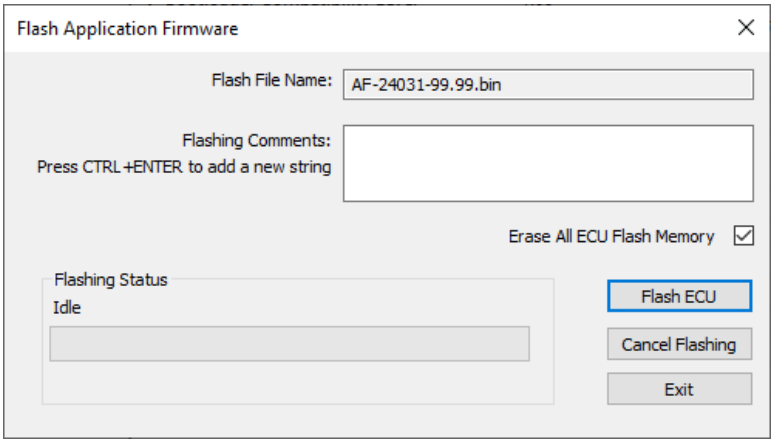


6. Click on the *Bootloader Information* group again and then on the ***F*** button in the Axiomatic EA toolbar. Select the flash file:

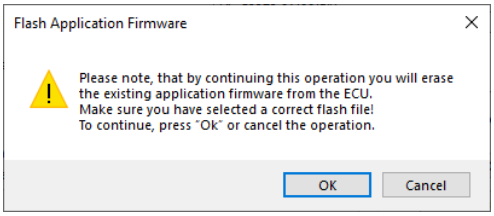


7. Open the flash file and start flashing operation by pressing the *Flash ECU* button. Make sure *Erase All ECU Flash Memory* is checked.

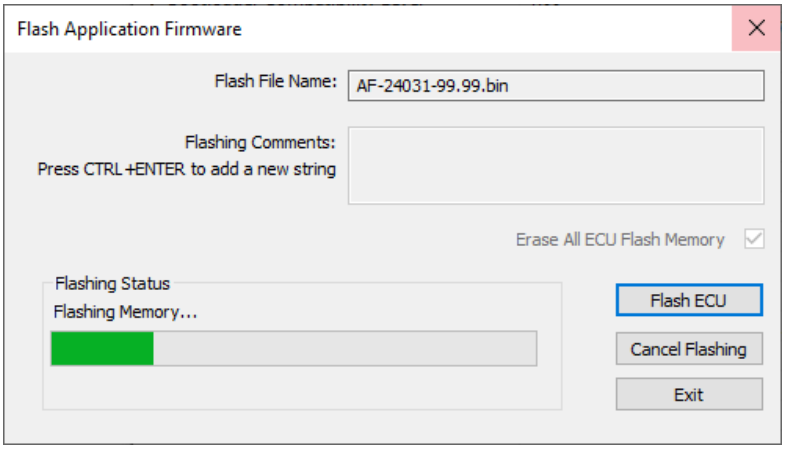
   Optionally, the user can write their comments in the *Flashing Comments* field.



8. Confirm the warning message from the Axiomatic EA.

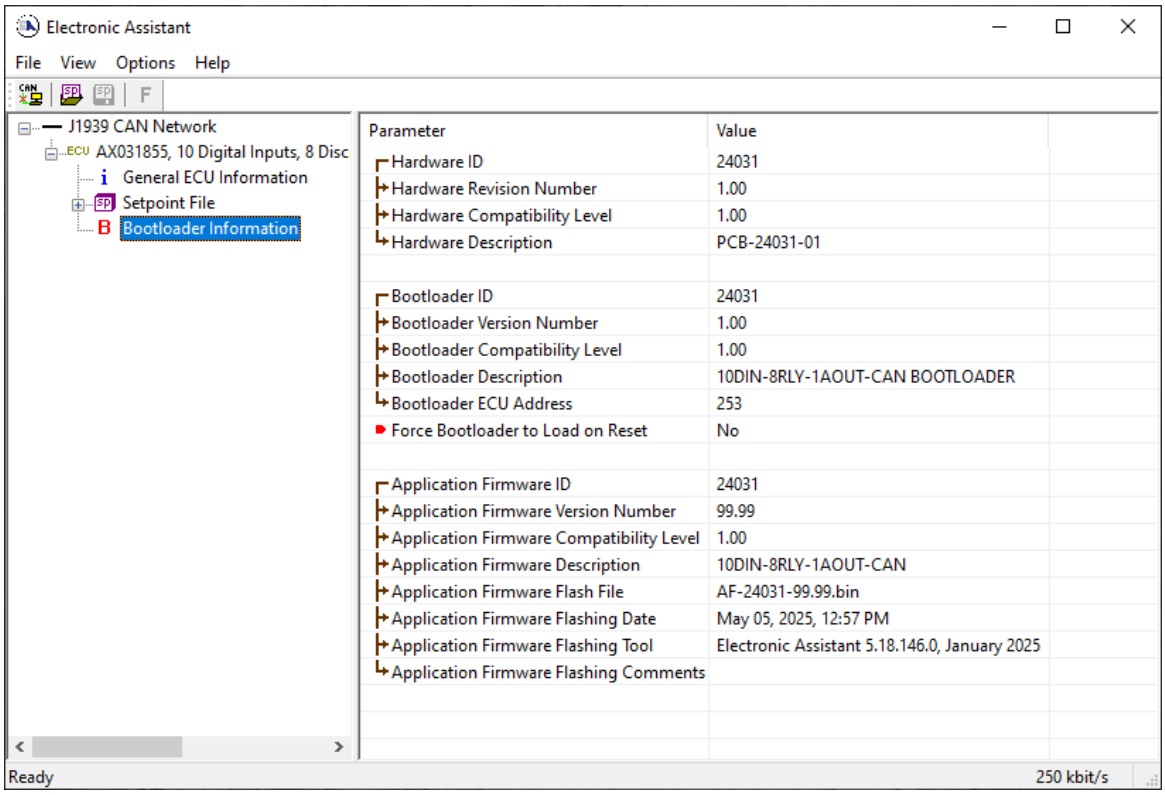


After confirming flashing, the user will see the flashing operation in dynamics on the Axiomatic EA screen.



9. When flashing is done, reset the ECU.

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



5. INSTALLATION INSTRUCTIONS

5.1. Dimensions and Pinout for AX031855

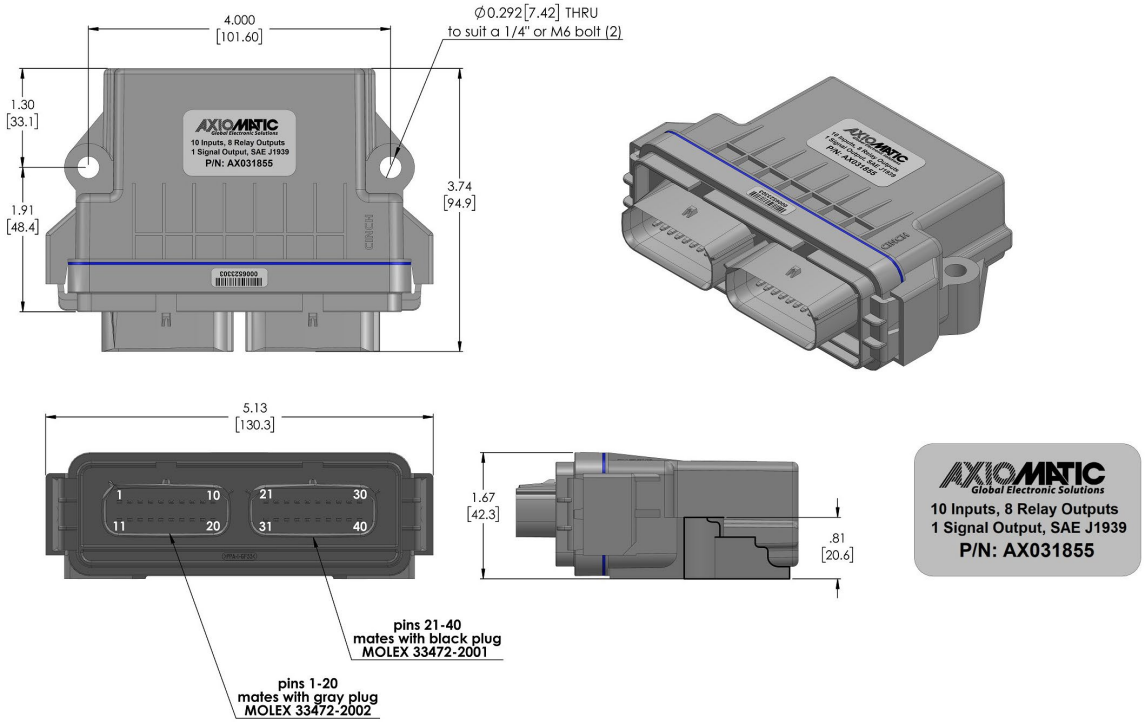


Table 29: Connector Pinout

40-pin two-part CINCH ME-MX receptacle P/N: 5810140011

Pin Out			
Pin 1 to 20 Mate with Molex 33472-2002 (Key B) Grey Plug		**Pin 21 to 40** Mate with Molex 33472-2001 (Key A) Black Plug	
Pin	**Function**	**Pin**	**Function**
1	Battery +	21	NO 1
2	Ground	22	NC 3
3	Digital Input 1	23	C3
4	Digital Input 3	24	NO 3
5	Digital Input 5	25	NC 5
6	Digital Input 7	26	C 5
7	Digital Input 9	27	NO 5
8	Analog Output	28	NC 7
9	NC 1	29	C 7
10	C 1	30	NO 7
11	CAN H	31	NO 2
12	CAN L	32	NC 4
13	Digital Input 2	33	C4
14	Digital Input 4	34	NO 4
15	Digital Input 6	35	NC 6
16	Digital Input 8	36	C 6
17	Digital Input 10	37	NO 6
18	Analog Output Return	38	NC 8
19	NC 2	39	C 8
20	C 2	40	NO 8

5.2. Installation Instructions

5.2.1. Mountings

Mounting holes are sized for ¼” or M6 bolts. The bolt length will be determined by the end-user’s mounting plate thickness. The mounting flange of the controller is 0.81 in. (20.6 mm) thick. It should be mounted with connectors facing left or right to reduce the likelihood of moisture entry. All field wiring should be suitable for the operating temperature range. Install the unit with appropriate space available for servicing and for adequate wire harness access (6 in. or 15 cm) and strain relief (12 in. or 30 cm).

5.2.2. Connections

Mates with Molex 33472-2002 (grey) and 33472-2001 (black)

A mating plug KIT (P/N: **AX070147**) is available from Axiomatic. It comprises 1x Molex 33472-2001 (Key A), 1x Molex 33472-2002 (Key B), 40x Molex 33012-2002 crimp terminals, and 6x Molex 34345-0001 cavity plugs.

6. Technical Specifications

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

Power Supply

Input Power Supply	12, 24, or 48 Vdc nominal 8 to 63 Vdc power supply range
Quiescent Current	56 mA @ 12 Vdc; 30.5 mA @ 24 Vdc; 17.9 mA @ 48 Vdc
Protection	Surge and transient protection are provided. Reverse polarity protection is provided. Undervoltage protection is provided. Hardware shuts down at 6 V. Overvoltage protection is provided. Hardware shuts down at 65 V.

Inputs

Digital Inputs	10 digital signal inputs user selectable as Active High with 10 kΩ pull-up, or Active Low with 10 kΩ pull-down resistor Impedance: 1 kΩ min. Amplitude: Low: 1.5 V max. High: 3.5 V min. Protected against shorts to Ground

Outputs

Signal Output	1 analog signal output selectable as follows. Voltage: Ranges: 0-5 V, 0-10 V, ±5 V, or ±10 V; Accuracy: ±0.2 % Current: Ranges: 0-20 mA, 0-24 mA, or 4-20 mA; Accuracy: ±0.2 % Protection against shorts at 25 mA max.
Relay Outputs	8 Form C relay outputs 3 contacts per output: NC, NO, and COM Max. 2 A @ 250 Vac or 2 A @ 30 Vdc per contact

General Specifications

Microcontroller	STM32F405RG
Control Logic	Standard embedded control logic is provided.
Isolation	Isolation is provided for the CAN line
CAN	1 isolated CAN port (SAE J1939) Supported baud rates: 250 kbit/s, 500 kbit/s, and 1 Mbit/s with auto-baud-rate detection
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.
User Interface	Axiomatic Electronic Assistant KIT - P/Ns: **AX070502** or **AX070506K**
Compliance	RoHS
Operating Temperature	-40 to 85 ºC (-40 to 185 ºF)
Storage Temperature	-50 to 120 ºC (-58 to 248 ºF)
Enclosure	CINCH mini-ME enclosure P/N: 5810130090 Polymer, Glass filled enclosure Flammability Rating: HB 5.13 in. x 3.74 in. x 1.67 in. (130.3 mm x 94.9 mm x 42.3 mm) L x W x H excludes mating connectors Refer to Dimensional Drawing
Protection	IP69K
Weight	0.438 lb. (0.199 kg)
Mounting	Mounting holes are sized for ¼" or M6 bolts. The bolt length will be determined by the end-user's mounting plate thickness. The mounting flange of the controller is 0.81 in. (20.6 mm) thick. It should be mounted with connectors facing left or right to reduce the likelihood of moisture entry. All field wiring should be suitable for the operating temperature range. Install the unit with appropriate space available for servicing and for adequate wire harness access (6 in. or 15 cm) and strain relief (12 in. or 30 cm).
Electrical Connections	40-pin two-part CINCH ME-MX receptacle P/N: 5810140011
Mating Plug Kit	Mates with Molex 33472-2002 (grey) and 33472-2001 (black) A mating plug KIT (P/N: **AX070147**) is available from Axiomatic. It comprises 1x Molex 33472-2001 (Key A), 1x Molex 33472-2002 (Key B), 40x Molex 33012-2002 crimp terminals, and 6x Molex 34345-0001 cavity plugs. To crimp wires onto the receptacle terminals, please use the recommended crimping tools from Molex.

VERSION HISTORY

Version	Date	Author	Modifications
1.0.0	May 5, 2025	Peter Sotirakos	Initial Draft
1.0.1	May 6, 2025	M Ejaz	Marketing review Changed the title of the UM

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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