TECHNICAL DATASHEET #TDAX021300

Valve Controller – 6 On/Off

P/N: AX021300

2 Analog and 3 Frequency Command Inputs
6 On/Off Outputs (Option: PWM)
CAN (SAE J1939)

with Axiomatic Electronic Assistant

Features:

- 2 user selectable analog inputs (0-5V, 0-20 mA, 4-20 mA, PWM, Frequency/RPM, Digital Active High, 16-bit Counter)
- 3 user selectable frequency inputs (Digital Active High, Digital Active Low, PWM, Frequency/RPM, 16-bit Counter)
- 6 outputs for hydraulic On/Off valves
- User selectable option for outputs: Pulsed, Timed, PWM
- 12V or 24VDC power (nominal)
- Standard control logic
- 1 CAN (SAE J1939), 1 RS-232
- CANopen® module available on request (P/N: AX021301)
- Hardware is available as a platform for application-specific software or setpoints
- The **Axiomatic Electronic Assistant** runs on a *Windows* operating system for user configuration. An Axiomatic USB-CAN converter links the PC to the CAN bus.
- Rugged IP67 packaging and connectors

Description: The controller drives up to 6 on/off valves at 5 Amps over a SAE J1939 network. Alternatively, the user can select pulsed, timed or PWM output types. It accepts up to 2 analog inputs (0-5V, 0-20 mA or 4-20 mA) and 3 digital inputs for connection to a variety of analog machine sensors or levers. The user can also select PWM, Frequency/RPM or 16-bit Counter inputs. Each input can be configured to measure the input value and send the data to a SAE J1939 network. In addition, any output on the controller could be configured to use any of the inputs as a control signal or an enable instead of taking the command information from the CAN bus. Standard embedded software is provided. Settings are user configurable via a *Windows*-based Axiomatic Electronic Assistant configuration tool interfacing to the controller via an USB-CAN device. A valuable diagnostic feature involves reading and retaining in the unit's memory the actual current draw from the solenoid(s). Rugged IP67 rated packaging in addition to a 9-36V power supply input section suits mobile equipment control applications.

Applications:

- Off-highway equipment
- Hydraulic systems

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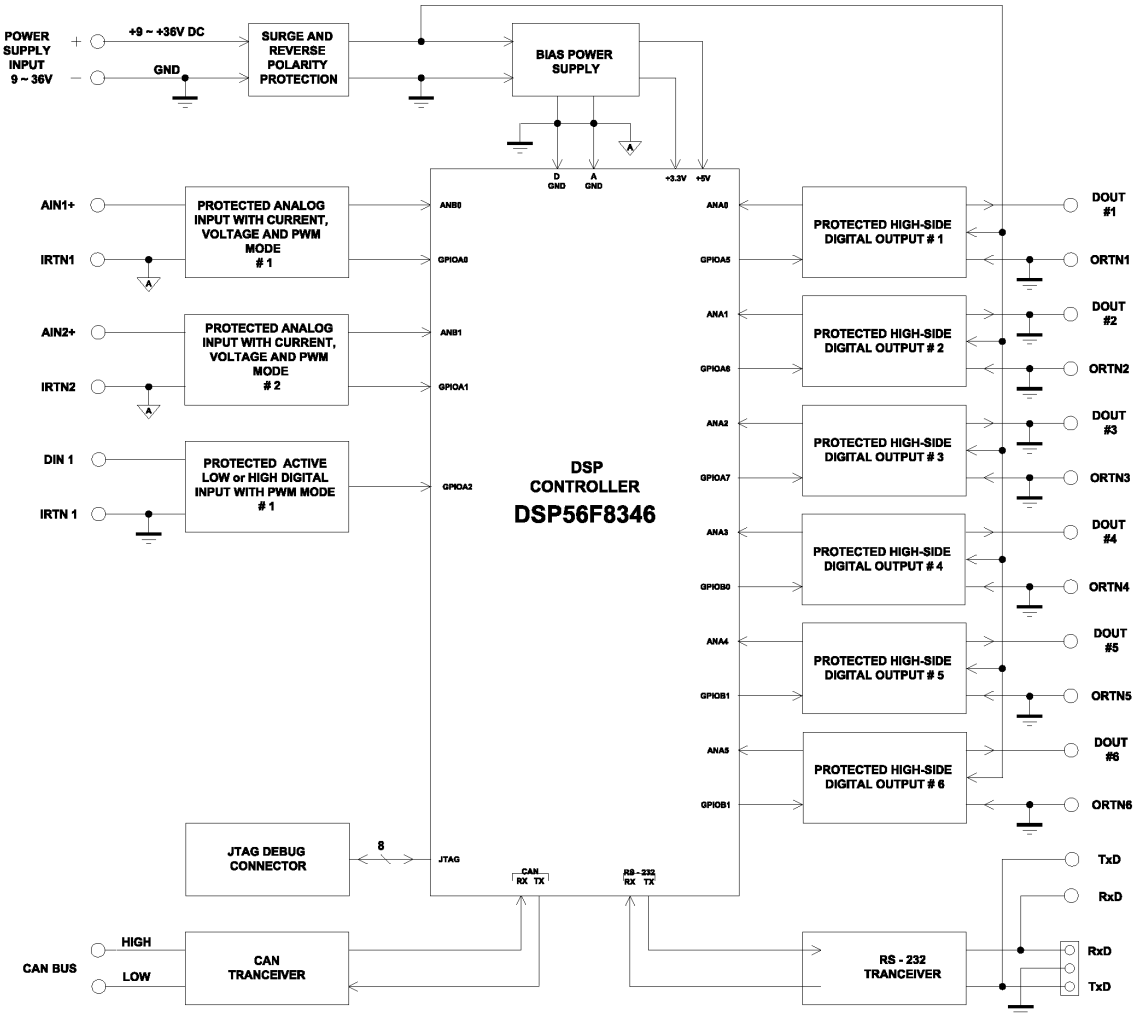
Ordering Part Numbers:

SAE J1939 Controller: **AX021300**
Accessories: **PL-DTM06-12SA-12SB** Mating Plug Kit (The KIT is comprised of: DTM06-12S, DTM06-12SB, 2 W12S, and 24 contacts)
Axiomatic Electronic Assistant Configuration KIT, P/N: **AX070506K**

BLOCK DIAGRAM



Technical Specifications:
Inputs

Power Supply Input - Nominal	12 or 24VDC nominal (9…36 VDC power supply range) Surge protection is provided. NB. The max. total current draw on the power supply input pins is 7 A @ 24VDC, at one time.
Reverse Polarity Protection	Provided
Analog Inputs	2 inputs (Refer to Table 1.0 and Table 2.0.) Inputs are user selectable with the *Windows*-based Axiomatic Electronic Assistant. • Analog (0-5V, 0-20mA or 4-20mA) • PWM (up to 5kHz, 0-100% D.C.) • Frequency/RPM (1-65kHz) • 16-bit Counter • Digital (Active High)
Analog GND	Analog GND connections are provided.
Digital Inputs	3 inputs (Refer to Table 1.0 and Table 2.0.) Inputs are user selectable with the *Windows*-based Axiomatic Electronic Assistant. • Digital (Active High or Active Low) • PWM (up to 5kHz, 0-100% D.C.) • Frequency/RPM (1-65kHz) • 16-bit Counter
Digital GND	A digital GND is provided.

Table 1.0 Selection of Inputs to AX021300

Input Type	Description
# of Inputs	There are a total of 5 input channels available, which are user selectable from a variety of input types. There are 5 setpoints per channel associated with the input and how the data is measured. *Refer to the user manual for details.*
Disable Inputs	Each input can be configured as a disable input command. When disable is selected, no CAN messages associated with that channel are sent to the network.
Analog Inputs	Up to 2 analog inputs are available. 0…5VDC The offset is in volts and the resolution setpoint is V/bit, when sending a CAN message. Error detection setpoints are interpreted in volts. 4…20mA or 0…20mA The offset is in milliamps and the resolution setpoint is mA/bit, when sending a message. Error detection setpoints are interpreted in milliamps.
Digital Inputs	Up to 5 active high, digital inputs is user selectable. Up to 2 active low, digital inputs is user selectable. Active High - The input is configured to read the state of the input (switch is connected to a +V signal when ON). Active Low – The input is configured to read the state of the input (switch is connected to a GND signal when ON). The controller interprets the offset as a state (OFF=0 or ON=1) and the resolution setpoint as state/bit, when sending the message. Error detection setpoints are not used, since error detection is not possible in this mode.
PWM Signal Inputs	Up to 5 PWM inputs are available to interface to a PWM signal from an ECM, PLC or other. PWM Signal Frequency: up to 6kHz Amplitude: 5-12V PWM Duty Cycle: 0 to 100% The offset is interpreted as percent duty cycle (%dc) and the resolution setpoint as %dc/bit, when sending the CAN message. Error detection setpoints will be interpreted in %dc.
Pulse Inputs	Up to 5 pulse inputs are available. This input counts the number of pulses over the period of the measuring window setpoint and calculates the frequency of the pulses. Hz = With a pulse per revolution of 0, the controller calculates the offset in Hz and the resolution setpoint as Hz/bit, when sending the CAN message. Error detection setpoints are in Hertz. RPM = With a non-zero pulse per revolution, the frequency is interpreted as a RPM input. The offset is in revolutions per minute (RPM) and the resolution setpoint is RPM/bit. Error detection setpoints are interpreted in RPM.
16-bit Counter Inputs	Up to 5 16-bit counter inputs are available. A counter input cannot be used to control an output. The input is configured to count pulses on the input until the value in the measuring window setpoint is reached. While the counter is active, a timer with a 1ms resolution is running in the background. When the count has been reached, the value in the 1ms timer is captured and updated to the input feedback variable. The timer is reset until the count value once again reaches the measuring window. Input and error detection setpoints are not used, since error detection is not possible in this mode.

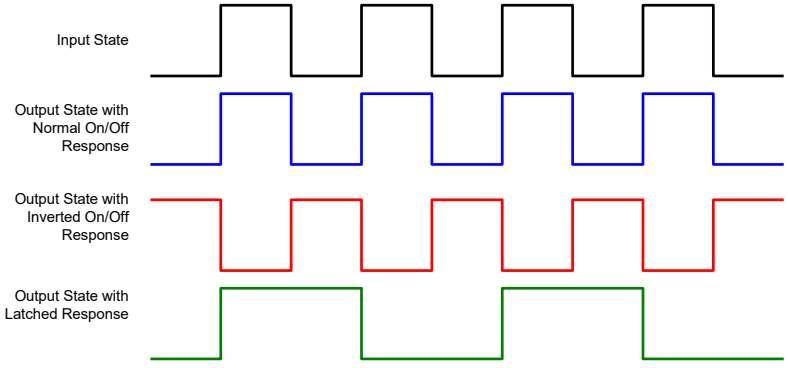
Table 2.0 - Absolute Maximums for Inputs

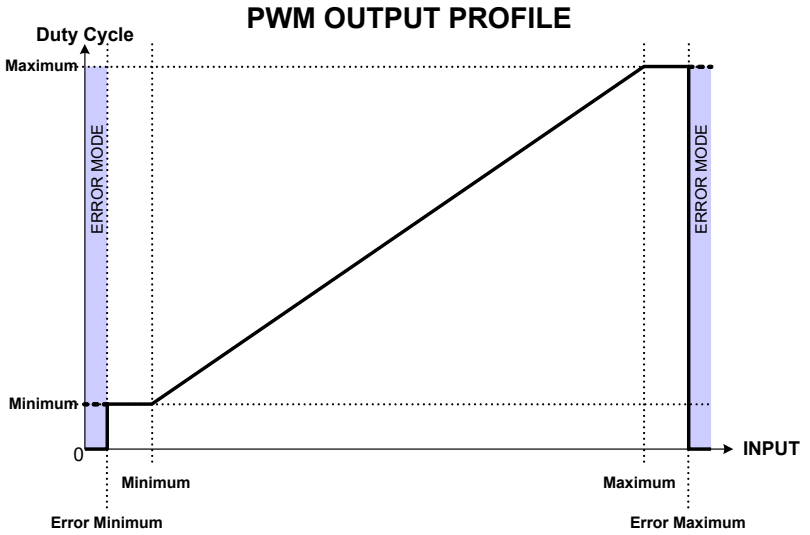
	Min	Max	Units	Comments
Power Supply	9	36	V dc	➢ Reverse Polarity and Surge protection is provided. ➢ Software, under and over voltage security features.
Analog Input Voltage	0.05	36	Vdc	
Analog Input Current	0	21	mA	
PWM Input Frequency	50	6000	Hz	➢ 200 =< Freq <= 1000 Hz recommended for better accuracy
PWM duty cycle Input	0	100	%	
Freq/RPM Input Frequency	10	65000	Hz	
Digital Input Voltage	4	36	Vdc	

Table 3.0 - Input Accuracy

Input Type	Accuracy
0 – 5 VDC	+/- 1 % of actual input voltage
0 (4) – 20 mA	100 %
PWM	+/- 0.1 % duty cycle
Frequency / RPM	+/- 0.15 % of actual input frequency

Outputs

Output Type	6 outputs are user selectable from the following. • Digital • Timed • Pulsed • PWM The output response is user selectable from the following. • Disabled • Normal On/Off • Inverted On/Off • Latched There are thirteen setpoints per channel that are associated with the output and how it is controlled and responds to the control signals.
Digital Output	High Side (sourcing) Drives up to 6 On/Off Valves (up to 5A each) The output toggles between OFF and ON states based on the states of the enable input/J1939 status byte, the control input/J1939 command message, and the value in the “Response” setpoint.  NB. The maximum total current draw permitted on the power supply input pins is 6 Amps @ 24VDC, at one time.
Pulsed Output	The output toggles between OFF and ON states based on the states of the enable input/J1939 status byte, the control input/J1939 command message, and the value in the “Response” setpoint. However, when the output is ON, the output will be turned on/off at the frequency set in the “Output Frequency” setpoint, with the duty cycle set in the “Pulse Duty Cycle” setpoint.

Timed Output	The output toggles between OFF and ON states based on the states of the enable input/J1939 status byte, the control input/J1939 command message, and the value in the “Response” setpoint. When a timed output comes ON, the output is turned on after the value in the “Timer Startup Delay” has elapsed. The output will stay on for the time set in “Timer ON Time”, then shut off. If the “Timer Repeat” setpoint is TRUE, then the output will be off for the “Timer OFF Time” before coming back on. The on/off cycle will continue while the output logic state is still ON.
PWM Output	The output is switched at the frequency the “Output Frequency” setpoint. The duty cycle is dependent on the values in the “Minimum and Maximum D.C.” as well as the “Minimum and Maximum Input” setpoints. The duty cycle varies linearly with respect to the control input/J1939 command message, as per the graph below. 
Overcurrent and Short Circuit Protection	Provided
Output Voltage Regulation	93 % of Supply voltage when all 6 outputs are ON (See Figure 1.0.)

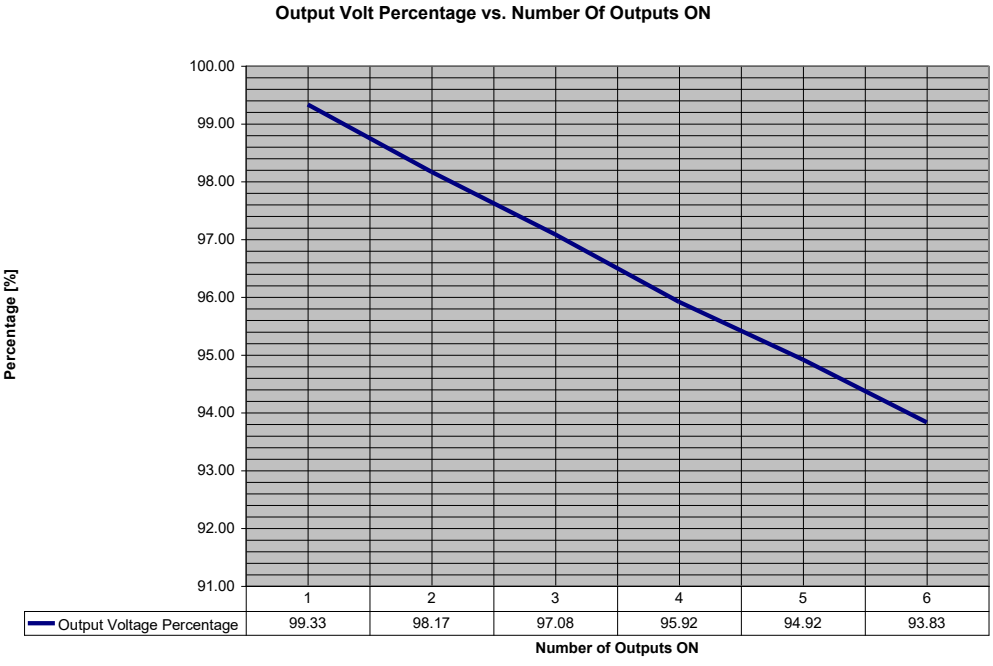


Figure 1.0 - % Output Voltage vs. No. of Outputs ON

General Specifications

<table>
<tr><td>Microprocessor</td><td>DSP56F8346</td></tr>
<tr><td>Control Logic</td><td>Standard control logic (Refer to User Manual UMAX021300.)
For application-specific control logic, contact Axiomatic.</td></tr>
<tr><td>Communications</td><td>1 CAN port (SAE J1939) (CANopen® is available on request)
1 RS-232</td></tr>
<tr><td>CAN Interface</td><td>1 CAN port (SAE J1939)
The software was designed to provide flexibility and provides the following.
• Configurable ECU Instance in the NAME (for multiple ECU's on the network)
• Configurable Input Parameters
• Configurable Output Parameters
• Configurable PGN and Data Parameters
• Configurable Diagnostic Messaging Parameters, as required
• Diagnostic Log, maintained in non-volatile memory
Note: Configurable parameters are also called setpoints.
Any input or output on the controller by default uses a Proprietary B message to send data to the network bus. There are nine setpoints per channel that are associated with the J1939 message that is sent to the network bus. There are eleven setpoints per channel that are associated with the J1939 command message that is received by the ECU from the network bus. There are five setpoints per channel that are associated with the J1939 feedback message that can be sent by the ECU to the bus. There are six setpoints per input channel, four per output channel, and seven per fault, that are associated with if and how diagnostic messages will be sent to the network bus. To use J1939 capabilities, refer to the user manual.
The controller AX021300, is compliant with Bosch CAN protocol specification, Rev.2.0, Part B, and the following J1939 standards.
Table 4: J1939 Compliance
<table>
<tr><th>OSI Network Model Layer</th><th>J1939 Standard</th></tr>
<tr><td>Physical</td><td>J1939/11 – Physical Layer, 250K bit/s, Twisted Shielded Pair.
J1939/15 - Reduced Physical Layer, 250K bits/sec, Un-Shielded Twisted Pair (UTP).</td></tr>
<tr><td rowspan="2">Data Link</td><td>J1939/21 – Data Link Layer</td></tr>
<tr><td>The controller supports Transport Protocol for Diagnostic DM1 and DM2 messages (PGN 65226 and 65227). It supports responses on PGN Requests (PGN 59904) and acknowledgements (PGN 59392). It also supports Proprietary B messaging (PGN 65280 to 65535), and uses a proprietary scheme described in the User Manual.</td></tr>
<tr><td rowspan="2">Network Layer</td><td>J1939/81 – Network Management
J1939, Appendix B – Address and Identity Assignments</td></tr>
<tr><td>Arbitrary Address Capable ECU - It can dynamically change its network address in real time.
The controller supports: Address Claimed Messages (PGN 60928), Requests for Address Claimed Messages (PGN 59904) and Commanded Address Messages (PGN 65240).</td></tr>
<tr><td rowspan="3">Application Layer</td><td>J1939/71 – Vehicle Application Layer</td></tr>
<tr><td>None of the application layer PGN's are supported as part of the default configurations. However, the controller could be configured such that any of the input messages to be sent will use a PGN from this section, or for the outputs to respond to the data in a message with a PGN from this section.
The data size, index, resolution and offset can all be configured for the appropriate SPN associated with the PGN.
It is the user's responsibility to configure the controller such that it will not violate the J1939 standard.</td></tr>
<tr><td>J1939/73 – Application Layer – Diagnostics</td></tr>
</table>
</td></tr>
</table>

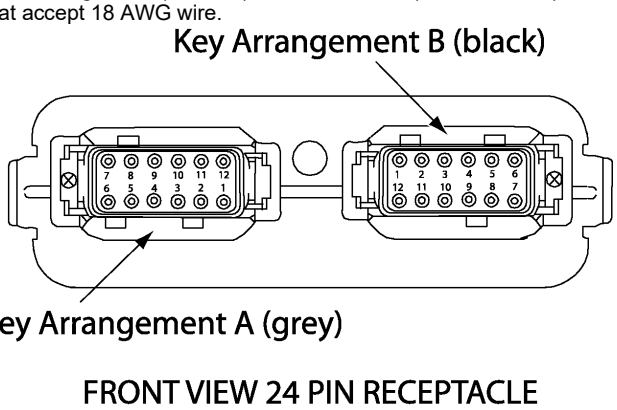
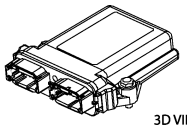
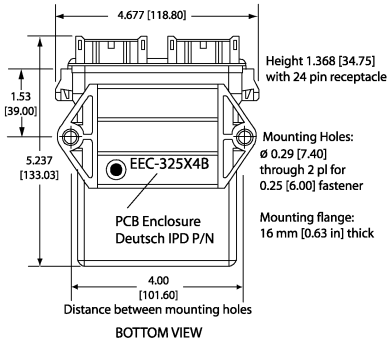
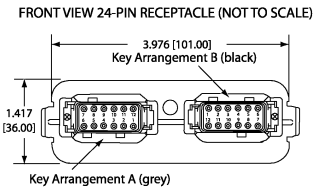
	The controller can be configured to send “Active Diagnostic Trouble Code” DM1 messages (PGN 65226) for any I/O channel. Warning and Protect diagnostics will automatically become previously active when cleared. “Previously Active Diagnostic Trouble Codes” DM2 messages (PGN 65227) are available on request. Shutdown diagnostics will be cleared upon receiving a “Diagnostic Data Clear/Reset for Active DTC’s” DM11 message (PGN 65235). Occurrence counts in the diagnostic log will be cleared upon receiving a “Diagnostic Data Clear/Reset for Previously Active DTC’s” DM3 message (PGN 65228).
User Interface	User configuration and diagnostics are provided with the Axiomatic Electronic Assistant. The Axiomatic Service Tool is a *Windows*-based graphical user interface that allows easy configuration of the controller setpoints. Refer to Table 5.0 for details.
Network Termination	It is necessary to terminate the network with external termination resistors. The resistors are 120 Ohm, 0.25W minimum, metal film or similar type. They are placed between CAN_H and CAN_L terminals at both ends of the network.
Diagnostics	Current draw from the solenoid(s) is read by the microprocessor and stored in memory.
Electrical Connections	Refer to Table 6.0. 24-pin receptacle (TE Deutsch P/N: DTM13-12PA-12PB-R008) Mating plug – TE Deutsch P/Ns: DTM06-12SA and DTM06-12SB, with 2 wedgelocks (WM12S) and 24 contacts (1062-20-0122) that accept 18 AWG wire.  FRONT VIEW 24 PIN RECEPTACLE
Packaging and Dimensions	High Temperature Nylon PCB Enclosure - (TE Deutsch P/N: EEC-325X4B) 4.62 x 5.24 x 1.43 inches 117.42 x 133.09 x 36.36 mm (W x L x H excluding mating plugs)  HOUSING DIMENSIONS Housing Material: High Temperature Nylon (Black) 3D VIEW Housing with 24 Pin Receptacle   Mating Plug Assemblies for 24-pin receptacle: Deutsch IPD P/N: DTM06-12SA and DTM06-12SB with wedgelocks WM12S and contacts (Contact factory for contact specification.) Dimensions: inches [mm] excluding mating plug(s)
Weight	0.55 lbs. (0.25 kg)
Operating Conditions	-40 to 85°C (-40 to 185°F)
Protection	IP67, Unit is conformally coated in the housing.

Table 5.0 - AX070500 Axiomatic Electronic Assistant

Axiomatic Electronic Assistant

The Axiomatic Electronic Assistant (EA) runs on any modern PC with the Microsoft Windows® 2000 operating system or higher. It comes with a royalty-free license for use.

System Requirements:
Operating System: *Windows* 2000 or higher including 64-bit editions

Port: USB 1.1 or 2.0 full speed

Display: VGA (XGA or better with 1024 x 768 recommended)

Setup and Configuration:
Refer to the User Manual UMAX07050X.

To order the Axiomatic EA KIT at the time of initial purchase, order AX070506K.

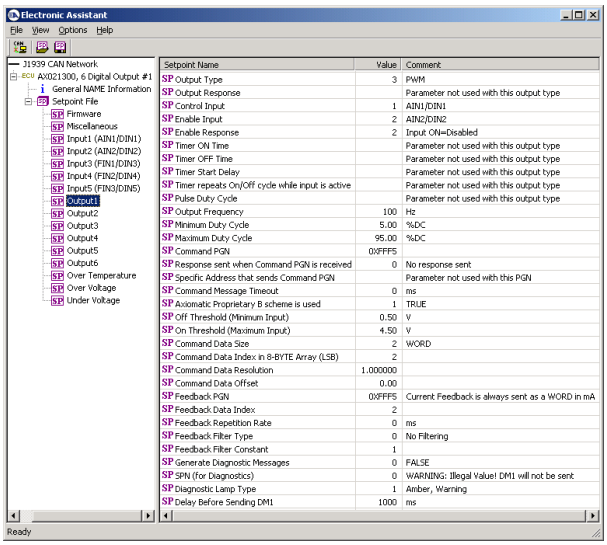


Figure 2.0 Configuration screen from the Axiomatic Electronic Assistant

The Axiomatic Electronic Assistant (EA) is a software configuration tool that runs on a PC connected to a J1939 bus via a USB to CAN converter, AX070506. Upon being connected to the bus, the Axiomatic EA will find all the Electronic Control Units (ECU) on the bus, and recognized those manufactured by Axiomatic. Using this tool, a user can quickly configure an Axiomatic ECU for the desired performance over a wide variety of applications.

Table 6.0 - Typical Connections, AX021300

Grey Connector		Black Connector	
Pin #	**Function**	**Pin #**	**Function**
1	Ground 6	1	BATT +
2	Ground 5	2	CAN HI
3	Ground 4	3	Serial Communication TXD (Not Used)
4	Ground 3	4	Serial Communication RXD (Not Used)
5	Ground 2	5	Input 1 (Analog)
6	Ground 1	6	Input 2 (Analog)
7	Digital Output 1	7	Ground
8	Digital Output 2	8	Input 5 (Digital)
9	Digital Output 3	9	Input 4 (Digital)
10	Digital Output 4	10	Input 3 (Digital)
11	Digital Output 5	11	CAN LO
12	Digital Output 6	12	BATT -

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/.

Note: CANopen® is a registered community trade mark of CAN in Automation e.V.

Form: TDAX021300-08/26/2026