

Single Input, Dual Output Valve Controller

1 Universal Input, +5V reference
CAN (SAE J1939)

with Axiomatic Electronic Assistant

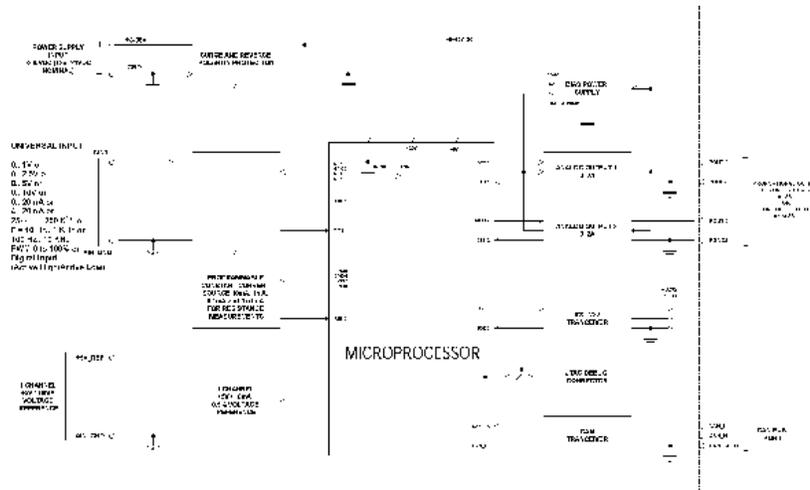
P/N: AX022000

Features:

- 1 universal signal input
- 2 proportional or on/off outputs up to 3 A
- User programmable functionality
- 8...36VDC (12Vdc or 24Vdc nominal)
- +5V reference to power a sensor
- 1 CAN (SAE J1939) port
- Aluminum enclosure with integral 12-pin connector
- IP67
- CE marking
- **Axiomatic Electronic Assistant** for user configuration



BLOCK DIAGRAM



Ordering Part Numbers:

SAE J1939 Controller:

For baud rate, refer to the table below for the appropriate P/N.

| Model P/N | Baud Rate | Standard Reference |
|-------------|------------|------------------------|
| AX022000 | 250 kBit/s | J1939/11, J1939/15. |
| AX022000-02 | 500 kBit/s | J1939/14. New standard |
| AX022000-03 | 1Mbit/s | Non-standard |

Accessories:

AX070105 Mating Plug Kit :1 DT06-12SA, 1 W12S, 12 0462-201-16141, 3 114017

Axiomatic Electronic Assistant Configuration KIT, P/Ns: **AX070502**, **AX070505K**, or **AX070506K**

Technical Specifications:

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

Inputs

| Power Supply Input | 12Vdc or 24Vdc nominal (8...36 VDC power supply range) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|-------|------------------------|---|----------------|---|---------------|--|-----------------|---------------|-------------------------|--|---------------------|------------------------|-----------|--|-----------------|-----------------------------------|---------------|-------------------------|-------------------------------|--|----------------|------|------------------------------------|--------|----|-----|----------------|---|-----|---|---------------|----|--------|----|---------------------|---|----|------|---------------|----|--------|----|
| Protection | Reverse polarity protection is provided. Overvoltage protection up to 38V is provided. Overvoltage (undervoltage) shutdown of the output load is provided. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CAN | SAE J1939 Command | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Universal Signal Input | Refer to Table 1.0. The input is user selectable. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1"> <thead> <tr> <th colspan="2">Table 1.0 – Input – User Selectable Options</th> </tr> </thead> <tbody> <tr> <td>Analog Input Functions</td> <td>Voltage Input, Current Input or Resistive Input</td> </tr> <tr> <td>Voltage Input</td> <td>0-1V (Impedance 1 MOhm) 0-2.5V (Impedance 1 MOhm) 0-5V (Impedance 200 KOhm) 0-10V (Impedance 133 KOhm for 0-5V, 133 to 20 KOhm for 5-10V))</td> </tr> <tr> <td>Current Input</td> <td>0-20 mA (Impedance 124 Ohm) 4-20 mA (Impedance 124 Ohm)</td> </tr> <tr> <td>Resistive Input</td> <td>25Ω to 250 kΩ</td> </tr> <tr> <td>Digital Input Functions</td> <td>Discrete Input, PWM Input, Frequency Input</td> </tr> <tr> <td>Digital Input Level</td> <td>5V CMOS Up to 10Vdc</td> </tr> <tr> <td>PWM Input</td> <td>0 to 100% 10 Hz to 1kHz 100 Hz to 10 kHz</td> </tr> <tr> <td>Frequency Input</td> <td>10 Hz to 1kHz 100 Hz to 10 kHz</td> </tr> <tr> <td>Digital Input</td> <td>Active High, Active Low</td> </tr> <tr> <td>Input Impedance</td> <td>1 MOhm high impedance, 10KOhm pull down, 10KOhm pull up to +5V</td> </tr> <tr> <td>Input Accuracy</td> <td>≤ 1%</td> </tr> <tr> <td>Input Resolution</td> <td>12-bit</td> </tr> </tbody> </table> | | Table 1.0 – Input – User Selectable Options | | Analog Input Functions | Voltage Input, Current Input or Resistive Input | Voltage Input | 0-1V (Impedance 1 MOhm) 0-2.5V (Impedance 1 MOhm) 0-5V (Impedance 200 KOhm) 0-10V (Impedance 133 KOhm for 0-5V, 133 to 20 KOhm for 5-10V)) | Current Input | 0-20 mA (Impedance 124 Ohm) 4-20 mA (Impedance 124 Ohm) | Resistive Input | 25Ω to 250 kΩ | Digital Input Functions | Discrete Input, PWM Input, Frequency Input | Digital Input Level | 5V CMOS Up to 10Vdc | PWM Input | 0 to 100% 10 Hz to 1kHz 100 Hz to 10 kHz | Frequency Input | 10 Hz to 1kHz 100 Hz to 10 kHz | Digital Input | Active High, Active Low | Input Impedance | 1 MOhm high impedance, 10KOhm pull down, 10KOhm pull up to +5V | Input Accuracy | ≤ 1% | Input Resolution | 12-bit | | | | | | | | | | | | | | | | | | |
| Table 1.0 – Input – User Selectable Options | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Analog Input Functions | Voltage Input, Current Input or Resistive Input | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Current Input | 0-20 mA (Impedance 124 Ohm) 4-20 mA (Impedance 124 Ohm) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Resistive Input | 25Ω to 250 kΩ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Digital Input Functions | Discrete Input, PWM Input, Frequency Input | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Digital Input Level | 5V CMOS Up to 10Vdc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PWM Input | 0 to 100% 10 Hz to 1kHz 100 Hz to 10 kHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Frequency Input | 10 Hz to 1kHz 100 Hz to 10 kHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Digital Input | Active High, Active Low | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Input Impedance | 1 MOhm high impedance, 10KOhm pull down, 10KOhm pull up to +5V | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Input Accuracy | ≤ 1% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Input Resolution | 12-bit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Minimum and Maximum Ratings | <table border="1"> <thead> <tr> <th colspan="4">Table 2.0. Absolute Maximum and Minimum Ratings</th> </tr> <tr> <th>Characteristic</th> <th>Min</th> <th>Max</th> <th>Units</th> </tr> </thead> <tbody> <tr> <td>Power Supply</td> <td>8</td> <td>36</td> <td>V dc</td> </tr> <tr> <td>Voltage Input</td> <td>0</td> <td>10</td> <td>V dc</td> </tr> <tr> <td>Current Input</td> <td>0</td> <td>21</td> <td>mA</td> </tr> <tr> <td>Current Input – Voltage Level</td> <td>0</td> <td>12</td> <td>Vdc</td> </tr> <tr> <td>Digital Type Input – Voltage Level</td> <td>0</td> <td>10</td> <td>Vdc</td> </tr> <tr> <td>PWM Duty Cycle</td> <td>0</td> <td>100</td> <td>%</td> </tr> <tr> <td>PWM Frequency</td> <td>50</td> <td>10 000</td> <td>Hz</td> </tr> <tr> <td>PWM Voltage pk - pk</td> <td>0</td> <td>10</td> <td>V dc</td> </tr> <tr> <td>RPM Frequency</td> <td>50</td> <td>10 000</td> <td>Hz</td> </tr> </tbody> </table> | Table 2.0. Absolute Maximum and Minimum Ratings | | | | Characteristic | Min | Max | Units | Power Supply | 8 | 36 | V dc | Voltage Input | 0 | 10 | V dc | Current Input | 0 | 21 | mA | Current Input – Voltage Level | 0 | 12 | Vdc | Digital Type Input – Voltage Level | 0 | 10 | Vdc | PWM Duty Cycle | 0 | 100 | % | PWM Frequency | 50 | 10 000 | Hz | PWM Voltage pk - pk | 0 | 10 | V dc | RPM Frequency | 50 | 10 000 | Hz |
| Table 2.0. Absolute Maximum and Minimum Ratings | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Characteristic | Min | Max | Units | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Power Supply | 8 | 36 | V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Voltage Input | 0 | 10 | V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Current Input | 0 | 21 | mA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Current Input – Voltage Level | 0 | 12 | Vdc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Digital Type Input – Voltage Level | 0 | 10 | Vdc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PWM Duty Cycle | 0 | 100 | % | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PWM Frequency | 50 | 10 000 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PWM Voltage pk - pk | 0 | 10 | V dc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RPM Frequency | 50 | 10 000 | Hz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

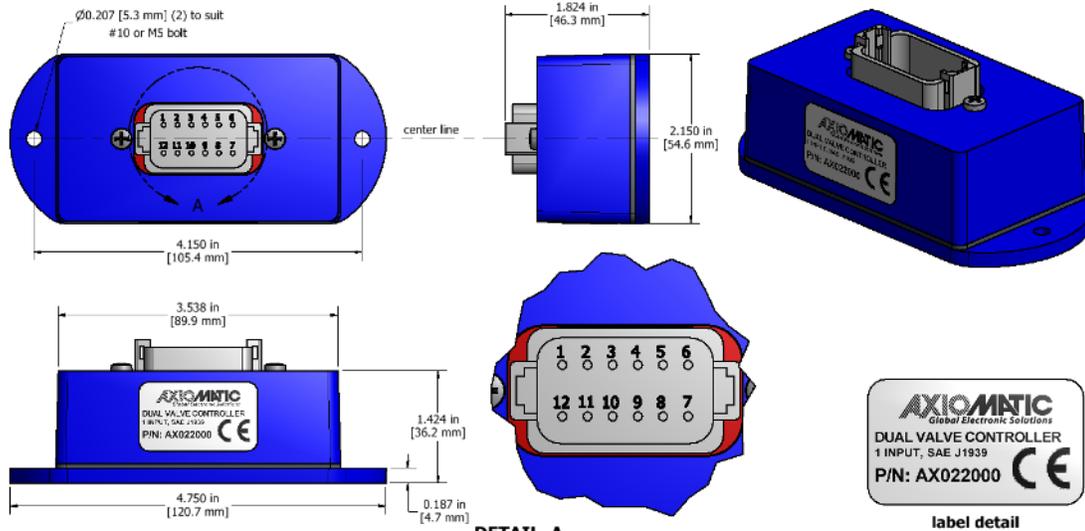
Outputs

| | |
|-----------------|--|
| CAN | SAE J1939 Messages |
| Output | 2 Proportional or On/Off Outputs (Up to 3A) High Side Switch, Current Sensing, Grounded Load The user can select the following options for output using the Axiomatic EA. <ul style="list-style-type: none"> Output Disable Discrete Output Output Current (PID loop*, with current sensing) Output Voltage Output PWM Duty Cycle *Parameters are password protected. |
| Output Accuracy | Output Current mode ≤ 2% Output Voltage mode ≤ 3% Output PWM Duty Cycle mode ≤ 3% |

| | |
|----------------------------------|---|
| Voltage Reference | +5V, 10 mA, 0.5% Short circuit protected (current limited to 22-24 mA) Protected from connection to the power supply rail. |
| Protection for Output + Terminal | Fully protected against short circuit to ground and short circuit to power supply rail. Unit will fail safe in the case of a short circuit condition, self-recovering when the short is removed. |

General Specifications

| | |
|----------------------|---|
| Microprocessor | STM32, 32-bit, 128 KByte flash program memory |
| Control Logic | User programmable functionality using the Axiomatic Electronic Assistant. Refer to UMAX07050X for details. (Application-specific control logic or factory programmed setpoints are available on request.) |
| Communications | 1 CAN port (SAE J1939), CANopen® is available as ordering P/N: AX022001 Refer to ordering part numbers for a list of models with different baud rates. |
| User Interface | Axiomatic Electronic Assistant for <i>Windows</i> operating systems, P/Ns: AX070502, AX070505K, or AX070506K It comes with a royalty-free license for use on multiple computers. The Axiomatic Electronic Assistant requires an USB-CAN converter to link the device's CAN port to a <i>Windows</i> -based PC. An Axiomatic USB-CAN Converter is available as part of the Axiomatic Configuration KIT. |
| 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 should be placed between CAN_H and CAN_L terminals at both ends of the network. |
| Operating Conditions | -40 to 85 °C (-40 to 185 °F) |
| Enclosure | Aluminum enclosure, integral connector (TE Deutsch equivalent) Encapsulated Refer to the dimensional drawing. |
| EMC Compliance | CE marking |
| Protection | IP67 rating for the product assembly |
| Weight | 0.70 lb. (0.32 kg) |



DETAIL A

DT15-12PA receptacle

Mating plug is Deutsch IPD P/N: DT06-12SA with 2 wedgelocks (W125) and 12 contacts (0462-201-20141). All field wiring should be suitable for the operating temperature range.

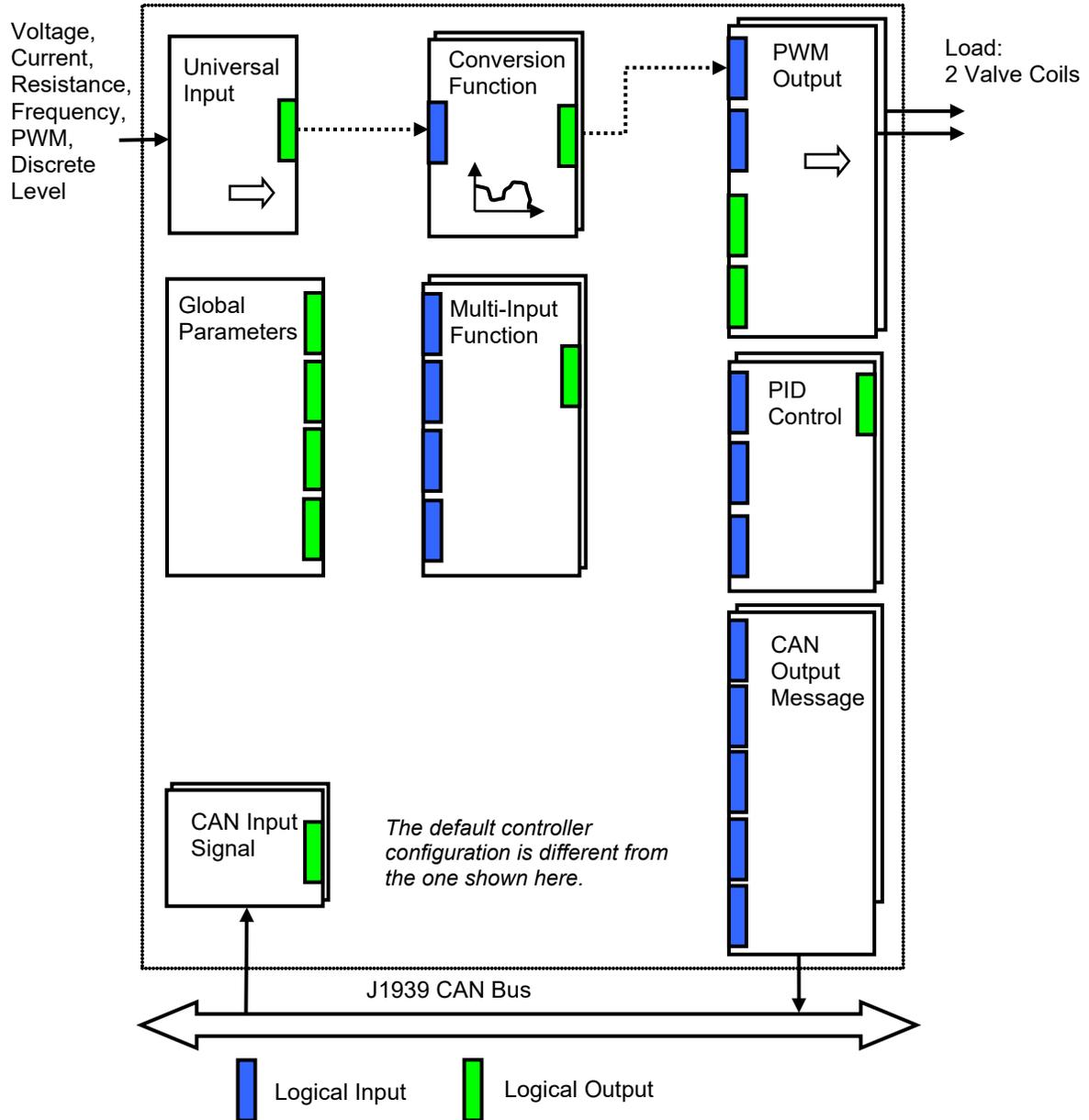
| Electrical Connections | <p>12-pin connector (equivalent TE Deutsch P/N: DT15-12PA). A mating plug kit is available as Axiomatic P/N: AX070105.</p> <table border="1" data-bbox="545 260 971 716"> <thead> <tr> <th colspan="2">CAN and I/O Connector</th> </tr> <tr> <th>Pin #</th> <th>Description</th> </tr> </thead> <tbody> <tr><td>1</td><td>Output 1</td></tr> <tr><td>2</td><td>Output 1 GND</td></tr> <tr><td>3</td><td>Power +</td></tr> <tr><td>4</td><td>CAN Shield</td></tr> <tr><td>5</td><td>CAN LO</td></tr> <tr><td>6</td><td>CAN Hi</td></tr> <tr><td>7</td><td>+5V reference</td></tr> <tr><td>8</td><td>Input GND</td></tr> <tr><td>9</td><td>Universal Input 1</td></tr> <tr><td>10</td><td>Power GND</td></tr> <tr><td>11</td><td>Output 2 GND</td></tr> <tr><td>12</td><td>Output 2</td></tr> </tbody> </table> | CAN and I/O Connector | | Pin # | Description | 1 | Output 1 | 2 | Output 1 GND | 3 | Power + | 4 | CAN Shield | 5 | CAN LO | 6 | CAN Hi | 7 | +5V reference | 8 | Input GND | 9 | Universal Input 1 | 10 | Power GND | 11 | Output 2 GND | 12 | Output 2 |
|------------------------|--|-----------------------|--|-------|-------------|---|----------|---|--------------|---|---------|---|------------|---|--------|---|--------|---|---------------|---|-----------|---|-------------------|----|-----------|----|--------------|----|----------|
| CAN and I/O Connector | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pin # | Description | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Output 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Output 1 GND | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Power + | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | CAN Shield | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | CAN LO | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | CAN Hi | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | +5V reference | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Input GND | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Universal Input 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Power GND | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | Output 2 GND | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | Output 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Installation | <p>Mounting holes sized for #10 or M4.5 bolts. The bolt length will be determined by the end-user's mounting plate thickness. The mounting flange of the controller is 0.19 inches (4.75 mm) thick.</p> <p>If the module is mounted without an enclosure, it should be mounted to reduce the likelihood of moisture entry. Install the unit with appropriate space available for servicing and for adequate wire harness access (6 inches or 15 cm) and strain relief (12 inches or 30 cm).</p> <p>The CAN wiring is considered intrinsically safe. The power wires are not considered intrinsically safe and so in hazardous locations, they need to be located in conduit or conduit trays at all times. The module must be mounted in an enclosure in hazardous locations for this purpose.</p> <p>All field wiring should be suitable for the operating temperature range of the module.</p> <p>All chassis grounding should go to a single ground point designated for the machine and all related equipment.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

The network part of the controller is compliant with Bosch CAN protocol specification, Rev.2.0, Part B, and the following J1939 standards:

| ISO/OSI Network Model Layer | J1939 Standard |
|-----------------------------|--|
| Physical | J1939/11 – Physical Layer, 250K bit/s, Twisted Shielded Pair. Rev. SEP 2006. J1939/15 - Reduced Physical Layer, 250K bits/sec, Un-Shielded Twisted Pair (UTP). Rev. AUG 2008. |
| Data Link | J1939/21 – Data Link Layer. Rev. DEC 2006 The controller supports Transport Protocol for Commanded Address messages (PGN 65240) and software identification -SOFT messages (PGN 65242). It also supports responses on PGN Requests (PGN 59904). |
| Network | J1939, Appendix B – Address and Identity Assignments. Rev. FEB 2010. J1939/81 – Network Management. Rev. 2003-05. The controller is an Arbitrary Address Capable ECU. It can dynamically change its network address in real time to resolve an address conflict with other ECUs. The controller supports: Address Claimed Messages (PGN 60928), Requests for Address Claimed Messages (PGN 59904) and Commanded Address Messages (PGN 65240). |
| Transport | N/A in J1939. |
| Session | N/A in J1939. |
| Presentation | N/A in J1939. |
| Application | J1939/71 – Vehicle Application Layer. Rev. FEB 2010 The controller can receive application specific PGNs with input signals and transmit application specific PGNs with up to five output signals. All application specific PGNs are user programmable. J1939/73 – Application Layer – Diagnostics. Rev. FEB 2010 Memory access protocol (MAP) support: DM14, DM15, DM16 messages used by the Axiomatic EA to program setpoints. |

CONTROL ARCHITECTURE

The controller consists of a set of internal functional blocks, which can be individually programmed and arbitrarily connected together to achieve the required system functionality, Fig. 1. The AX022000 is user programmable for functionality using the Axiomatic Electronic Assistant.



As an example, the Universal Input is connected to a Conversion Function block and the Conversion Function block is connected to a PWM Output block, providing a path for the input signal from input to output through the Conversion Function.

Figure 1. The Controller Internal Structure

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Form: TDAX022000-06/12/23