

# 10 Universal Signal Inputs CAN Controller

V, mA, Digital, PWM, Hz/RPM, Counter Inputs  
CAN (SAE J1939)

with Simulink®

with Electronic Assistant

P/N: AX030120

## Features:

- 10 user selectable signal inputs:
  - 0-5 V
  - 0-10 V
  - 0-20 mA
  - 4-20 mA
  - PWM (low or high frequency)
  - Frequency/RPM
  - Counter
  - Digital
- 12V, 24Vdc (nominal) power input
- 1 CAN port (SAE J1939) (CANopen® in P/N AX030121)
- Rugged packaging and connectors (TE Deutsch)
- Standard control logic
- CE mark (EMC Directive)
- Developed with Simulink®
- Electronic Assistant for parameter configuration



**Description:** The 10 Universal Signal Input Module accepts up to 10 analog or digital type inputs (0-5V, 0-10V, 0-20 mA or 4-20 mA, Digital, PWM, Frequency/RPM or Counter). The modules can be connected to a variety of analog machine sensors or levers, PLC's, switches, PWM signals, etc. It interfaces with the machine's CAN network (SAE J1939). Standard embedded software is provided. Rugged IP67 rated packaging in addition to a wide-ranging power supply input section for 12V or 24Vdc power suits applications in the harsh environment of mobile equipment with on-board battery power. All setpoints are user configurable using the Electronic Assistant. The device operates with Simulink® for easy graphical programming in a model-based simulation and development environment.

**Applications:** The controller is designed to meet the rugged demands of construction equipment, power generator sets and heavy duty industrial machine control applications.

## Ordering Part Numbers:

SAE J1939 Controller: For baud rate, refer to the table below for the appropriate P/N.

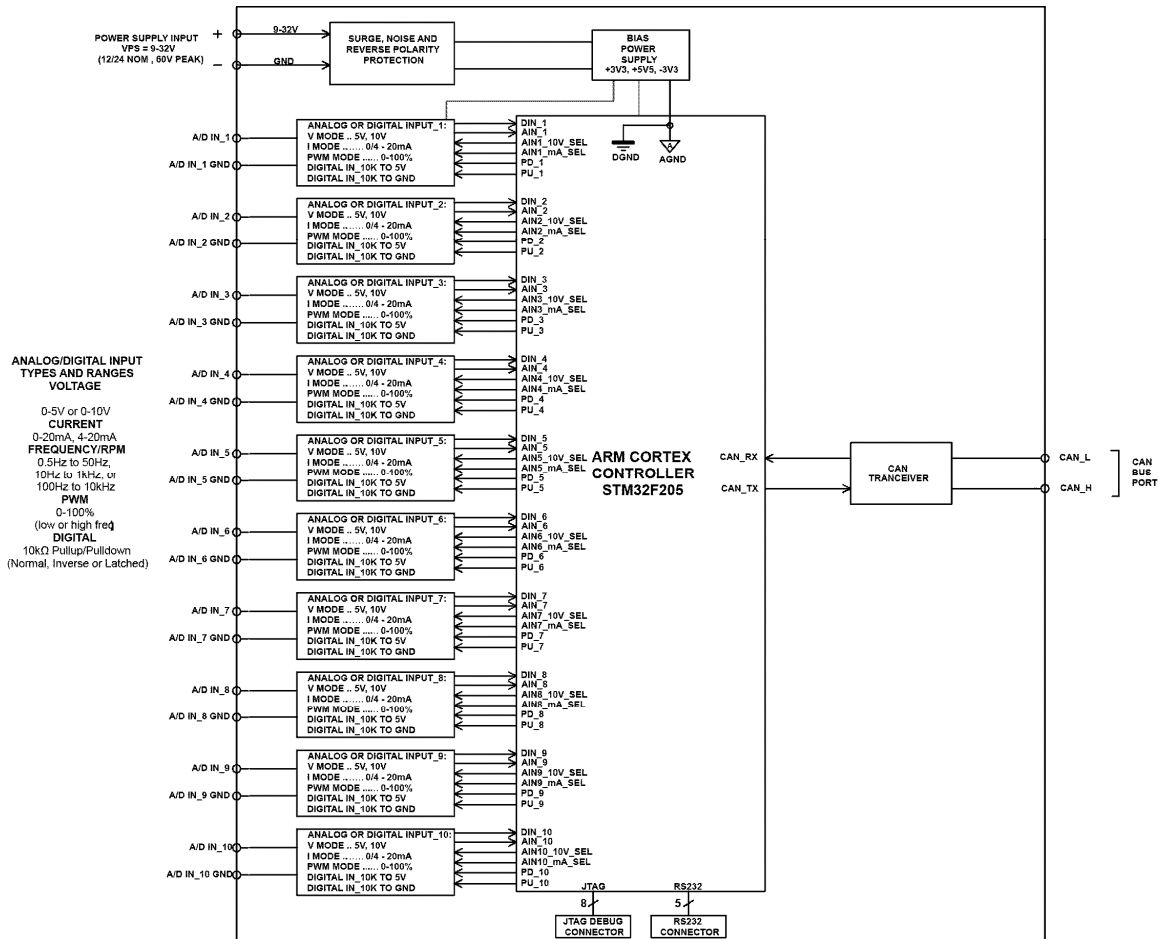
Model P/N	Baud Rate	Standard Reference
AX030120	250 kBit/s	J1939/11, J1939/15.
AX030120-01	500 kBit/s	J1939/14. New standard
AX030120-02	1Mbit/s	Non-standard

Accessories:

**PL-DTM06-12SA-12SB** Mating Plug Kit (1 DTM06-12S, DTM06-12SB, 2 WM12S, 24 contacts)

Electronic Assistant Configuration KIT: **AX070502**

# BLOCK DIAGRAM



## 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 [www.axiomatic.com/service.html](http://www.axiomatic.com/service.html).

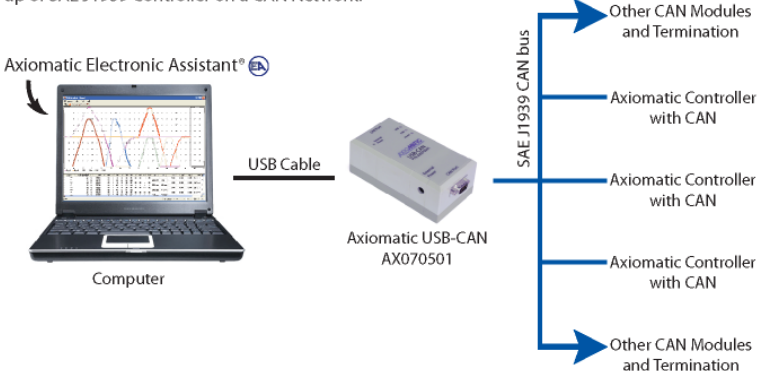
## Power Input Specifications

Power Supply Input - Nominal	12 or 24Vdc nominal operating voltage 8...60 Vdc power supply range for voltage transients
Surge Protection	Provided
Reverse Polarity Protection	Provided
Quiescent Current	< 25mA @ Vin = 24V

## Signal Input Specifications

Inputs	<p>10 user selectable inputs (See Table 1.0.)</p> <ul style="list-style-type: none"> <li>Analog 12-bit (0-5V, 0-10V, 0-20 mA, 4-20 mA)</li> <li>PWM 12-bit (low or high frequency)</li> <li>Frequency/RPM</li> <li>Counter input 16-bit</li> <li>Digital (active high/active low) [ON when input <math>\geq</math> 1.5V]</li> </ul> <p>The "Input Sensor Type" setpoint is used to configure input type.</p> <table border="1" data-bbox="602 443 1101 852"> <caption>Table 1.0. Inputs – Sensor Type Selections</caption> <thead> <tr> <th>Setpoint</th> <th>Input Type</th> </tr> </thead> <tbody> <tr><td>0</td><td>Disabled</td></tr> <tr><td>1</td><td>Voltage (0-5 V)</td></tr> <tr><td>13</td><td>Voltage (0-10 V)</td></tr> <tr><td>2</td><td>Current (0-20 mA)</td></tr> <tr><td>21</td><td>Current (4-20 mA)</td></tr> <tr><td>40</td><td>Frequency (0.5 to 50 Hz)</td></tr> <tr><td>41</td><td>Frequency (10 Hz to 1 kHz)</td></tr> <tr><td>4</td><td>Frequency (100 Hz to 10 kHz)</td></tr> <tr><td>3</td><td>PWM Low Frequency (&lt;1 kHz)</td></tr> <tr><td>51</td><td>PWM High Frequency (&gt;100 Hz)</td></tr> <tr><td>5</td><td>16-bit Counter</td></tr> <tr><td>6</td><td>Digital (normal)</td></tr> <tr><td>61</td><td>Digital (inverse)</td></tr> <tr><td>62</td><td>Digital (latched)</td></tr> </tbody> </table> <p>All inputs with the exception of 16-Bit Counter are sampled every 1ms. Analog Input types have a 12-bit resolution.</p> <p>With current inputs, short circuit protection is provided.</p>	Setpoint	Input Type	0	Disabled	1	Voltage (0-5 V)	13	Voltage (0-10 V)	2	Current (0-20 mA)	21	Current (4-20 mA)	40	Frequency (0.5 to 50 Hz)	41	Frequency (10 Hz to 1 kHz)	4	Frequency (100 Hz to 10 kHz)	3	PWM Low Frequency (<1 kHz)	51	PWM High Frequency (>100 Hz)	5	16-bit Counter	6	Digital (normal)	61	Digital (inverse)	62	Digital (latched)										
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Input Impedance	<p>0-5V: 1 MOhm            0-10V: 170 kOhm            0(4)-20mA: 249 Ohm            Frequency/Digital Input: Pull Up/Pull Down 22 KOhm</p>																																								
Scan Rate	<p>Each input is scanned in 100uS.            A complete scan of 10 inputs occurs with new measured values every 1mS.</p>																																								
Analog GND	<p>10 Analog GND connections are provided.            Grounds are connected internally.</p>																																								

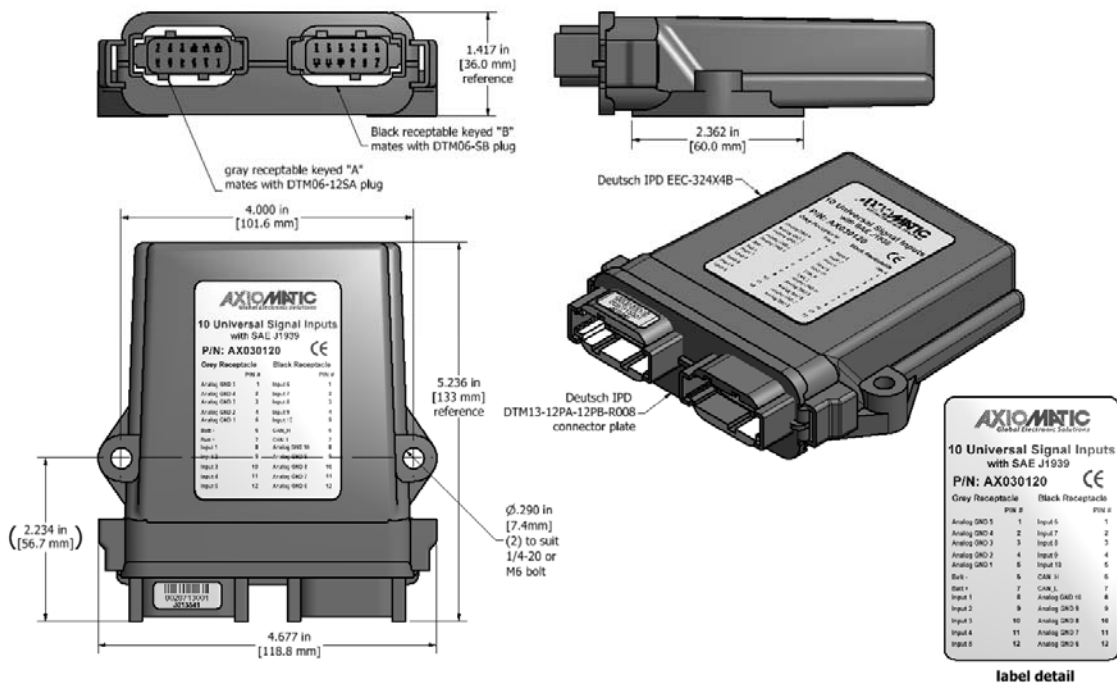
## General Specifications

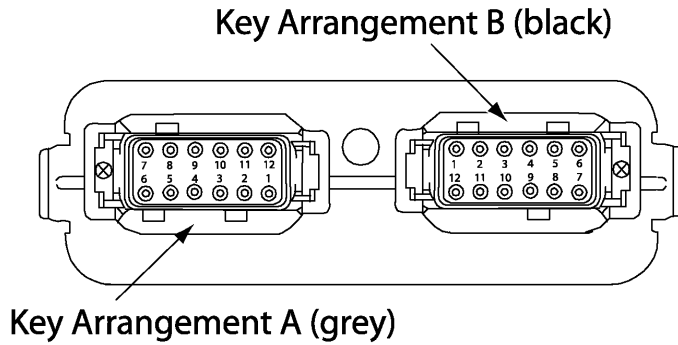
Microprocessor	STM32F205VGT6
Communications	1 CAN port (2.0B, SAE J1939) 500 kbps and 1 Mbps baud rate models are available. (See ordering part numbers.) A CANopen® model is available (PN AX030121). An on-board RS-232 port is used for factory programming only.
EMC Compliance	CE mark
Vibration	MIL-STD-202G, Method 204D, test condition A – 10 g peak (Sine) MIL-STD-202G, Method 214A, test condition B – 7.68 Grms (Random)
Shock	MIL-STD-202G, Method 213B, test condition A 50 g half sine pulse, 6 ms, 6 pulses per axis
User Interface	<p>User configuration and diagnostics are provided with the Axiomatic Electronic Assistant. The Axiomatic Service Tool is a <i>Windows</i>-based graphical user interface that allows easy configuration of the controller setpoints.</p> <p>Set up of SAE J1939 Controller on a CAN Network:</p> 
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.
Control Logic	<p>Configurable properties of the controller are divided into function blocks, namely input function block, diagnostic function block; lookup table function block, programmable logic function block, math function block, CAN receive message function block and CAN transmit message function block. Input function block includes properties used to select input sensor functionality. Diagnostic function block properties are used to configure fault detection and reaction functionalities. The Math function block gives user an opportunity to process inputs with basic mathematical or logical functions. The CAN transmit message function block configures properties of the messages sent to the CAN bus.</p> <p>The software was designed to provide flexibility to the user with respect to messages sent from the module (ECU) over the CAN bus, by providing:</p> <ul style="list-style-type: none"> <li>• Configurable ECU Instance in the NAME (to allow multiple ECU's on the same network)</li> <li>• Configurable Input Parameters</li> <li>• Configurable PGN and Data Parameters</li> <li>• Configurable Diagnostic Messaging Parameters, as required</li> <li>• Diagnostic Log, maintained in non-volatile memory</li> </ul> <p>The CAN Transmit function block is used to send any output from another function block (i.e. input, math) to the J1939 network. The AX030120 ECU has ten CAN Transmit Messages and each message has 5 signals.</p> <p>The "Transmit PGN" setpoint sets PGN used with the message. The user should be familiar with the SAE J1939 standard and select values for PGN/SPN combinations as appropriate from section J1939/71. By default, all messages are sent on Proprietary B PGNs as broadcast messages.</p> <p>None of the application layer PGNs are supported as part of the default configurations, but they can be selected as desired for transmit function blocks.</p> <p>Setpoints are accessed using standard Memory Access Protocol (MAP) with</p>

	<p>proprietary addresses. The Electronic Assistant® (EA) allows for quick and easy configuration of the unit over CAN network.</p> <p>Refer to the User Manual UMAX030120 for details. The AX030120 can be upgraded with new application firmware over the CAN bus using the Electronic Assistant. <i>For application-specific control logic, contact Axiomatic.</i></p>																																																																							
SAE J1939 Compliance	<p>The ECU is compliant with the following SAE J1939 standards.</p> <ul style="list-style-type: none"> <li>• J1939 Recommended Practice for a Serial Control and Communications Vehicle Network, SAE, April 2011</li> <li>• J1939/21 Data Link Layer, SAE, December 2010</li> <li>• J1939/71 Vehicle Application Layer, SAE, March 2011</li> <li>• J1939/73 Application Layer-Diagnostics, SAE, February 2010</li> <li>• J1939/81 Network Management, SAE, May 2003</li> </ul> <p>It supports following PGNs from the standard.</p> <table border="1" data-bbox="597 642 1346 1791"> <thead> <tr> <th colspan="4">Table 4.0. SAE J1939 PGNs</th> </tr> </thead> <tbody> <tr> <td colspan="4"><b>From J1939-21 – Data Link Layer</b></td> </tr> <tr> <td></td> <td>Request</td> <td>59904</td> <td>0x00EA00</td> </tr> <tr> <td></td> <td>Acknowledgement</td> <td>59392</td> <td>0x00E800</td> </tr> <tr> <td></td> <td>Transport Protocol – Connection Management</td> <td>60416</td> <td>0x00EC00</td> </tr> <tr> <td></td> <td>Transport Protocol – Data Transfer Message</td> <td>60160</td> <td>0x00EB00</td> </tr> <tr> <td></td> <td rowspan="2">Proprietary B</td> <td>From 65280</td> <td>0x00FF00</td> </tr> <tr> <td></td> <td>To 65535</td> <td>0x00FFFF</td> </tr> <tr> <td colspan="4"><b>From J1939-73 – Diagnostics</b></td> </tr> <tr> <td></td> <td>DM1 – Active Diagnostic Trouble Codes</td> <td>65226</td> <td>0x00FECA</td> </tr> <tr> <td></td> <td>DM2 – Previously Active Diagnostic Trouble Codes</td> <td>65227</td> <td>0x00FECB</td> </tr> <tr> <td></td> <td>DM3 – Diagnostic Data Clear/Reset for Previously Active DTCs</td> <td>65228</td> <td>0x00FECC</td> </tr> <tr> <td></td> <td>DM11 – Diagnostic Data Clear/Reset for Active DTCs</td> <td>65235</td> <td>0x00FED3</td> </tr> <tr> <td colspan="4"><b>From J1939-81 – Network Management</b></td> </tr> <tr> <td></td> <td>Address Claimed/Cannot Claim</td> <td>60928</td> <td>0x00EE00</td> </tr> <tr> <td></td> <td>Commanded Address</td> <td>65240</td> <td>0x00FED8</td> </tr> <tr> <td colspan="4"><b>From J1939-71 – Vehicle Application Layer</b></td> </tr> <tr> <td></td> <td>Software Identification</td> <td>65242</td> <td>0x00FEDA</td> </tr> </tbody> </table>	Table 4.0. SAE J1939 PGNs				<b>From J1939-21 – Data Link Layer</b>					Request	59904	0x00EA00		Acknowledgement	59392	0x00E800		Transport Protocol – Connection Management	60416	0x00EC00		Transport Protocol – Data Transfer Message	60160	0x00EB00		Proprietary B	From 65280	0x00FF00		To 65535	0x00FFFF	<b>From J1939-73 – Diagnostics</b>					DM1 – Active Diagnostic Trouble Codes	65226	0x00FECA		DM2 – Previously Active Diagnostic Trouble Codes	65227	0x00FECB		DM3 – Diagnostic Data Clear/Reset for Previously Active DTCs	65228	0x00FECC		DM11 – Diagnostic Data Clear/Reset for Active DTCs	65235	0x00FED3	<b>From J1939-81 – Network Management</b>					Address Claimed/Cannot Claim	60928	0x00EE00		Commanded Address	65240	0x00FED8	<b>From J1939-71 – Vehicle Application Layer</b>					Software Identification	65242	0x00FEDA
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Simulink®	Model AX030120 was developed with Simulink®. <b>Simulink®</b> is a model-based design tool from Mathworks®. Using Simulink®, the OEM machine designer may simulate their control system with the Axiomatic module included. This permits fine tuning of the design parameters and testing of functionality prior to machine prototype installation. The Hardware Interface Library for Simulink® is available from Axiomatic on request.
Diagnostics	The 10 Universal Input ECU supports diagnostic messaging. DM1 message is a message, containing Active Diagnostic Trouble Codes (DTC) that is sent to the J1939 network in case a fault has been detected. The Universal Inputs setpoint group includes diagnostic related setpoints. There are three additional fault diagnostic setpoint groups namely Over Temperature, Over Voltage and Under Voltage.
Electrical Connections	Deutsch DTM series 24 pin receptacle (DTM13-12PA-12PB-R008) Mating plug: Deutsch DTM06-12SA and DTM06-12SB with 2 wedgelocks (WM12S) and 24 contacts (0462-201-20141). 20 AWG wire is recommended for use with contacts 0462-201-20141.
Enclosure and Dimensions	High Temperature Nylon housing - Deutsch IPD PCB Enclosure (EEC-325X4B) 4.677 x 5.236 x 1.417 inches 118.80 x 133.00 x 36.00 mm (W x L x H excluding mating plugs)
Operating Conditions	-40 to 85°C (-40 to 185°F)
Weight	0.55 lb. (0.25 kg)
Protection	IP67, Unit is conformal coated in the housing.
Mounting	Mounting holes sized for ¼ inch or M6 bolts. The bolt length will be determined by the end-user's mounting plate thickness. The mounting flange of the controller is 0.63 inches (16 mm) thick. If the module is mounted without an enclosure, it should be mounted vertically with connectors facing left and right to reduce likelihood of moisture entry. 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.  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 inches or 15 cm) and strain relief (12 inches or 30 cm).

### Dimensions and Typical Connections:





### FRONT VIEW 24 PIN RECEPTACLE

Table 5.0. Electrical Pin Out			
Grey Connector		Black Connector	
Pin #	Function	Pin #	Function
1	Analog GND 5	1	Input 6
2	Analog GND 4	2	Input 7
3	Analog GND 3	3	Input 8
4	Analog GND 2	4	Input 9
5	Analog GND 1	5	Input 10
6	Batt -	6	CAN_H
7	Batt +	7	CAN_L
8	Input 1	8	Analog GND 10
9	Input 2	9	Analog GND 9
10	Input 3	10	Analog GND 8
11	Input 4	11	Analog GND 7
12	Input 5	12	Analog GND 6

**Notes:**

CANopen® is a registered community trademark of CAN in Automation e.V.

Simulink® is a registered trademark of The Mathworks, Inc.

Form: TDAX030120-07/15/19