

Features:

- Command messages are received through the CAN network (no physical inputs)
- 9 outputs are user selectable from the following (up to a maximum of 7A of controller power supply intake at one time).
 - Output Disabled
 - Proportional Current
 - Hotshot Digital
 - On/Off Digital
 - Proportional Voltage
 - PWM Duty Cycle
- 12V, 24V, 42V, 48V or 72VDC nominal input power
- 1 CAN port (CANopen®), 1 RS-232 port
- SAE J1939 module available on request (P/N: AX021200)
- Hardware is also available as a platform for application-specific software
- Rugged IP67 packaging and connectors
- An USB-CAN converter (not supplied) links the PC to the CAN bus for set-up using a commercially-available CANopen configuration tool (not supplied). Alternatively, the controller can be configured by a CAN master on the network.



Description:

The controller features 1 CAN port for controlling the outputs and diagnostics over the CAN bus (CANopen). It accepts a wide variety of nominal input power supply voltages (12V, 24V, 42V, 48V or 72VDC). Using the CAN network, it can provide control of up to nine outputs, configured for a wide variety of responses. For example, it can drive proportional valves, on/off valves or provide a hotshot control profile. PWM signal or proportional voltage outputs are also user selectable. Standard software is provided. The sophisticated microprocessor can accommodate complex application-specific control algorithms for advanced machine control on request. Rugged IP67 rated packaging in addition to the wide-ranging power supply input section suits the harsh environment of mobile equipment with on-board battery power. Settings are user configurable via a *Windows*-based commercially available CANopen configuration tool interfacing to the controller via an USB-CAN device.

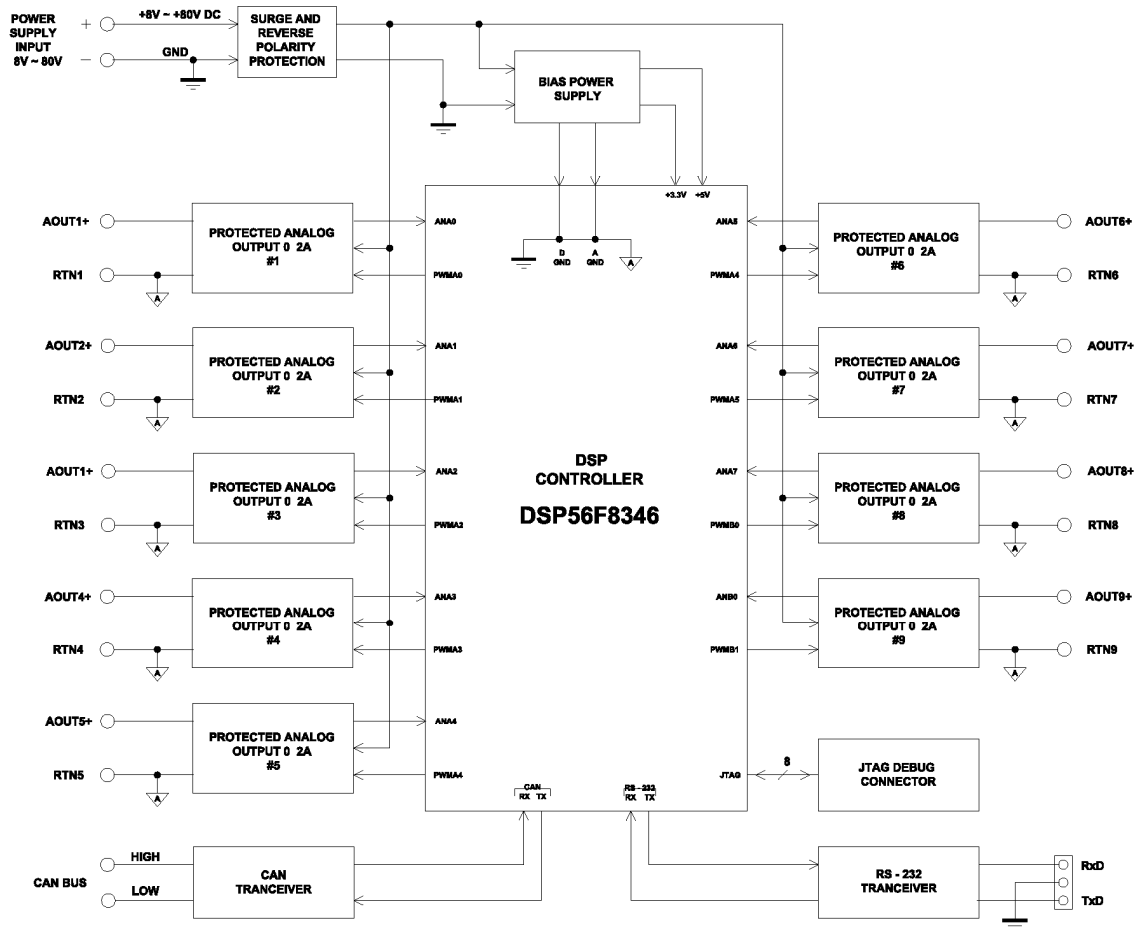
Applications:

- Off-highway construction equipment
- Municipal vehicles
- Material handling equipment (forklifts, etc.)

Ordering Part Numbers:

<p><i>CANopen® version</i></p> <p>Controller: AX021201 EDS File: EDS-AX021201 <i>Contact Axiomatic for a quotation to provide application-specific control logic.</i></p> <p>Accessories: PL-DTM06-12SA-12SB Mating Plug Kit (The KIT is comprised of: DTM06-12S, DTM06-12SB, 2 W12S and 24 contacts. The Axiomatic stock # is FG-IOCTRL-19.)</p> <p>PC-based CANopen Configuration Tool: <i>Industry standard CANopen PC-based software</i></p>

Block Diagram:



Technical Specifications:

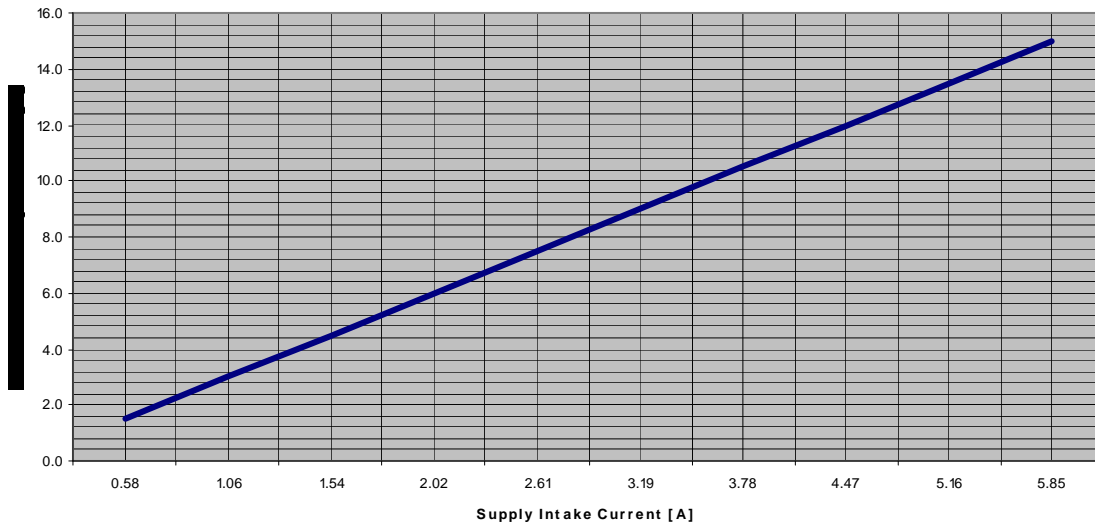
Input Power Supply Specifications

Power Supply Input - Nominal	12V, 24V, 42V, 48V or 72V DC nominal Maximum 80 VDC power supply (8...80VDC) Surge protection is provided. NB. The maximum total current draw permitted on the power supply input pins is 7 Amps @ 24VDC, at one time.
Reverse Polarity Protection	Provided
Input Impedance	400 KOhms

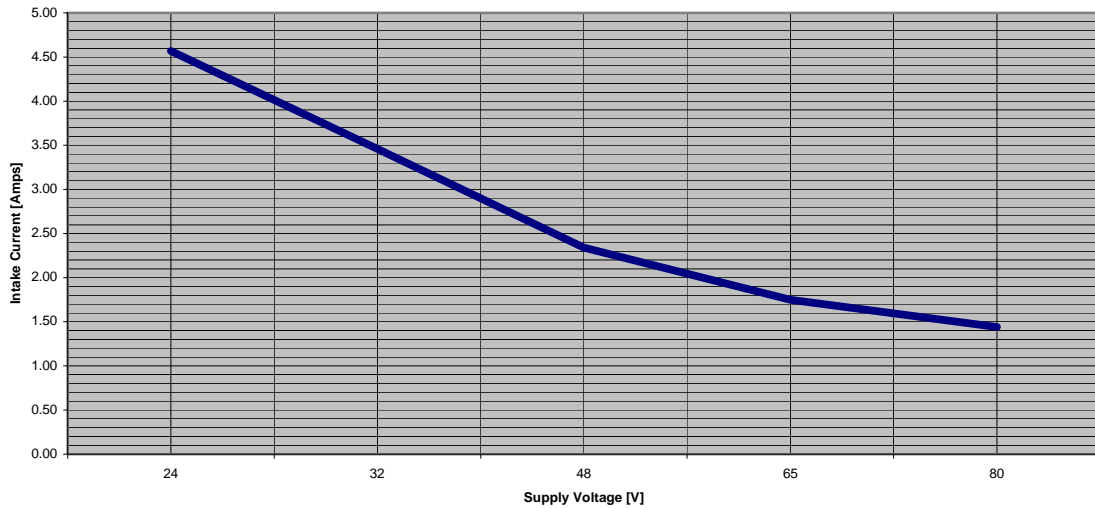
Minimum and Maximum Operational Voltage and Current Intake

	Voltage Input [V]	Approximate Current Intake [mA]
Minimum	8	325
	12	187
	24	103
	36	76
	48	68
	60	66
	72	64

Supply Intake Current vs Total Output Current [A]



Supply Voltage vs Intake Current when all outputs ON at 1500 mA



WARNING: The 9 outputs are user selectable from 0 to 2000 mA but the unit can only handle a maximum of 7A of controller power supply intake at one time. At no time should the total intake current of the controller exceed 7A due to the rating of the connector. Failure to do so will result in unpredictable damage to unit.

Input Specifications

CAN commands (no physical inputs available)	Control inputs are taken from the CANopen® network. <i>Refer to the user manual for details.</i>
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Output Specifications

Proportional Outputs	High side (sourcing) 9 outputs, 12 or 24V Each output is independently configurable up to 2A. The number of outputs ON at one time is limited by the rating of the Deutsch IPD contacts (pins on the connector). NB. The maximum total current draw permitted on the power supply input pins is 7 Amps @ 24VDC, at one time. Each output has a current feedback signal to the processor.
Output Type	The user can select between the following outputs. <i>Refer to Table 1.0.</i> Proportional Current (0...2A) Hotshot Digital (0...2A, 0...10000 mSec.) On/Off Digital (0...2A) Proportional Voltage (0...85V) PWM Duty Cycle (150Hz...5000Hz, 0 to 100%) Digital outputs can be controlled by writes to object 6200h (DO Write States). An analog output function block handles the control of proportional outputs configured for non-digital response by object 6310h.
Output Adjustments	Digital Current: 0 to 2000 mA Hotshot Hold Time: 0 to 10000 ms Proportional Current: 0 to 2000 mA Proportional Voltage: 0 to 85V PWM Duty Cycle: 0 to 100% PWM Frequency: 150 Hz to 5000 Hz Ramp Up: 0 to 10000 ms Ramp Down: 0 to 10000 ms Dither Frequency: 50 to 400 Hz Dither Amplitude: 0 to 500 mA <i>For default settings, refer to the user manual.</i>
Control Logic	Standard embedded software. Application-specific setpoints or control logic are available on request. <i>Refer to the user manual for details.</i>
Current Feedback	The current feedback is sampled every 10ms. The repetition rate is user selectable as well as the type of filter that is applied to the measured data, before it is used in the PID control loop and/or sent to the bus. The available filters are: <ul style="list-style-type: none"> • Filter Type 0 = No Filter • Filter Type 1 = Moving Average • Filter Type 2 = Repeating Average
Protection	Overcurrent protection is provided. Short circuit protection is provided. NB. Outputs are separately protected against short circuits to both power and GND
Error Detection	The controller can detect and flag overcurrent and open circuit loads, which can be read via the CANopen® network for diagnostic purposes.
Output Impedance	18-19 KOhms

Table 1.0 Output Types for AX021201

Type	Description
Hotshot Digital	In this mode, the output can be hotshot with a current to turn the load on, and then dropped to a holding current to keep the load on with less energy. For digital loads that have a high duty cycle, using this type of output can help improve the overall system efficiency. The current at which the output is hotshot, and the length of time it is held at this value, are both configurable setpoints, as is the holding current. <i>Refer to Figure 2.0.</i> In this mode, the output is controlled using the object 0x6200 (DO Write State). Dither, Breakpoint and Ramp setpoints do not apply in this mode. Feedback messages and error detection properties are the same as for proportional current outputs. Accuracy: +/-1% over the 2000 mA range
On/Off Digital	In this mode, the output will either be off, or switched to the power supply voltage. The output will respond to changes in the object 0x6200 (DO Write State) the same way as for a hotshot digital response. If the current at the load is greater than or equal to 2500mA, an overcurrent will be flagged. This threshold is not user configurable. There is no open circuit detection in this mode. This means that very low currents, such as an indicator lamp, can be connected.

<p>Proportional Current</p>	<p>The controller regulates the current through a solenoid to precisely control the response of a proportional valve. The unit measures the current feedback, and uses it in a high-speed P-I-D loop to accurately set the current through the load. A high frequency signal (20kHz) is used to provide an output with low ripple. If required, a low frequency signal can be superimposed on the output to dither the load with adjustable frequency and amplitude.</p> <p>The output current will vary linearly with respect to the command signal received from the bus. Refer to Figure 1.0. All proportional outputs can be controlled by writes to object 7330h (AO Field Value) or object 7F50h (Received PV). Manufacturer object 30C0h has been introduced as a means of indicating the measured feedback current of the outputs to the bus at any time.</p> <p>The object 7F50h can be mapped to a PDO to send a process value to the controller. In order for the controller to accept the received PV, the status of object 6F52h must be validated. The conversion from received process value to field value is generally described as a linear transformation. The two pairs of process values and their corresponding field values define calibration points 1 and 2. (Input Scaling 1 PV/ Input Scaling 1 FV and Input Scaling 2 PV/ Input Scaling 2 FV) See DS-404 for more information.</p> <p>If ramps are used (non-zero value), a step change in the command signal will result in a smooth change at the output. The rate of change in the ramp is calculated by dividing the output current range (2000mA) by the time in the corresponding object to get the mA/ms rate.</p> <p>Dither objects apply when a current output is selected.</p> <p>A feedback signal sent to the network will be sent as a WORD with a 1mA/bit resolution, and 0mA offset. The data in the message will be the current through the load, as measured by the controller.</p> <p>For error detection, if the absolute difference between the measured current and the target current is greater than or equal to 200mA, the controller will flag an error at the output. If the measured value is higher than the target, the controller flags an overcurrent; otherwise, it flags an open circuit at the load. These thresholds are not user configurable.</p> <p>Accuracy: +/-2% over the 2000 mA range</p>
<p>Proportional Voltage</p>	<p>The controller will adjust the duty cycle of the output PWM signal such that the average voltage from the pin will be between 0 and 24V, as per the value in object \$7330 (AO Field Value). To control the output, Field Value object is expected to have 2 decimal places of resolution.</p> <p>The unit measures the power supply voltage, and uses it to calculate the required duty cycle of the output signal. A high frequency signal (20kHz) is used to provide an output that will have low ripple after filtering. External filtering will be required to turn this signal into a voltage output.</p> <p>If ramps are used (non-zero value), a step change in the command signal will result in a smooth change at the output. The rate of change is calculated by dividing the output voltage range by the time in the corresponding object to get the V/ms rate.</p> <p>If the current at the load is greater than or equal to 2500mA, an overcurrent will be flagged. This threshold is not user configurable. There is no open circuit detection in this mode.</p> <p>Accuracy: +/-5% average of the actual output voltage with respect to the target commanded voltage.</p>
<p>PWM Duty Cycle</p>	<p>In this mode, the controller will adjust the duty cycle of the output PWM signal from 0% to 100%, as per the value in the object \$7330 (AO Field Value). To control the output, the Field Value object is expected to have 2 decimal places of resolution. When Process Value control is used the response profile in Figure 1.0 will apply.</p> <p>The frequency of the PWM will be determined by the value in object \$30 D0 (PWM Frequency). However, there are several restrictions for this object as listed below.</p> <ol style="list-style-type: none"> Certain channels always have the same frequency for the output signal. This means that if any one of these channels is configured for a current output (proportional or hotshot), the PWM Frequency setpoint will be ignored, and the output frequency will always be 20kHz. The output channels that share a frequency are channels 1 to 6, and channels 7 to 9 respectively. If both current and PWM output types are required, they will have to be split between those two groups in order for the controller to perform as expected. If condition (a) has been met (no current output in that group of channels), then the frequency that will be used for the group will be of the output channel with the LOWEST index number that has been configured as a PWM duty cycle output, and has a non-zero entry in this setpoint. This parameter will be ignored for all the other channels. The new PWM frequency will NOT take effect until the unit has been reset by cycling the power. <p>If ramps are used (non-zero value), a step change in the command signal will result in a smooth change at the output. The rate of change in the ramp is calculated by dividing the output duty cycle range (100%) by the time in the corresponding object to get the %/ms rate.</p>

	<p>If the current at the load is greater than or equal to 2500mA, an overcurrent will be flagged. This threshold is not user configurable. There is no open circuit detection in this mode.</p> <p>Accuracy: +/- 1.15% average</p>
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Output Response Profiles:

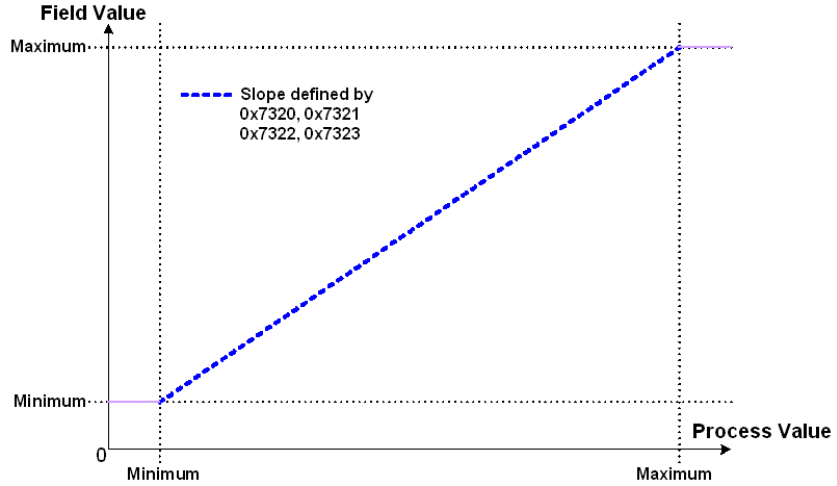


Figure 1 – Process Value vs. Field Value (Proportional Outputs)

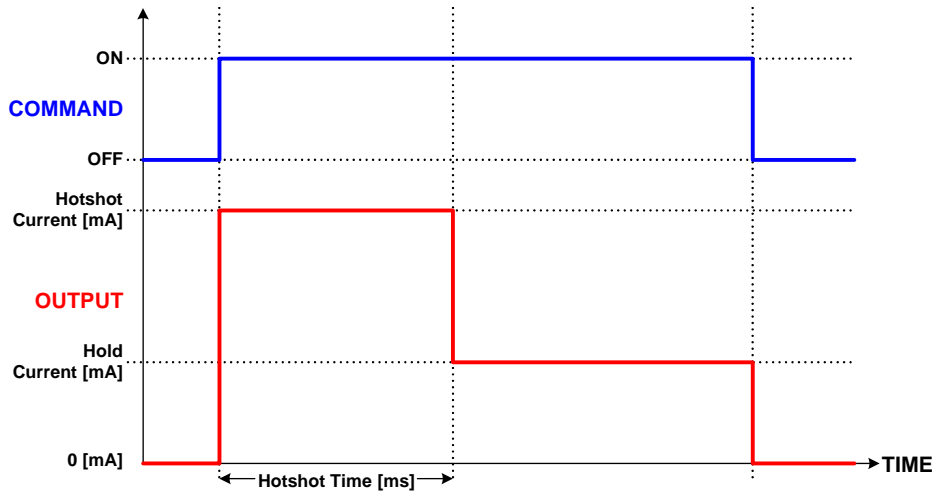
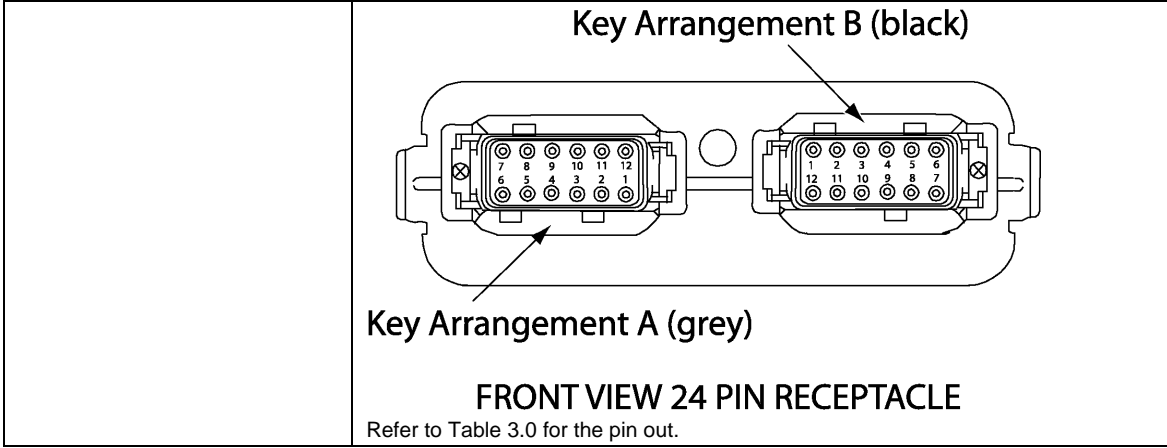


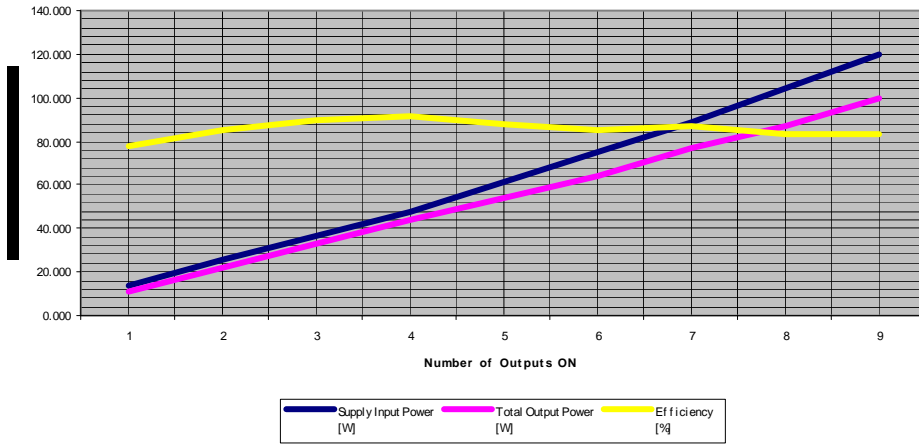
Figure 2 –Hotshot Digital Profile

General Specifications

Microprocessor	DSP56F8346						
Efficiency	85.5%@24V, 89.2% over entire voltage range <i>Refer to Figure 3.0.</i>						
Control Logic	Standard embedded software. The CANopen® object dictionary is based on the CiA device profile DS-404 V1.2. The object dictionary also includes some manufacturer specific objects for extended functionality. Refer to the user manual for details and a list of communication objects. <i>Application-specific software is available on request.</i>						
Communications	1 CAN port (CANopen®) SAE J1939 (model AX021200) available 1 RS-232 port						
CAN Interface	1 CAN port (CANopen®) The controller's object dictionary is compatible with the CiA DS-404 device profile (Device profile for measurement devices and closed-loop controllers). In addition to the standard objects for this device profile, the controller also includes a number of manufacturer specific objects to extend the functionality beyond that of the basic profile. Refer to the user manual for details. The Axiomatic AX021201 is compliant with the following CAN in Automation (CiA) standards. <table border="1" data-bbox="613 772 1393 955"> <tr> <td>[DS-301]</td> <td>CiA DS-301 V4.02 – CANopen Application Layer and Communication Profile. CAN in Automation 2002</td> </tr> <tr> <td>[DS-404]</td> <td>CiA DS-404 V1.2 – Device Profile for Measurement Devices and Closed-Loop Controllers. CAN in Automation 2002</td> </tr> <tr> <td>[DS-305]</td> <td>CiA DS-305 V2.0 – Layer Setting Service (LSS) and Protocols. CAN in Automation 2006</td> </tr> </table>	[DS-301]	CiA DS-301 V4.02 – CANopen Application Layer and Communication Profile. CAN in Automation 2002	[DS-404]	CiA DS-404 V1.2 – Device Profile for Measurement Devices and Closed-Loop Controllers. CAN in Automation 2002	[DS-305]	CiA DS-305 V2.0 – Layer Setting Service (LSS) and Protocols. CAN in Automation 2006
[DS-301]	CiA DS-301 V4.02 – CANopen Application Layer and Communication Profile. CAN in Automation 2002						
[DS-404]	CiA DS-404 V1.2 – Device Profile for Measurement Devices and Closed-Loop Controllers. CAN in Automation 2002						
[DS-305]	CiA DS-305 V2.0 – Layer Setting Service (LSS) and Protocols. CAN in Automation 2006						
User Interface	A CANopen master on the network or a PC-based CANopen configuration tool (not supplied) to access the object dictionary and an USB-CAN converter (not supplied) is used for configuration during initial set-up.						
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.						
Diagnostics – CAN Network	The controller can detect and flag overcurrent and open circuit loads and provides this information to the CAN network. The controller supports a number of EMCY (Emergency Frame Codes) as defined by DS-404 and DS-301 and these include error codes. Refer to the user manual for details.						
RS-232	The RS-232 interface can be used to changes some setpoints during set up. It also provides the tools for troubleshooting and debugging the controller. For example, how much current is being sourced from an output is available from this port as is the microprocessor's temperature. It can also be used to verify that the CAN commands are truly assigning an output as ON or OFF. For more detailed information please refer to the User Manual.						
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. Use dielectric grease on the pins when installing the controller.						



Input vs Output Power vs Efficiency



Input vs Output Power and Efficiency over 20-80V range

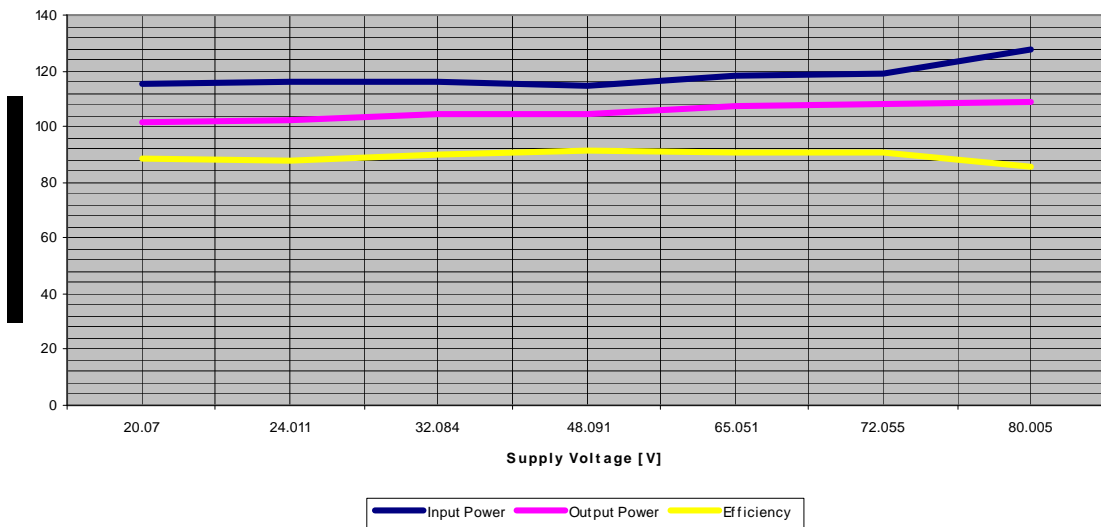


Figure 3.0 – Efficiencies

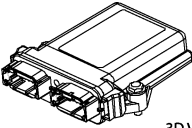
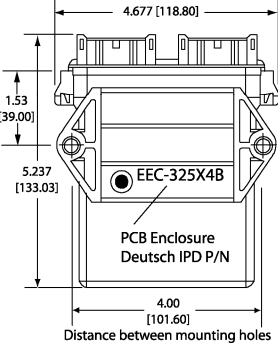
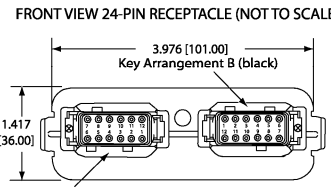
<p>Packaging and Dimensions</p>	<p>High Temperature Nylon housing - Deutsch IPD PCB Enclosure (EEC-325X4B) 4.62 x 5.24 x 1.43 inches 117.42 x 133.09 x 36.36 mm (W x L x H excluding mating plugs)</p> <div style="text-align: center;">  <p>3D VIEW Housing with 24 Pin Receptacle</p> </div> <div style="text-align: center;"> <p>HOUSING DIMENSIONS Housing Material: High Temperature Nylon (Black)</p> </div> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>BOTTOM VIEW</p> </div> <div style="text-align: center;">  <p>FRONT VIEW 24-PIN RECEPTACLE (NOT TO SCALE)</p> </div> </div> <p>Dimensions: inches [mm] excluding mating plug(s)</p>
<p>Operating Conditions</p>	<p>-40 to 70°C (-40 to 158°F) with all 9 outputs ON at 1.5A -40 to 85°C (-40 to 185°F) with less than 9 outputs ON at 1.5A</p>
<p>Weight</p>	<p>0.60 lbs. (0.27 kg)</p>
<p>Protection</p>	<p>IP67, Unit is conformal coated in the housing.</p>

Table 3.0 – Pin out: AX021201

Grey Connector		Black Connector	
Pin #	Function	Pin #	Function
1	Ground 5	1	Output 6
2	Ground 4	2	Output 7
3	Ground 3	3	Output 8
4	Ground 2	4	Output 9
5	Ground 1	5	RS232 TXD (Not Used)
6	BATT -	6	CAN HI
7	BATT +	7	CAN LO
8	Output 1	8	RS232 RXD (Not Used)
9	Output 2	9	Ground 9
10	Output 3	10	Ground 8
11	Output 4	11	Ground 7
12	Output 5	12	Ground 6

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

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.

Form: TDAX021201-07/31/12