

Technical Brief

The ECV eCompass Series provides stable azimuth, pitch, and roll measurements in dynamic conditions. An enhanced version of our ECG Series, the ECV includes a full suite of precision, 3-axis, MEMS sensors and an optional dual-axis electrolytic tilt sensor, for the ultimate in near-level accuracy. A high performance microcontroller orchestrates the fast measurement sequence, sensor calibration adjustments, frame-of-reference translations, trigonometric calculations, and advanced signal processing required to provide accurate heading, pitch, and roll outputs.

The ECV's sensor suite consists of the following:

- 3-axis angular rate gyros
- 3-axis accelerometer
- 3-axis magnetometer
- 2-axis electrolytic tilt sensor

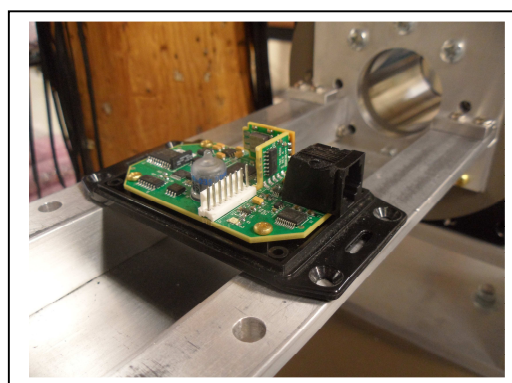
Each sensor is sampled at over 200 readings per second using a 12-bit SAR A/D converter with multiplexed inputs. The readings are averaged to produce eleven, 27.5 Hz, raw signal streams. The raw measurements are calibrated and combined to provide azimuth, pitch, roll, inclination, acceleration, and other outputs. Calibrated measurements are available as outputs to be used by external navigation algorithms. Serial outputs from the ECV are compatible with other Jewell eCompass models. These include standard NMEA 0183 HDT, HDG, and XDR sentences,

as well as the proprietary HTM ASCII sentence. Advanced binary messages are available at fast data rates (up to 56K baud) for applications requiring additional outputs. Examples of available binary data include inclination, input voltage level, ambient temperature, and both raw and calibrated sensor measurements. In all, there are more than 50 quantities available in binary output form.

The advanced capabilities of the ECV are supported by updated eCompass PC software that simplifies engineering verification and integration tasks. The software provides the following functionality:

- Monitor and change compass settings
- Perform magnetic calibration
- Capture selected measurement data (spreadsheet-compatible file format)
- Maintain communication and setting logs

For more information, pricing, and availability, please call Jewell Instruments or e-mail sensors@jewellinstruments.com.



Features

◆ **Static Accuracy**

- ⇒ Azimuth within 0.5° typical (0.1° resolution)
- ⇒ Pitch and roll within 0.2°

◆ **Dynamic Performance**

- ⇒ Gyro gimbal equations performed in firmware
- ⇒ Azimuth within 3° typical for rates < 150 °/sec
- ⇒ Pitch and roll within 1° typical for rates < 150 °/sec

◆ **Wide Operating Range**

- ⇒ Ambient temperature -40° to 105°C (-40° to 220°F)
- ⇒ ±300°/sec angular rate
- ⇒ Total magnetic field (earth + hard-iron) to ±1.5 Gauss
- ⇒ ±80° dip angle range
- ⇒ Total acceleration field to 1.5g (gravity = 1g)
- ⇒ ±90° electrolytic tilt sensor pitch & roll range (±180° optional)

◆ **Fast Response**

- ⇒ Up to 27.5 calibrated measurements per second
- ⇒ Wake from standby in 50 msec

◆ **Single Supply Operation**

- ⇒ 7 to 45V unregulated DC
- ⇒ Thermal overload and reverse polarity protection

◆ **Low Power**

- ⇒ 40 mA operating
- ⇒ 10 mA idle
- ⇒ 5 mA standby

◆ **Wide Selection of ASCII or Binary Output data**

- ⇒ Heading, pitch, and roll
- ⇒ Temperature, input voltage, and dip angle
- ⇒ Magnetometer X, Y, and Z
- ⇒ Total, horizontal, and vertical magnetic field strength
- ⇒ Raw and conditioned gyro data

◆ **Two independent serial channels**

- ⇒ Full-duplex RS-232 for the external RJ12
- ⇒ Either RS-232 or full-duplex RS-485 for the internal connector

◆ **In-System Configuration and Test**

- ⇒ Laptop can be connected while unit operates in situ
- ⇒ Perform hard and soft iron calibration
- ⇒ Monitor outputs and change user-definable settings

The rate gyros are high stability, low noise, and vibration rejecting components. A unique, interlocking PCB design creates a rigid 3D configuration to maintain positional stability over temperature. Each gyro is sampled at over 200 Hz using a 12-bit, SAR-type A/D converter.

Inertial sensors include both a tri-axis accelerometer and a dual-axis electrolytic tilt sensor. Either the electrolytic tilt sensor or the accelerometer can be used for long-term pitch and roll measurements. Both sensors are calibrated over their full tilt and operating temperature range to eliminate bias, sensitivity, and cross-axis effects.

The ECV is plug compatible with all of Jewell's eCompass models: ECS, ECL and ECG. The ECV board is the same size as the ECG and it fits in the same enclosure with the same mounting hole pattern. Identical NMEA sentences are available in all devices. The gyros can be turned on and off with seamless transfer between static and dynamic modes of operation.

Tuning the ECV is as easy as setting a time constant. There are 3 independent time constants that control pitch, roll, and azimuth complementary filters. Like the ECG, the ECV has separate serial channels for the external RJ12 and internal J2 connector; there are independent baud rates and separate on/off options for automatic data. If binary data is desired, additional parameters are available select which items to transmit.

The ECV comes with an upgraded version of Jewell Instruments' PC software that is backward compatible with the entire eCompass line. The magnetic calibration procedure required upon installation is identical. Cabling and power requirements are similar, but the ECV requires an input voltage greater than 6V to accommodate the high precision rate gyros.

Specifications

Heading Performance

Parameter	Value	Conditions
Accuracy ¹	$\pm 0.5^\circ$ rms	Static, Tilt < 35° Dip < 60°
	$\pm 3.0^\circ$ rms	Dynamic, rate < 150°/sec
Repeatability	$\pm 0.3^\circ$	Static, no filter
Response time	36 msec	Minimum, no filter
Dip Angle Range	$\pm 80^\circ$	
Tilt Range	$\pm 90^\circ$ Pitch/ $\pm 180^\circ$ Roll	
Update rate	27.5 measurements per second	
¹ May require calibration after installation to eliminate effect of local magnetic field		

Pitch and Roll Performance

Parameter	Value	Conditions
Accuracy	$\pm 0.3^\circ$	Factory calibrated
Repeatability	$\pm 0.2^\circ$	No filter
Range	$\pm 90^\circ$ Pitch/ $\pm 180^\circ$ Roll	($\pm 42^\circ$) electrolytic tilt only
Settling time	50 msec	Gyro enabled

Electrical

Parameter	Value	Conditions
Supply Voltage (V _{DD})	5 - 45Vdc unregulated	
Supply Current	40 mA operating	typical
<i>Below values are the same color</i>		
	10 mA idle	typical
	5 mA standby	typical

Environmental

Parameter	Value	Conditions
Operating Temp	-40° to 105°C	-20°C with electrolytic tilt
Storage Temperature	-50° to 150°C	
Humidity	0 to 90%	Non-condensing
Shock	200g	Max horizontal (with electrolytic tilt)

Mechanical

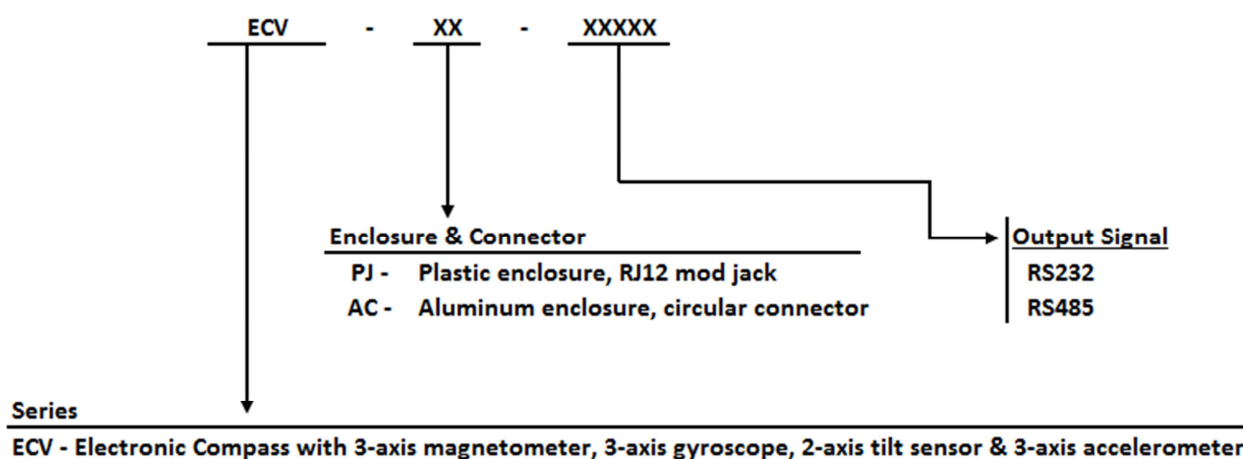
Enclosure material	Plastic Enclosure (P Option): (ABS) Flame Retardant UL94 VO Aluminum Enclosure (A Option): Diecast Aluminum Alloy (Type 360.1)
PCB Size	1.8"W x 3.0"L x 0.6"H
PCB Mounting	4 #4 screws, 1.4" x 2.6" spacing
Connectors	8 pin, single-row, 0.1" friction header 6 pin RJ12 modular jack
Weight	Plastic Enclosure (P Option): 3.2 oz. (90.7 grams) Aluminum Enclosure (A Option): 7.2 oz. (204.1 grams)

Interface

Signal type	RS-232 and RS-485
Baud rate	2400, 4800, 9600, 19200, or 38400 bps
Character Format	8 data, no parity, 1 stop
Input Buffer Size	110 characters
Output Buffer Size	110 characters
Output Format	NMEA 0183 and binary
Output Data Rate	1 to 1650 sentences per minute
Operating Modes	Continuous or sample
Angle Units	Degrees, mils, radians, 16-bit integer

*Specifications subject to change without notice on account of continued product development

How to Order

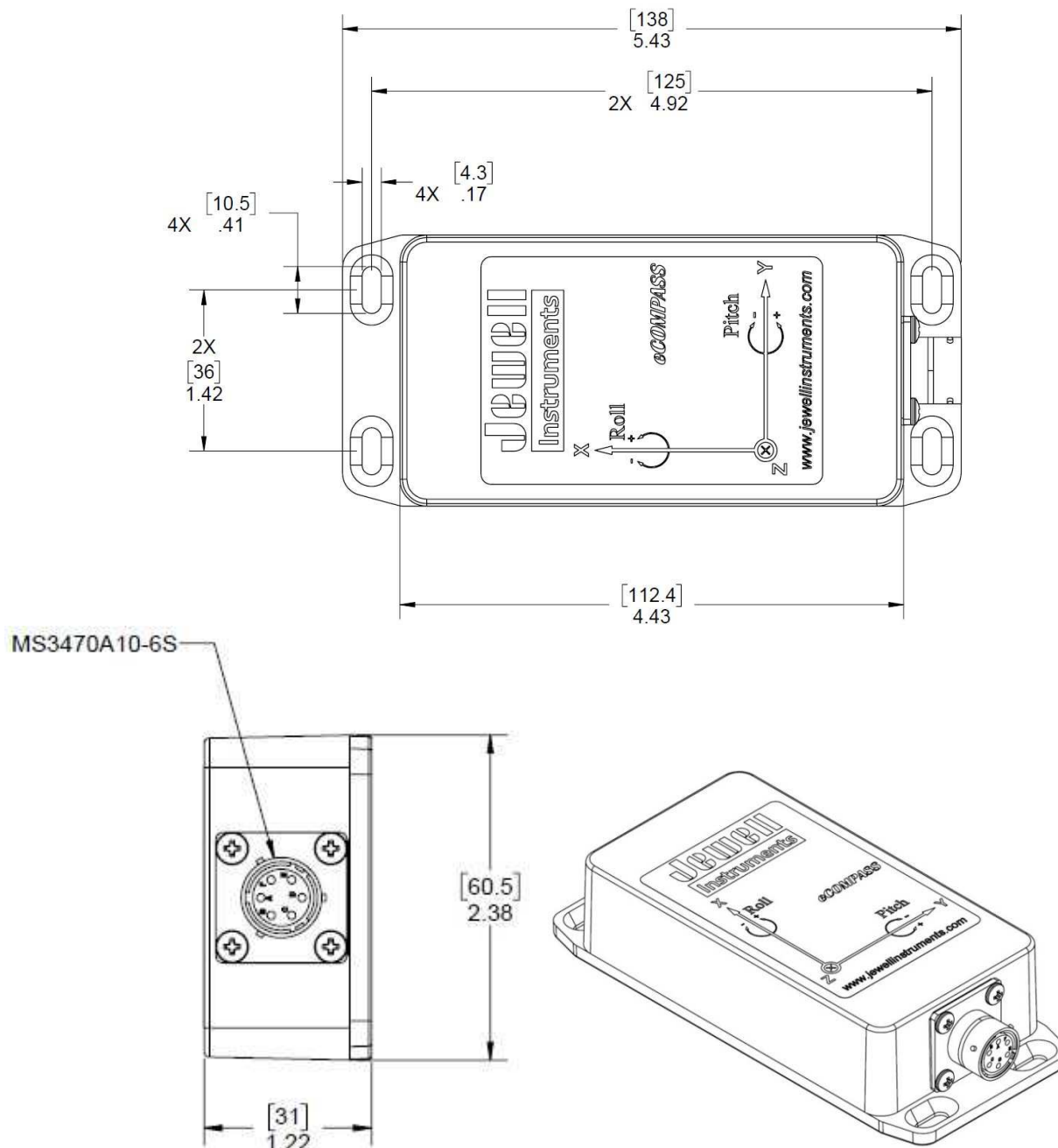


Example:

ECV-PJ-RS232

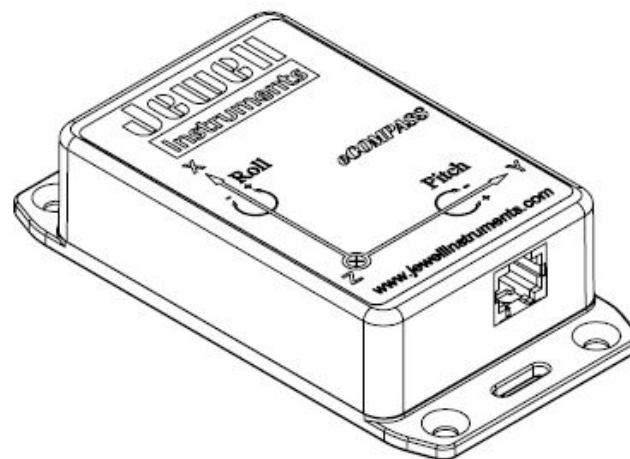
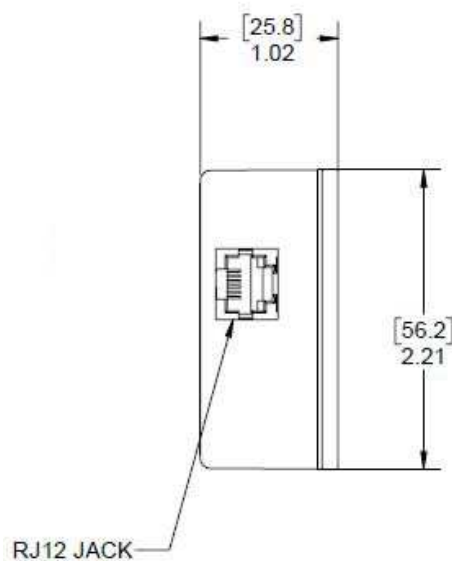
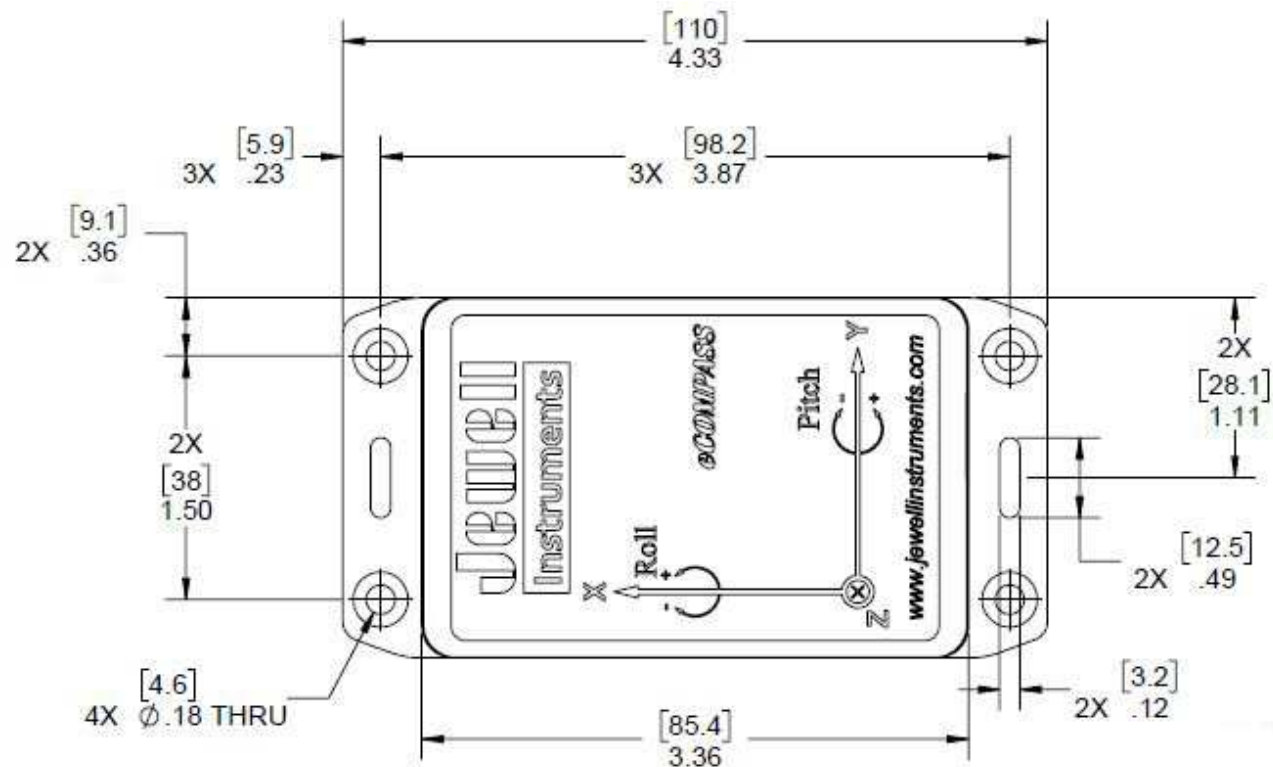
ECV Electronic Compass with 3-axis magnetometer, 3-axis gyroscope, 2-axis tilt sensor & 3-axis accelerometer plastic enclosure, RJ12 mod jack & RS232 output signal

Dimensions of Aluminum Enclosure



Dimensions in IN [MM]

Dimensions of Plastic Enclosure



Dimensions in IN [MM]

Pin Outs

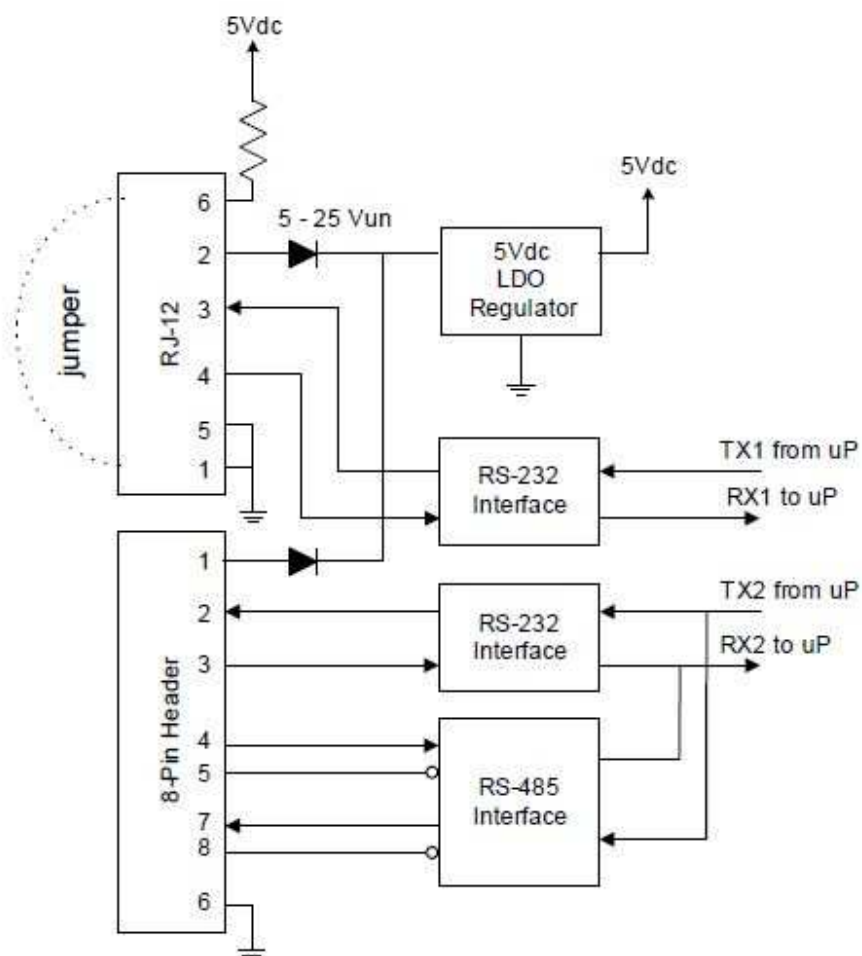
Circular Connector

J1 RJ-12 Jack Pin Out	
Pin 1	Ground
Pin 2	Power
Pin 3	TX
Pin 4	RX
Pin 5	Ground
Pin 6	100K

Mod Jack

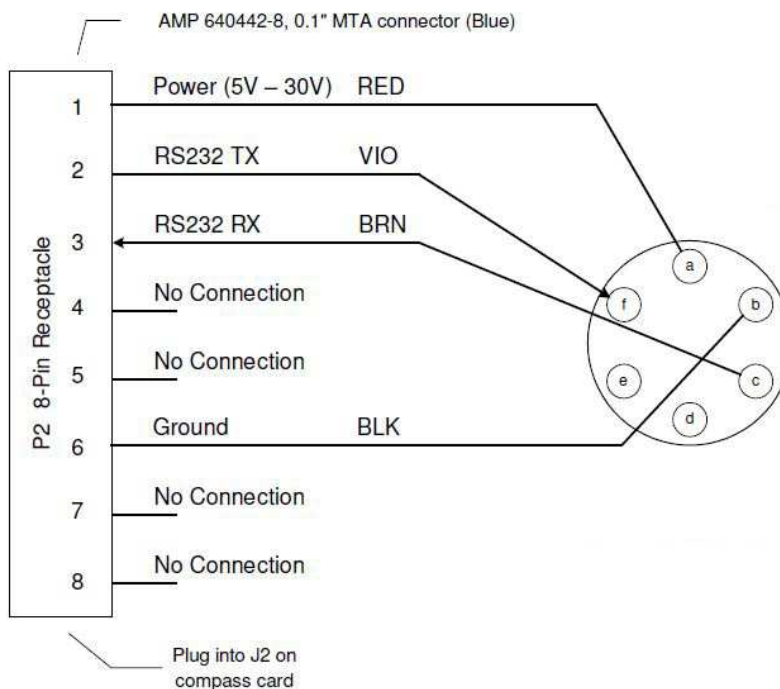
J2 8-Pin Header Pin Out	
Pin 1	Power
Pin 2	RS232 TX Out
Pin 3	RS232 RX In
Pin 4	RS485 RX+
Pin 5	RS485 RX-
Pin 6	Ground
Pin 7	RS485 TX+
Pin 8	RS485 RX-

Interface Block Diagram



Wiring Drawings

RS-232



RS-485

