PNI CommBoard (RS-232, RS-485)

General Description

The CommBoard is a communication interface designed to connect the MicroMag and V2Xe modules to a host system that uses a standard serial interface, such as a PC. It is typically used as a prototyping and evaluation tool for PNI's line of compass and magnetometer modules. The PNI CommBoard is also used for production when the host system requires a higher level serial protocol to interface to the PNI sensor modules. The first version of the PNI CommBoard features a user selectable RS-232 or RS-485 interface to the host system. The CommBoard developer kit comes with software for the PC that has a graphical user interface (GUI) to control every aspect of the CommBoard and any PNI module that is attached to it.

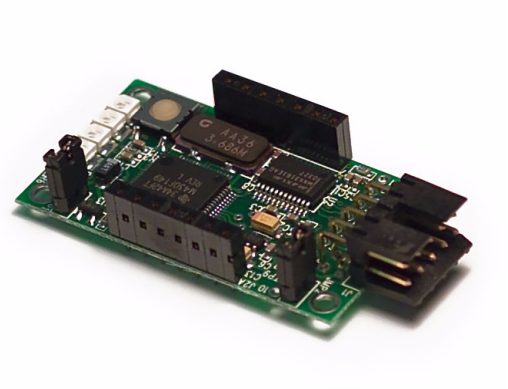
In the future, different interfaces may be made available as customer needs are identified. Please contact PNI for support with your custom interface high-volume opportunity.

Features

- Small size: 53 x 25 x 11 mm
- RS-232 and RS-485 interfaces for connection with PCs or other serial interface systems
- GUI control software available from PNI, either as part of the developer kit or via the web
- Built-in support for PNI MicroMag and V2Xe sensor modules, as well as several future products
- Voltage regulator converts 6 - 12 VDC to 3 VDC for power to the sensor modules
- Minimal code changes required when upgrading from PNI's TCM-2 line of tilt compensated magnetometer compass modules

Applications

- Fast compass and magnetometer prototyping
- New product evaluation
- Education, school projects
- Any legacy compass application that has an RS-232 interface but needs the performance of the new PNI products
- Production applications where standards based protocols are preferred over SPI



Ordering Information

Name	Part Number	Package
CommBoard (with cable and software)	90009	Each
CommBoard	11867	Each

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Specifications

CAUTION

Stresses beyond those listed under Table 1 may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 1. Absolute Maximum Ratings

Symbol	Parameter	Minimum	Maximum
V_{DD}	DC supply voltage	–0.3 VDC	16 VDC
V_{IN}	Input pin voltage (CTS, RxD) to ground	–25 VDC	25 VDC
	Input pin voltage (TxD, RTS) to ground	–13.2 VDC	13.2 VDC
	Input pin voltage (D+, D–) to ground	–13.2 VDC	13.2 VDC
T_{STRG}	Storage temperature	–40 °C	85 °C

Table 2. Characteristics

Parameter	Minimum	Maximum	Typical
Operating Characteristics			
Current - standby (Low power mode, no module loaded)			
LPM0[a]			14.4 mA RMS
LPM1[b]			7.0 mA RMS
LPM2[c]			5.4 mA RMS
RS-232 Receiver Inputs (CTS, RxD)			
Input threshold low	0.6 VDC		
Input threshold high		2.0 VDC	
RS-232 Transmitter Output (TxD)			
Output voltage swing (both transmitter outputs loaded with 3 kΩ to GND)	±5 VDC		±5.4 VDC

Parameter	Minimum	Maximum	Typical
Output resistance V_{CC} = V+ = V– = 0, output = 2 V	300 Ω		10 MΩ
Output short circuit current Output = GND		±60 mA	±30 mA
RS-485 Transceiver Signals (D–, D+)			
Input differential threshold	–200 mVDC	–50 mVDC	
Differential output voltage (R = 27 Ω)	1.5 VDC		
Change in magnitude of differential output voltage for complementary output states (R = 27 Ω or 50 Ω)	–0.2 VDC	0.2 VDC	
Common mode output voltage (R = 27 Ω or 50 Ω)		3.0 VDC	
Change in magnitude of common mode output voltage for complementary output states (R = 27 Ω or 50 Ω)		0.2 VDC	
Output short-circuit current (V_Y or V_Z = +12 V to –7 V)		±250 mA	

a. The unit is in normal operating mode with the LEDs enabled.
b. The unit is in normal operating mode with the LEDs disabled.
c. The unit is in a Sleep mode and will need to be awakened via the CTS (Wake Up) line.

Serial Pin Descriptions

Table 3. Serial Pin Descriptions

Pin	Name	Function
1	TxD	RS-232 transmitter output (transmitted data)
2	Reserved	RS-232 transmitter output (reserved)
3	n/c	not connected
4	RxD	RS-232 receiver input (received data)
5	D–	RS-485 transceiver signal (inverting RS-485 signal)
6	D+	RS-485 transceiver signal (non-inverting RS-485 signal)
7	n/c	not connected
8	GND	Ground
9	VCC	Supply voltage (5 to 12 VDC)
10	GND	Ground

RS-232 and RS-485 Jumper Settings

Refer to Figure 5 on page 2-36 for jumper locations.

Table 4. Jumper Configuration

Configuration	Mode
JMP1 installed[a]	RS-232
JMP1 removed[a]	RS-485
JMP2 installed[b]	RS-485; 120 Ω line termination
JMP2 removed[b]	RS-485; no line termination

a. The processor only checks the status of JMP1 at power up. If the position of the jumper needs to be changed, either cycle the power or press the RESET switch after the change has been made.
b. JMP2 must *only* be installed on the last unit of the network. All other units need to have JMP2 removed for proper RS-485 operation.

Hardware Modes

The CommBoard provides a serial interface to PNI's sensor modules. Its purpose is to translate a serial command from a host system into the appropriate SPI command. If the sensor module does not support the command, it will return the appropriate error code. Otherwise, it will return the associated data. See the applicable PNI module data sheet for specific information on communication and control using the SPI interface.

- RS-232 mode uses software handshaking to communicate.
  - Xon = ^Q = 0 x 11 (okay to send data)
  - Xoff = ^S = 0 x 13 (stop sending data)
- RS-485 mode is only Half-Duplex.
  - The Continuous Output (**go)** command is not allowed since Half-Duplex implies queried responses only.
  - The CommBoard acts as a Slave when the JMP1 is removed.

Example

```
!FF00$C194.74X-106.00Y-403.00Z98.00:E200*1E
!DdSs${data}*<dcs><es>
```

Table 5. Hardware Modes

!	RS-485 data delimiter
Dd	Destination address
Ss	Source address
$	Start data delimiter
{data}	Selected data output
*	End data delimiter
<dcs>	NMEA checksum for a complete string
<es>	End of message based on eol variable <cr> or <lf> or <cr><lf>

NOTE The query and response format must match. All examples in this manual show the query and response of the RS-232 mode. When using RS-485 just add the RS-485 data delimiter, destination address, and source address to the examples shown.

Standard Data Output Modes

PNI Standard Output Mode (sdo=t)

The PNI Standard Output mode may be configured to provide all sensor data available, or only the data you require.

Example

```
$C194.74X-106.00Y-403.00Z98.00:E200*1E
${data}*<dcs><es>
```

Table 6. Standard Output Modes

$	Start data delimiter
{data}	Selected data output
*	End data delimiter
<dcs>	NMEA checksum between “$” and “*”
<es>	End of message based on eol variable <cr> or <lf> or <cr><lf>

NMEA Output Mode (National Marine Electronics Association) (sdo=n)

The NMEA Output mode conforms to the 0183 specification. In this mode, only compass heading information is available.

Example

```
$HCHDM,71.33,M*2F
$HC<sid>,{data},<dt>*<dcs><es>
```

Table 7. NMEA Output Modes

$	Start data delimiter
HC	Heading compass (magnetic), Talker ID
<sid>	Heading magnetic = HDM, heading true = HDT, Sentence ID
,71.33	Heading degrees
<dt>	Data type M = magnetic, T = true
*	End data delimiter
<es>	End of message based on eol variable <cr> or <lf> or <cr><lf>

Raw Output Mode (sdo=r)

The Raw Output mode allows for the output of the raw, uncorrected data for any or all of the required sensors.

Example

```
$raw,X53Y-420Z0*6E
$raw,{data}*<dcs><es>
```

Table 8. Raw Output Modes

$	Start data delimiter
{data}	Selected data output
*	End data delimiter
<dcs>	NMEA checksum between “$” and “*”
<es>	End of message based on eol variable <cr> or <lf> or <cr><lf>

Command Line Interface

The Command Line interface allows you to use a simple terminal program to communicate with the CommBoard. The Command Line interface also allows applications written in Assembly, Basic, or C to communicate with the CommBoard via the RS-232 or RS-485.

Command Sequence

The sequence of command line events is:

1. Type in the command on the terminal program: `cmd?<es>`
2. The module processes the command.
3. A reply is send back to you.
   - **a** If no error `$cmdreply*<dcs><es>`
   - **b** If errer `$cmdreply:Exxx*<dcs><es>`

Table 9. Command Notation Table

Command Symbol	Response Symbol	Description
?		Indicates query only command or variable
=		Indicates assign only command or variable
<aq>		Use **?** for query or **=<val>** for assign
<es>		Ending sequence **<cr>** or **<lf>** or **<cr><lf>**
	$	Start of checksum data
	!	RS-485 address follows
	:	If error occurs; **:Ennn**
	*****	End of checksum data
	<dcs>	Data checksum; between **$** and ***** [a]
	<er>	Start of data
n	**n**	Usually a lower case ‘n’ will represent a digit (0-9).
n.n	**n.n**	Represents a decimal value (positive or negative)
x	**x**	Usually a lower case ‘x’ will represent a hex digit (0-F)
xx	**xx**	Represents a Uint8
xxxx	**xxxx**	Represent a Uint16
xxxxxxxx	**xxxxxxxx**	Represents a Uint32

a. The NMEA XOR checksum method for the values between ‘$’ and ‘*’.

Example Command Notation

`m<aq><es>`

This could be interpreted as a query: `m?<es>`

This could be interpreted as a response: `m=<val><es>`

Example Response Notation

`$m=<val>*<dcs><er>`

Ending Sequence

The CommBoard will accept either <cr> or <lf> or <cr><lf> as an end of line (eol) indicator.

EOL (end of line) Response

The CommBoard will send a response to you in the chosen EOL format.

If (eol=cr)	Send (“\r”)
If (eol=lf)	Send (“\n”)
If (eol=crlf)	Send (“\r\n”)

Error Codes

Error codes are a bitmap to the error that has occurred and are sent when an error condition has occurred.

Example

```
$C194.74X-106.00Y-403.00Z98.00:E200*1E
$Cnnn.nnXnnn.nnYnnn.nnZnnn.nn:Exxx*<dcs><er>
```

Exxx: "xxx" are hex values between 0 - F.

The built-in error command to parse error messages, `error ffff<cr><lf>`, will list the error codes.

Table 10. Error Codes

Code	Description
E800	EEPROM1 error [a]
E400	EEPROM2 error [a]
E200	Module not calibrated
E100	Module not capable
E080	Internal error
E040	Command parameter invalid
E020	Command/data mode conflict
E010	Command invalid or unavailable
E008	Module not found
E004	Magnetometer out of range
E002	Inclinometer out of range
E001	Magnetic distortion alarm [b]

a. Indicates a possible problem with the unit. Please contact PNI Corporation.
b. Indicates that the magnetic field has changed significantly since the last calibration. See the specific module data sheet for the parameter range.

Action Commands

factory (Factory Settings Restore)

Restores the CommBoard and module to the factory default configuration.

Syntax `factory<es>`

Response Format `$factory*<dcs><er>`

go (Continuous Output)

Instructs the CommBoard to enter continuous mode. The CommBoard will begin sampling sensors at the rate specified by the Polling Frequency (**pollfreq)** command.

Syntax `go<es>`

Response Format `${selectData}*<dcs><er>`

Notes Stopped using the **h** command.

h (Halt Continuous Output)

Instructs the CommBoard to exit the continuous output mode.

Valid Values

`h<es>`	if halt = d
`h`	if halt = e

Response Format `$h*<dcs><er>`

help or ? (Help Menu)

Instructs the CommBoard to display the Help menu.

Syntax `help<es> or ?<es?`

Response Format Menu Data

id? (Module Identification)

Displays the module type. If the MicroMag responds with either a 01 or 02, contact PNI Corporation as there could possibly be a damaged or unconnected sensor.

Syntax `id?<es>`

Response Format `$id=xx*<dcs><er>`

Valid Values

xx = 00	None
xx = 01	MicroMag (X sensor only)
xx = 02	MicroMag (Y sensor only)
xx = 03	MicroMag (X and Y sensors)
xx = 10	V2Xe

info? (Module Information)

Displays the CommBoard software version, module type, and module software version, if applicable.

Syntax `info?<es>`

Response Format

`$info,PNI-commboard Vnnn*<dcs>`	CommBoard
`info,{module info}*<dcs>`	Module

Query Commands

c? (Compass Update)

Retrieves the compass heading. Based upon the setting of the Data Output Format **(sdo)** command and the Compass Units **(uc)** command. Refer to "pollfreq" on page 22.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

Syntax `c?<es>`

Response Format `$c{hdg}*<dcs><er>`

Valid Values

hdg = 0 to 359.99	if uc = d
hdg = 0 to 6399	if uc = m

error x (Error Code List)

Retrieves a description of the error code entered from the CommBoard. Refer to "Error Codes" on page 11.

Syntax `error x<es>`

`error ffff<es>`

Response Format `$error x:(description)*<dcs><er>`

Valid Values

`x`	the error number returned by the CommBoard following the "E" in the response string
`ffff`	lists all error codes

I? (Inclinometer Update)

Retrieves the inclinometer values. The inclinometer output is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `i?<es>`

Response Format `$Pn.nRn.n*<dcs><er>`

Valid Values

P	Pitch
R	Roll

m? (Magnetometer Update)

Retrieves the corrected X, Y, and Z axis magnetometer data. Corrected data is that which is used to calculate heading. The Z sensor output is not available on all modules. Refer to the specific module data sheet for more information.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

Syntax `m?<es>`

Response Format `$Xn.nYn.nZn.n*<dcs><er>`

Valid Values `xn.n`

s? (Single Sample Update)

Retrieves the user selected calibration information. Based upon the settings of the various Configuration commands.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

Syntax `s?<es>`

Response Format `${selectedData}*<dcs><er>`

Valid Values

selectedData	varies according to the user settings

sr? (Single Raw Sample Update)

Retrieves the raw data (uncorrected ASIC output) for the sensors selected. For example, X, Y, and Z axis magnetometers. The Z sensor output is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `sr?<es>`

Response Format `${selectedRawData}*<dcs><er>`

Valid Values selectedRawData varies according to the user settings

t? (Temperature Update)

Retrieves the temperature value. Outputs are based on the setting of the Temperature Units (**ut)** command. The temperature output is not available in all modules. Refer to the specific data sheet for more information.

Syntax `t?<es>`

Response Format `$Tn.n*<dcs><er>` !sdo = t

Valid Values `Tn.n` the calibrated temperature sensor output.

x? (X Axis Sensor Update)

Retrieves only the corrected X axis magnetometer values used for heading calculation.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

Syntax `x?<es>`

Response Format `$Xn.n*<dcs><er>`

Valid Values n.n

y? (Y Axis Sensor Update)

Retrieves only the corrected Y axis magnetometer values used for heading calculation.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

Syntax `y?<es>`

Response Format `$Yn.n*<dcs><er>`

Valid Values n.n

z? (Z Axis Sensor Update)

Retrieves only the corrected Z axis magnetometer values. The Z sensor output is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `z?<es>`

Response Format `$Zn.n*<dcs><er>`

Valid Values n.n

Configuration Commands

b (Baud Rate)

Sets the baud rate of the CommBoard.

Syntax `b<aq><es>`

Response Format `$b={value}*<dcs><er>`

Valid Values

Table 11.

0 = 300	5 = 9600 (default)
1 = 600	6 = 19200
2 = 1200	7 = 38400
3 = 2400	8 = 57600
4 - 4800	

Query Response b?<es>

ec (Compass Data Enable)

Enables the compass data output.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

Syntax `ec<aq><es>`

Response Format `$ec={value}*<dcs><er>`

Valid Values

e =	enabled (default)
d =	disabled

Query Response ec?<es>

echo (Echo Characters Enable)

Enables character echo, which directs the CommBoard to echo locally typed characters onto the display.

Syntax `echo<aq><es>`

Response Format `$echo={value}*<dcs><er>`

Valid Values

e =	enabled
d =	disabled (default value)

Query Response echo?<es>

em (Magnetometer Data Enable)

Enables all of the magnetometer data output. For example, `em=e` will set `ex=e`, `ey=e` and `ez=e`.

NOTE If any axis is disabled after `em=e, em?` will still respond with `em=e`.

Syntax `em<aq><es>`

Response Format `$em={value}*<dcs><er>`

Valid Values

e	enabled
d	disabled (default)

Query Response em?<es>

eol (End of Line Enable)

Sets the type of end of line output.

Syntax `eol<aq><es>`

Response Format `$eol={value}*<dcs><er>`

Valid Values

cr	output cr after line
lr	output lr after line
crlf	output crlf after line (default)

Query Response eol?<es>

ep (Pitch Data Enable)

Enables the pitch data output. Pitch output is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `ep<aq><es>`

Response Format `$ep={value}*<dcs><er>`

Valid Values

e	enabled
d	disabled (default)

Query Response ep?<es>

er (Roll Data Enable)

Enables the roll data output. Roll output is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `er<aq><es>`

Response Format `$er={value}*<dcs><er>`

Valid Values

e	enabled
d	disabled (default)

Query Response er?<es>

et (Temperature Data Enable)

Enables the temperature data output. Temperature output is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `et<aq><es>`

Response Format `$et={value}*<dcs><er>`

Valid Values

e	enabled
d	disabled (default)

Query Response et?<es>

ex (X Axis Data Enable)

Enables the X axis data output.

Syntax `ex<aq><es>`

Response Format `$ex={value}*<dcs><er>`

Valid Values

e	enabled
d	disabled (disable)

Query Response ex?<es>

ey (Y Axis Data Enable)

Enables the Y axis data output.

Syntax `ey<aq><es>`

Response Format `$ey={value}*<dcs><er>`

Valid Values

e	enabled
d	disabled (default)

Query Response `ey?<es>`

ez (Z Axis Data Enable)

Enables the Z axis data output. The Z sensor output is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `ez<aq><es>`

Response Format `$ez={value}*<dcs><er>`

Valid Values

e	enabled
d	disabled (default)

Query Response ez?<es>

halt (Single Character Halt Enable)

Enables sending a single Halt (**h**) command to cancel the Continuous Output (**go)** mode.

Syntax `halt<aq><es>`

Response Format `$halt={value}*<dcs><er>`

Valid Values		
	e	enabled; h (default)
	d	disabled; h<es>

Query Response halt?<es>

lpm (Low Power Mode)

Selects the low power mode for the CommBoard. Once set to `lpm=2`, the CommBoard will "wake" from ultra low power and go into `lpm=0` when it receives a character over the RS-232 interface. Table 2 on page 3 lists the current draw at the different lpm levels.

Syntax `lpm<aq><es>`

Response Format `$lpm={value}*<dcs><er>`

Syntax		
	0	no conversion (default)
	1	LEDs off
	2	ultra low power

Query Response `lpm?<es>`

pollfreq (Polling Frequency)

Sets the sample polling frequency of the Continuous Output (**go)** command.

Syntax `pollfreq<aq><es>`

Response Format `$pollfreq=nn*<dcs><er>`

Syntax		
	nn	0 = 1 sample/2 seconds 1 - 16 = value in Hz (default is 8)

Query Response `pollfreq?<es>`

rs485 (RS-485 Slave Address)

Sets the slave address for the CommBoard in RS-485 mode.

Syntax `rs485<aq><es>`

Response Format `$rs485=xx*<dcs><er>`

Syntax	xx	00 to 7F (default is 00)

Query Response `rs485?<es>`

sdo (Data Output Format)

Sets the data output format to PNI standard, NMEA, or RAW. Refer to “Standard Data Output Modes” on page 6 for more information.

Syntax `sdo<aq><es>`

Response Format `$sdo={value}*<dcs><er>`

Valid Values	t	PNI standard format (default)
	n	NMEA 0183 compatible format
	r	raw output format (uncorrected from sensors)

Query Response `sdo?<es>`

uc (Compass Units)

Sets the compass output to either degrees or mils.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

Syntax `uc<aq><es>`

Response Format `$uc={value}*<dcs><er>`

Valid Values	d	degrees (default)
	m	mils

Query Response uc?<es>

ui (Inclinometer Units)

Sets the inclinometer units to either degrees or mils. Inclinometer output is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `ui<aq><es>`

Response Format `$ui={value}*<dcs><er>`

Valid Values

d	degree (default)
m	mils

Query Response ui?<es>

ut (Temperature Units)

Sets the temperature units to either degrees or mils. Thermometer output is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `ut<aq><es>`

Response Format `$ut={value}*<dcs><er>`

Valid Values

f	Fahrenheit (default)
c	Celsius

Query Response `ut?<es>`

Module Commands

cc (Clear Calibration Data)

Clears the previous calibration information. This option is based on the calibration of the PNI Corporation's TCM2 module and is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `cc<es>`

Response Format `$cc*<dcs><er>`

cclip (Inclinometer Clip Value)

Sets the clipping value for the maximum positive and negative angle of the inclinometer. When the inclinometer angle exceeds this value, it is clipped to the set value along with an out of range flag. This option is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `cclip<aq><es>`

Response Format `$cclip=nn.n*<dcs><er>`

Syntax	nn.n	0 to maximum tilt value allowed by the module (0 is the default)

Query Response `cclip?<es>`

damping (Digital Damping Enable)

Enables digital damping on the compass heading output. Refer to specific module data sheet for more information.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

Syntax `damping<aq><es>`

Response Format `$damping={value}*<dcs><er>`

Syntax

d	disabled (default)
e	enabled

Query Response `damping?<es>`

dampsize (Digital Damping Sample Size)

Sets the value for the digital damping of the compass heading output. Refer to specific module data sheet for more information.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

Syntax `dampsize<aq><es>`

Response Format `$dampsize=nn*<dcs><er>`

Syntax

nn	1 - 8 for the MicroMag (1 is the default)
	1 - 8 for the V2Xe (1 is the default)

Query Response `dampsize?<es>`

lc (Last Calibration Score)

Retrieves the last calibration score. This option is based on the calibration score of the PNI Corporation's TCM2 module and is not available on all modules. Refer to the specific module data sheet for more information.

Syntax `lc?<es>`

Response Format `$HnVnMn.n*<dcs><er>`

Syntax n is equal to the score value.

Hn	0 - 9
Vn	0 - 9
Mn.n	>0

mag_dec (Declination Value)

Sets the declination offset for a reading of True North. Based on the setting of the Compass Units (**uc)** command. Positive declination is easterly declination and negative is westerly declination. This is not applied until True North is set to true.

Declination, also called magnetic variation, is the difference between true and magnetic north, relative to a point on the earth. It is measured in degrees east or west of true north. Correcting for declination is accomplished by storing the correct declination angle, and then changing the heading reference from magnetic north to true north. Declination angles vary throughout the world, and change very slowly over time. For the greatest possible accuracy, go to the National Geophysical Data Center web page below to get the declination angle based on your latitude and longitude: `http://www.ngdc.noaa.gov/cgi-bin/seg/gmag/fldsnth1.pl`

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

Syntax `mag_dec<aq><es>`

Response Format `$mag_dec=nnn*<dcs><er>`

Syntax

nnn = ±180	If `uc = d`, then mag_dec is in degrees (default is 0)
nnn = ±3200	If `uc = m`, then mag_dec is in mils (default is 0)

Query Response `mag_dec?<es>`

mpcal (Multi-Polled Calibration Enable)

Enables the multi-polled calibration.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

2-Axis Compass Calibration using the CommBoard

Calibration is the process used with PNI sensor technology to separate the earth's magnetic field from magnetic field distortions. Magnetic field distortions are created by the environment into which the sensors are mounted. By implementing a simple calibration routine with the sensors in a fixed position within the host system, the maximum and minimum strength fields can be determined and then used to correct the sensor output for the distortions present. A calibration should be performed under the following conditions:

- when the unit is first installed into a host system.
- when the unit is moved.
- when the unit indicates that it is in need of a calibration.

Follow the steps below to perform a calibration.

1. Place the unit to be calibrated into the host system.
2. Set the unit at its intended operating position in as level of a position as possible.
3. Sent the Multi-Polled Calibration Enable (`mpcal=e`**)** command. This enables the calibration routine.
4. Rotate the unit through two 360 degree circles while maintaining a level position. The rotations should be no faster than 30 seconds each to achieve the highest possible accuracy.
5. Sent the Multi-Polled Calibration Disable (`mpcal=d`) command. This disables the calibration routine.
6. Send the Save Settings (`save`) command to save the calibration information to the CommBoard and the attached module, where applicable.

Syntax `mpcal<es>`

Response Format `$mpcal{value}*<dcs><er>`

Syntax

d	disabled (default)
e	enabled

Query Response mpcal?<es>

ps (ASIC Period Select)

Sets the value for the ASIC period select. The lowest setting (/32) will provide the fastest response, but the lowest resolution. The highest setting will provide the slowest response, but the highest resolution. Refer to specific module data sheet for more response times and maximum setting allowed.

Syntax `ps<aq><es>`

Response Format `$ps=n*<dcs><er>`

Syntax

n =	= 0	= /32
	= 1	= /64
	= 2	= /128
	= 3	= /256
	= 4	= /512 (default)
	= 5	= /1024
	= 6	= /2048
	= 7	= /4096

Query Response `ps?<es>`

save (Save Settings)

Saves the configuration parameters to the CommBoard and attached module (where applicable). Also used to save calibration coefficients to the CommBoard and attached module (where applicable).

Syntax `save<aq><es>`

Response Format `$save*<dcs><er>`

sn (North Mode)

Used to set either True or Magnetic North. True North sets the heading reference to True North or Magnetic North. If the value is set to true, then declination is applied to get the True North heading.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), the CommBoard will calculate and output this data.

Syntax `sn<aq><es>`

Response Format `$sn={value}*<dcs><er>`

Syntax		
	m	magnetic (default)
	t	true

Query Response `sn?<es>`

be (Big Endian)

Used to set the endianism of multi-byte parameters (Float32, Uint32, SInt32). If enabled, all parameters communicated between the module and the CommBoard are assumed to be big endian, if disabled they are assumed to be little endian.

NOTE For modules that do not have an onboard processor (for example, the MicroMag), this setting will not apply.

Syntax `be<aq><es>`

Response Format `$be={value}*<dcs><er>`

Syntax		
	e	enabled (default)
	d	disabled

Query Response `be?<es>`

SPI Interface to Sensor Module

Table 12. SPI Pin Descriptions

Pin	Name	Description
1	SCLK	Serial clock output for the SPI port
2	MISO	Serial data input. Master In Slave Out
3	MOSI	Serial data output. Master Out Slave In
4	SSNOT	Active low chip select for SPI port
5	DRDY	Data ready input
6	SYNC	Sync output
7	GND	Ground
8	GIO0	Reserved I/O
9	GIO1	Reserved I/O
10	GIO2	Reserved I/O
11	GIO3	Reserved I/O
12	VDD	Supply voltage, 3 VDC regulated
13	VCC	Unregulated CommBoard input supply voltage
14	GND	Ground

SPI Port Pin Descriptions

MOSI
Master Out Slave In

The data sent to the CommBoard. Data is transferred most significant bit first. The MOSI line will accept data once the SPI is enabled by taking SSNOT low. Valid data must be presented at least 100 nS before the rising edge of the clock, and remain valid for 100 nS after the edge. New data may be presented to the MOSI pin on the falling edge of SCLK.

SSNOT
Slave Select Line

Selects the CommBoard as the operating slave device. The SSNOT line must be low prior to data transfer and must stay low during the entire transfer. Once the command byte is received by the CommBoard, and the CommBoard begins to execute the command, the SSNOT line can be deselected until the next SPI transfer.

SCLK
Serial Clock

Used to synchronize both the data in and out through the MISO and MOSI lines. SCLK is generated by a master device. SCLK should be 1 MHz or less. The CommBoard is configured to run as a slave device, making it an input. One byte of data is exchanged over eight clock cycles. Data is captured by the master device on the rising edge of SCLK. Data is shifted out and presented to the CommBoard on the MOSI pin on the falling edge of SCLK.

MISO
Master In Slave Out

The data sent from the CommBoard to the master. Data is transferred most significant bit first. The MISO line is placed in a high impedance state if the slave is not selected (SSNOT = 1).

SPI Hardware Handshaking Line Descriptions

SYNC

SYNC is usually low. SYNC must be toggled from low-high-low. This is the SPI reset. This line is used to reset the SPI slave when communications get out of synchronization. SYNC is normally used during the module startup.

DRDY
Data Ready

The module returns DRDY. DRDY is low after a SYNC. Once a command has been received and the data is read, DRDY goes high. This is only used with modules that do not have processor.

N O T E

See the applicable PNI module data sheet for specific information on communication and control using the SPI interface.

PNI CommBoard (RS-232 and RS-485)

LED Status Indicators

1 A live indicator, toggling every 1/2 second.

2 Not used.

3 Not used

4 On during transition, off when not in transition.

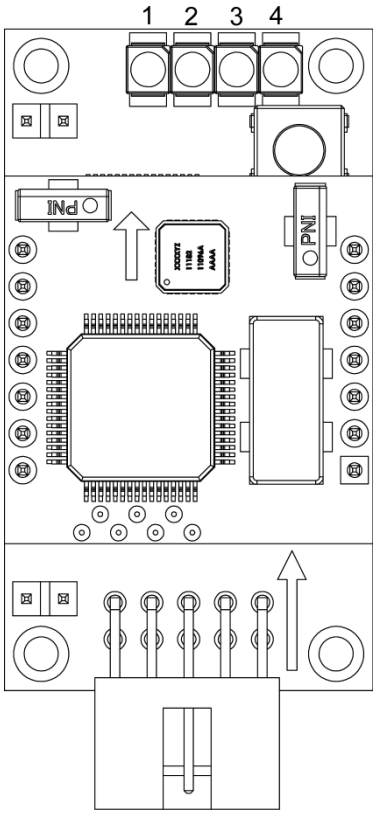

Figure 1. CommBoard Status Indicators

Communication Block Diagram

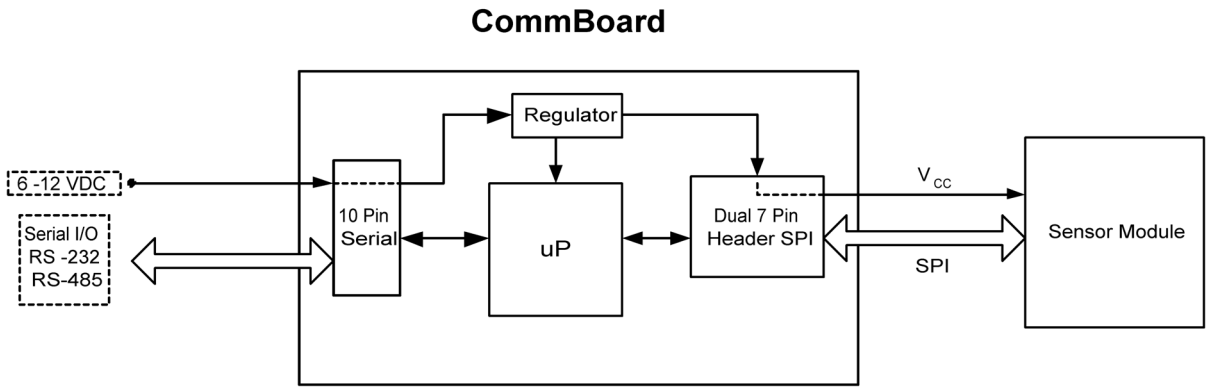

Figure 2. Block Diagram

Assembly Views

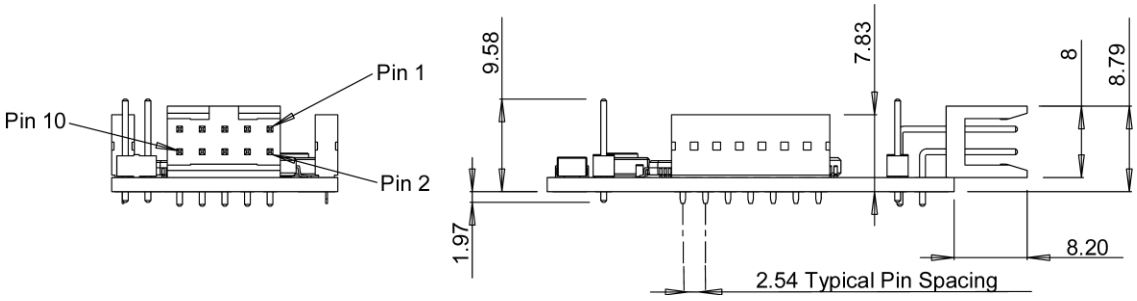

Figure 3. Side Views

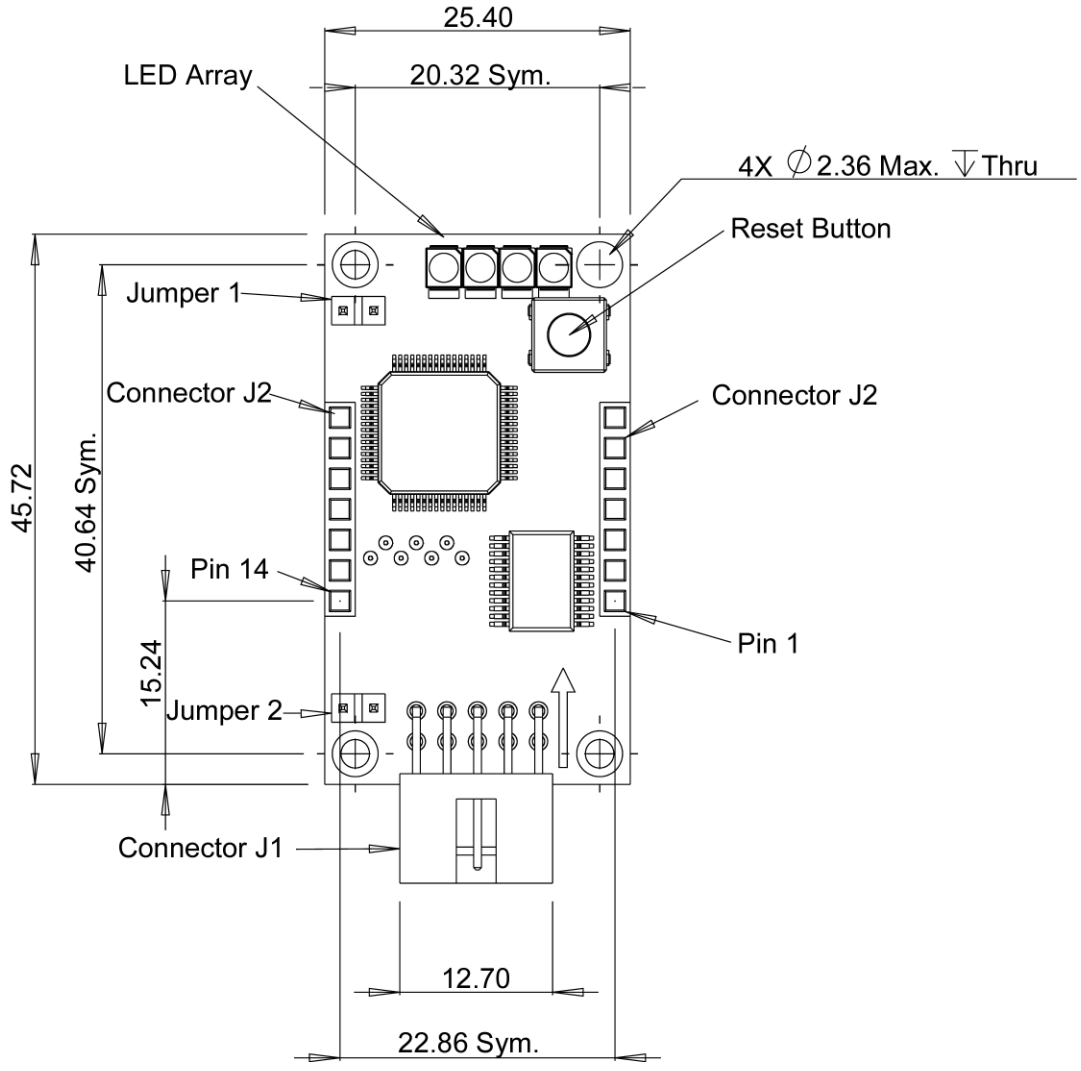

Figure 4. Top View

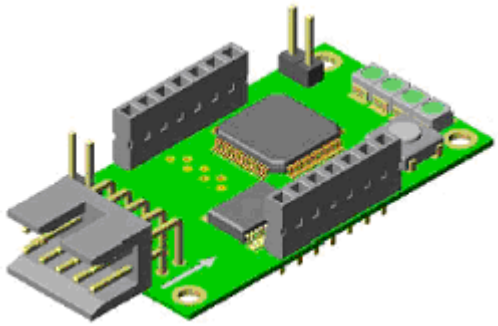

Figure 5. Jumpers and Connectors

Table 13. Connector J1

Pin	Name	Function
1	TxD	RS-232 transmitter output
2		Reserved
3	CTS	Clear to send
4	RxD	RS-232 receiver input
5	D–	RS-485 transceiver signals
6	D+	RS-485 transceiver signals
7	n/c	Not connected
8	GND	Ground
9	VCC	Supply voltage
10	GND	Ground

Table 14. Connector J2

Pin	Function	I/O Direction
1	SCLK	Output
2	MISO	Input
3	MOSI	Output
4	SSNOT	Output
5	DRDY	Input
6	SYNC	Output
7	GND	
8	GIO0	Output low
9	GIO1	Output low
10	GIO2	Output low
11	GIO3	Output low
12	VDD	
13	VCC	
14	GGND	

Table 15. Jumper Configuration

Configuration	Mode
JMP1 installed	RS-232
JMP1 removed	RS-485
JMP2 installed	RS-485 termination
JMP2 removed	RS-485 no termination

Interchangeable Sensor Module

Unless otherwise stated:

- This document pertains to PNI Corporation part number 11588.
- All units are in metric, millimeters.
- Tolerances are ±0.1 mm.
- Table 13 provides pinout definitions for connector J1.
- Table 14 provides pinout definitions for connector J2.
- The arrow on callout 6 on Figure 6 is defined as pointing in the outward direction.

CAUTION

During installation, ensure that the white silk-screened arrows on both the stacked board and the CommBoard are pointing towards CommBoard LEDs. Do not misalign or plug the stacked board into the 7-pin headers backwards. Refer to Figure 6 and to Figure 7.

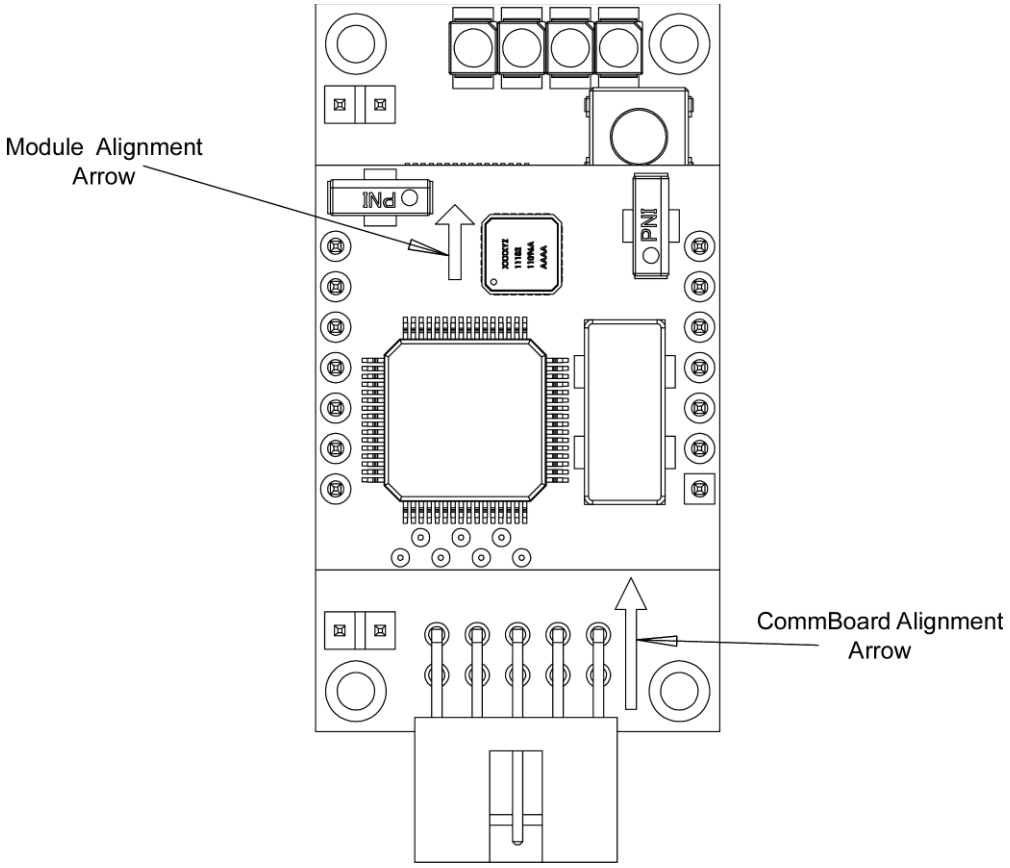

Figure 6. CommBoard with Module Plugged-In

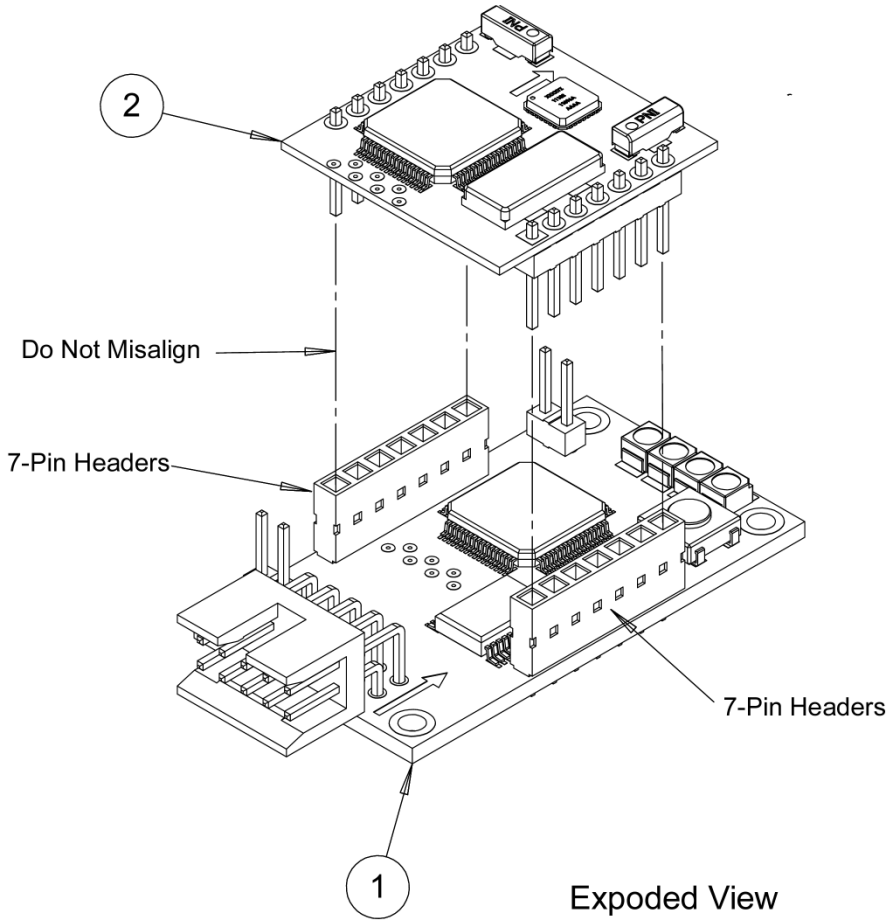

Figure 7. CommBoard with Interchangeable Sensor Module

- Item 1, CommBoard
- Item 2, Interchangeable sensor module

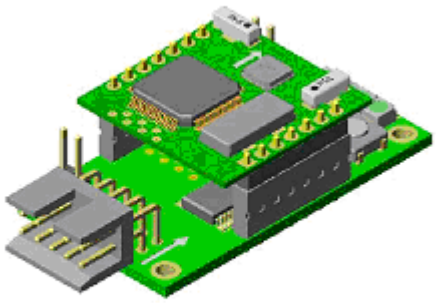

Figure 8. Assembled CommBoard

Dual In-Line and DB9 Connectors

Unless otherwise specified:

1. All units are in standard U.S. inches.
2. Cable assemply specifications provided in Table 16.
3. The pin descriptions for the DB9 female connector are provided in Table 17.
4. The pin descriptions for the Dual In-Line connector are provided in Table 18.
5. The 9 VDC power cables should be 3.0 x 0.2 inches in length.

Table 16. Cable Assembly, refer to Callouts on Figure 9

Item Number	PNI Part Number	Description	Approved Vendor	Vendor Part Number
1	10357	10 conductor 24 AWG stranded (7 x 32)	Belden	9540
2	11772	Crimp housing	FCI	65846-010
3	11710	Strap battery 9 VDC I-style 4” lead	Keystone	2238
4	11712	D-SUB 9 connector, female	JIC	DB-09S-UL
5	11711	Metal hood, U-shaped	JIC	HD-09MTL-V
6	11773	Connector crimps	FCI	482510-000

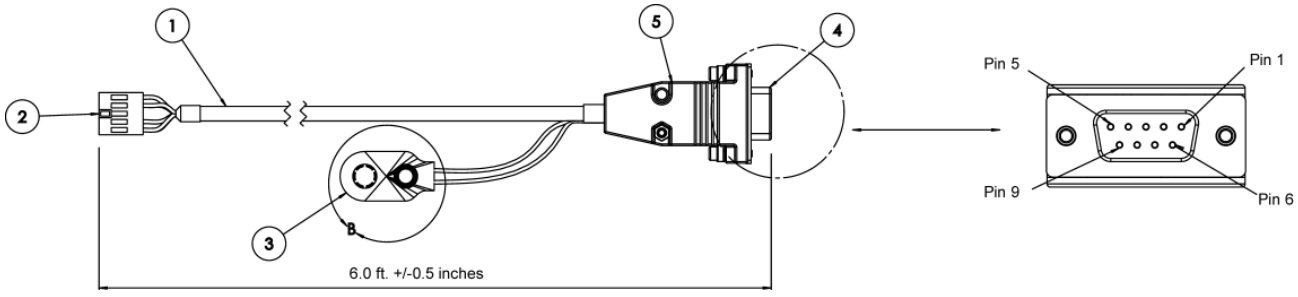

Figure 9. Cable Assembly

Table 17. DB9 Connector Pin Descriptions. Refer to Figure 10.

Pin	Wire	Description
1	not connected	
2	Yellow	TxD (RS-232)
3	Blue	RxD (RS-232)
4	not connected	
5	Green	GND
6	not connected	
7	White	CTS
8	not connected	
9	not connected	

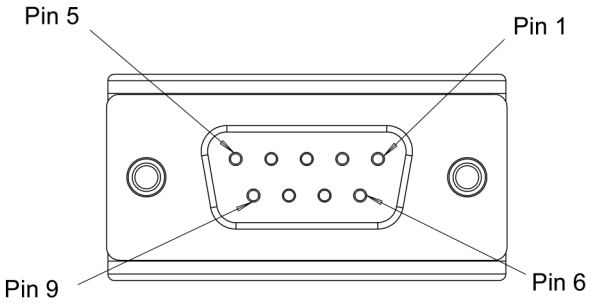

Figure 10. DB9 Close-up

Table 18. Dual In-Line Pin Descriptions. Refer to Figure 11.

Pin	Wire	Description
1	Yellow	TxD (RS-232)
2	not connected	
3	White	CTS
4	Blue	RxD (RS-232)
5	not connected	
6	not connected	
7	not connected	
8	Green	GND
9	Red	Vsupply 5 to 12 VDC
10	Black	GND

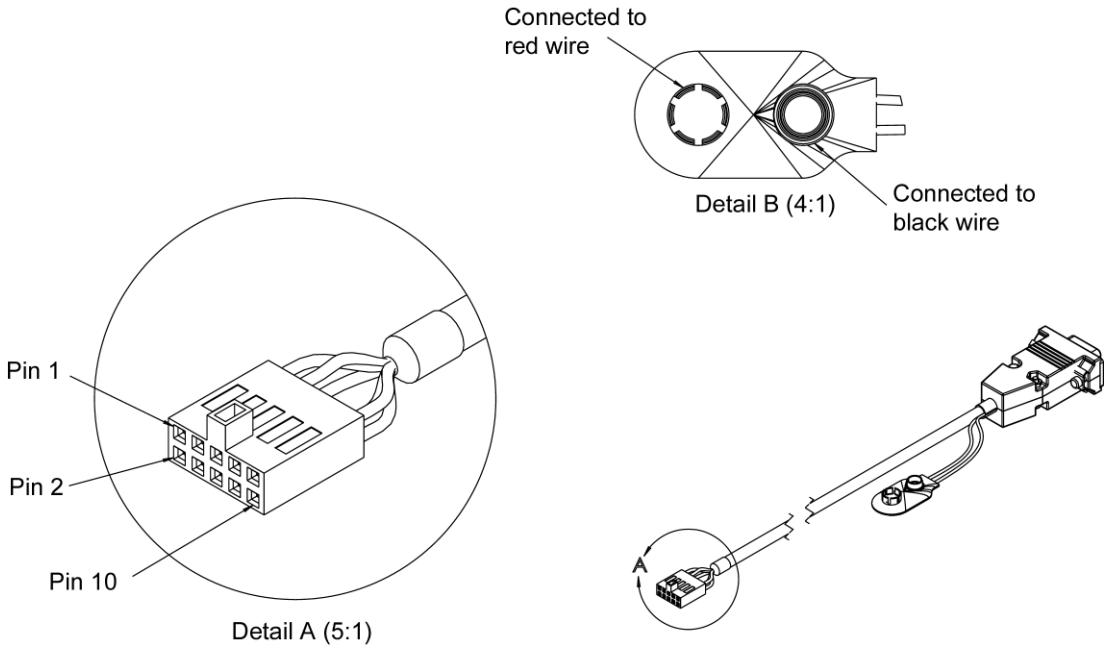

Figure 11. Dual In-Line Connector