Operating Instructions

AT10.1/AT30 SERIES

MICROPROCESSOR-CONTROLLED FLOAT BATTERY CHARGER
COMMUNICATIONS MODULE

(DNP3 Level 2 / Modbus Protocols)

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AT SERIES COMMUNICATIONS MODULE

DNP3 LEVEL 2 / MODBUS COMMUNICATIONS
FOR THE AT10.1 AND AT30 SERIES BATTERY CHARGERS

- The AT Communications Module allows the user to remotely monitor and control the AT Series Battery Charger over a serial connection.
- Supports DNP3 Level 2 and Modbus protocols over RS-232 or RS-485 half-duplex.
- The option can be used with a modem for telephone communications.
- All features of the AT Series front instrument panel are accessible remotely.
- SCADA (Supervisory Control And Data Acquisition) systems will be able to control, monitor, and log the events of the battery charger.

SUPPLIED COMPONENTS

The AT Series Communications Module option (**EJ5037-0#**) includes the AT Series Communications PC Board (A12), external power supply resistor(s) (R29), this Operating Instructions manual (**JA5026-00**), and a field-retrofit instruction sheet (**JD5008-00**). A compatible industry-standard modem and modem cable are also available. Refer to the items listed below for part information and check off which items were supplied.

STANDARD COMMUNICATION MODULES   Part No

- ☐ Communications Module for **12 Vdc** AT charger   EJ5037-01
- ☐ Communications Module for **24 Vdc** AT charger   EJ5037-02
- ☐ Communications Module for **48 Vdc** AT charger   EJ5037-03
- ☐ Communications Module for **130 Vdc** AT charger   EJ5037-04

OPTIONAL ACCESSORIES   Part No

- ☐ Ethernet Interface (Modbus)   EJ5226-0#
- ☐ Ethernet Interface (DNP3)   EJ5226-1#
- ☐ Fiber Optic Modem Interface (Modbus/DNP3)   EJ5230-##

SUPPLEMENTAL DOCUMENTATION

A number of supplemental documents for the AT Series Communications Module option are available online, and may be used in conjunction with this manual:

Doc. No.	Online Hyperlink	Description
JA0102-04	http://www.ATSeries.net/PDFs/JA0102-04.pdf	AT Series Comm. Mod. Manual
JD5008-00	http://www.ATSeries.net/PDFs/JD5008-00.pdf	AT Comm. Mod. Field Install.
JD5012-00	http://www.ATSeries.net/PDFs/JD5012-00.pdf	Main Ctrl PCB A1 Replacement
JE5107-00	http://www.ATSeries.net/PDFs/JE5107-00.pdf	AT Series Comm. Mod. Assy.
JF5026-00	http://www.ATSeries.net/PDFs/JF5026-00.pdf	AT Series Comm. Module FAQs

1 Introduction

The AT Series Communications Module option allows user's to remotely monitor and control an AT Series Battery Charger over a serial connection. With this option, users may perform remotely everything that is accessible at the charger's front panel display. The communications option supports DNP3 Level 2 and Modbus protocols over RS-232 or RS-485 serial communications. Configuration is done by DIP switches and a setup program for additional parameters. The communications board supports baud rates of 9600 bps and 19200 bps. For more information see the Frequently Asked Questions in Appendix A

2 Protocols

2.1 Modbus

The communications option can be setup to communicate on standard Modbus networks using either of two transmission modes: ASCII (American Standard Code for Information Interchange) or RTU (Remote Terminal Unit). The advantage of ASCII allows less strict serial timing requirements without causing communication errors. The advantage of RTU allows more data to be transmitted than ASCII mode for higher throughput.

Modbus ASCII mode supports the following serial settings:
- No parity, 7 data bits, 2 stop bits
- Even parity, 7 data bits, 1 stop bit
- Odd parity, 7 data bits, 1 stop bit

Modbus RTU mode supports the following serial settings:
- No parity, 8 data bits, 2 stop bits
- Even parity, 8 data bits, 1 stop bit
- Odd parity, 8 data bits, 1 stop bit

Refer to the Modbus Section 6 on page 28 for information on its implementation.

2.2 DNP3

The communications option supports DNP3 Level 2. This implementation of DNP3 meets Level 2 conformance and supports change events with unsolicited messaging.

The DNP3 Level 2 protocol supports the following serial settings:
- No parity, 8 data bits, 1 stop bit
- No parity, 8 data bits, 2 stop bits
- Even parity, 8 data bits, 1 stop bit
- Odd parity, 8 data bits, 1 stop bit

Refer to the DNP V3.00 Section 5 on page 17 for information on its implementation.

3 Hardware

3.1 Installation

<div style="background-color:orange;text-align:center">⚠ WARNING</div>

Disconnect and lock out all power to the battery charger before starting any maintenance procedures. Turn the ac power off at the distribution panel upstream from the battery charger. Disconnect the battery from the charger output terminals. This includes remote sense wires if they were installed.

<div style="background-color:blue;color:white;text-align:center">NOTICE</div>

This part is susceptible to damage from static discharge. Please use the following precautions:

- If you have a ground wrist strap, please use it to ground yourself to the charger enclosure using the ground stud on the back of the door.
- Touch the ground stud on the back of the door before handling circuit boards or other static sensitive parts.
- Handle circuit boards only by their edges.
- Ground yourself again before you replace any connectors or terminals on the new part.
- If you are replacing a static sensitive circuit board parts, be sure you are grounded before removing the new part from its anti-static carrier.

Installation Steps

Step 1 Turn off the ac and dc circuit breakers on the charger. Using a voltmeter, verify that all potential voltages on the I/O panel are zero. This includes the dc output terminals TB1(+) & TB1(-), and the Remote Sense terminals (+) & (-).

Step 2 Locate the stand-offs that hold the main control card. Use needle nose pliers to pinch the retaining ear on the stand-offs, and gently pull the main control card back off the stand-offs, roughly 0.25 inches. It is best to unlatch all stand-offs first with the main control card still resting on them. Finally, remove the main control card in one motion.

Step 3 The EN5004-## communications module pc board (A12) mounts to the left of the EN5002-00 main control pc board (A1), with connector (P13) plugged into J13. Make sure that the pins on the connector line up. See **Figure 1**.

Step 4 Position the boards over the stand-offs. Firmly push both boards onto the stand-offs until they are fully seated under the plastic clips. Minimize pc board flexing by pushing directly on the areas surrounding stand-offs holes. Check the front panel for proper alignment of indicating lights and push button switches.
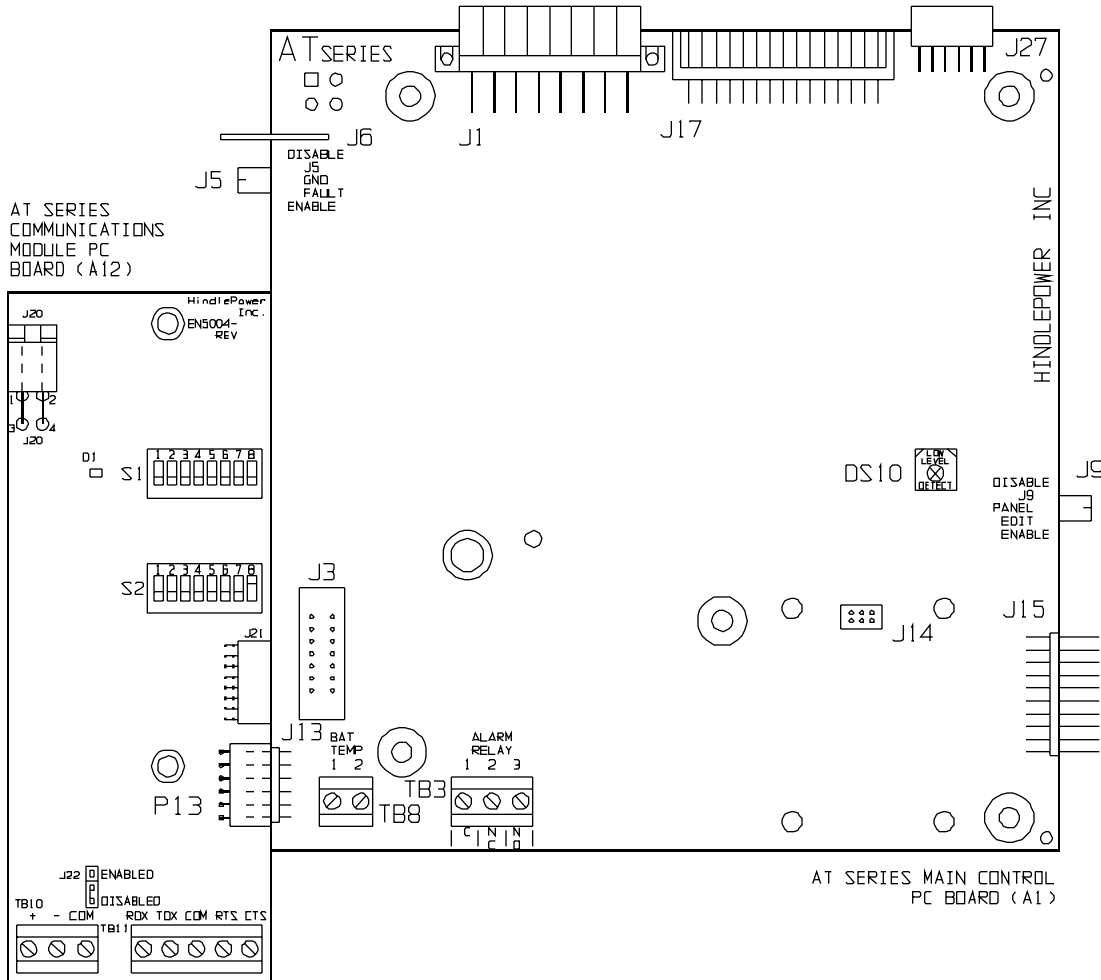
Figure 1
EN5004-00 AT Series Communications PC Board (A12)
Connected To EN5002-00 Main Control PC Board (A1)

Step 5 Connect the ballast resistor(s) (R29) to the power supply connection plug (J20). Pin 2 on J20 is +Vdc and pin 4 is common. See **Figure 2**.

Step 6 Connect the serial connection to TB10 for RS-485 (see Section 3.2.1 on page 5) or TB11 for RS-232 (see Section 3.2.2 on page 8).

Step 7 Check your work, read all the steps again, and make sure that all the instructions were performed.

Checks:

    ☐   All stand-offs are fully latched.
    ☐   All wire harness connectors are properly mated.
    ☐   Indicator lights properly align with the front panel.
    ☐   Push button switches work properly.

COMPONENT LISTING
AT Series Communications PC Board (A12)

INDICATOR LIGHTS:
D1   Status LED

JUMPERS:
J20   Power Supply Connection
J21   Factory Connection
J22   RS-485 Terminating Resistor
      (enable/disable)

CONNECTORS:
P13   Plug for Main Control PC Board (A1)
      J13 Connection

SWITCHES:
S1   Configuration Switches
S2   Modbus Address

TERMINAL BLOCKS:
TB10 RS-485 User Connection
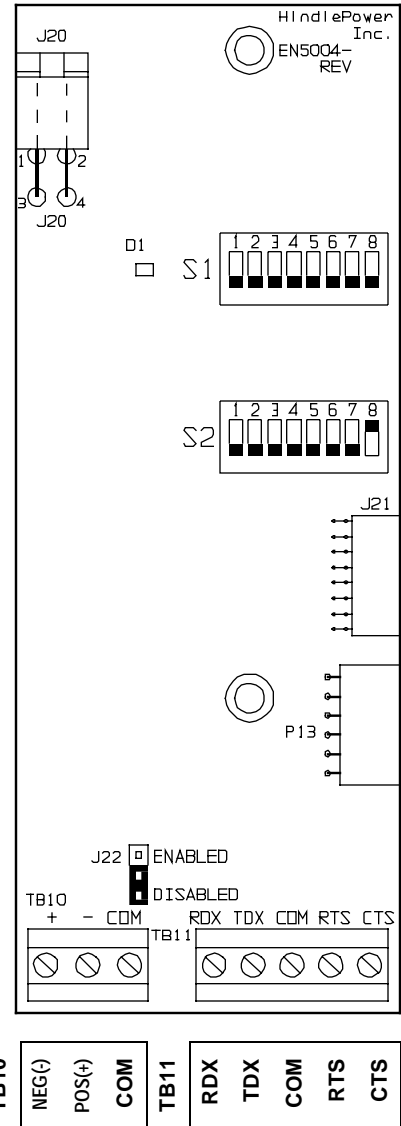TB11 RS-232 User Connection

Figure 2
EN5004-00 AT Series
Communications PC Board (A12)

3.2 Serial Connections

The communications option supports RS-232 and RS-485. RS-232 is a standard serial communications used on personal computers. It has a limited cable distance and is susceptible to electrical noise. RS-485 serial communications allow longer distances and allow multiple devices to be connected to the same serial network. TB10 terminal block is for the RS-485 connections and TB11 terminal block is for the RS-232 connections.

3.2.1 RS-232

Set configuration switch S1-5 to OFF to select RS-232. Configuration switch S1-6 enables or disables the RTS and CTS handshaking lines. Terminal block

TB11 User Connection				
Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
RDX	**TDX**	**COM**	**RTS**	**CTS**

TB11 is for the RS-232 user connections. In each section for RS-232 3-wire and 5-wire installation, a typical connection diagram is shown. Each diagram shows the pin-out used for a standard personal computer (PC) for either a 25-pin or 9-pin serial connection.

HARDWARE

3.2.1 RS-232 3-Wire

For a RS-232 3-wire operation, the hardware handshaking lines are disabled. Disable the hardware handshaking lines by setting configuration switch S1-6 to the OFF position.
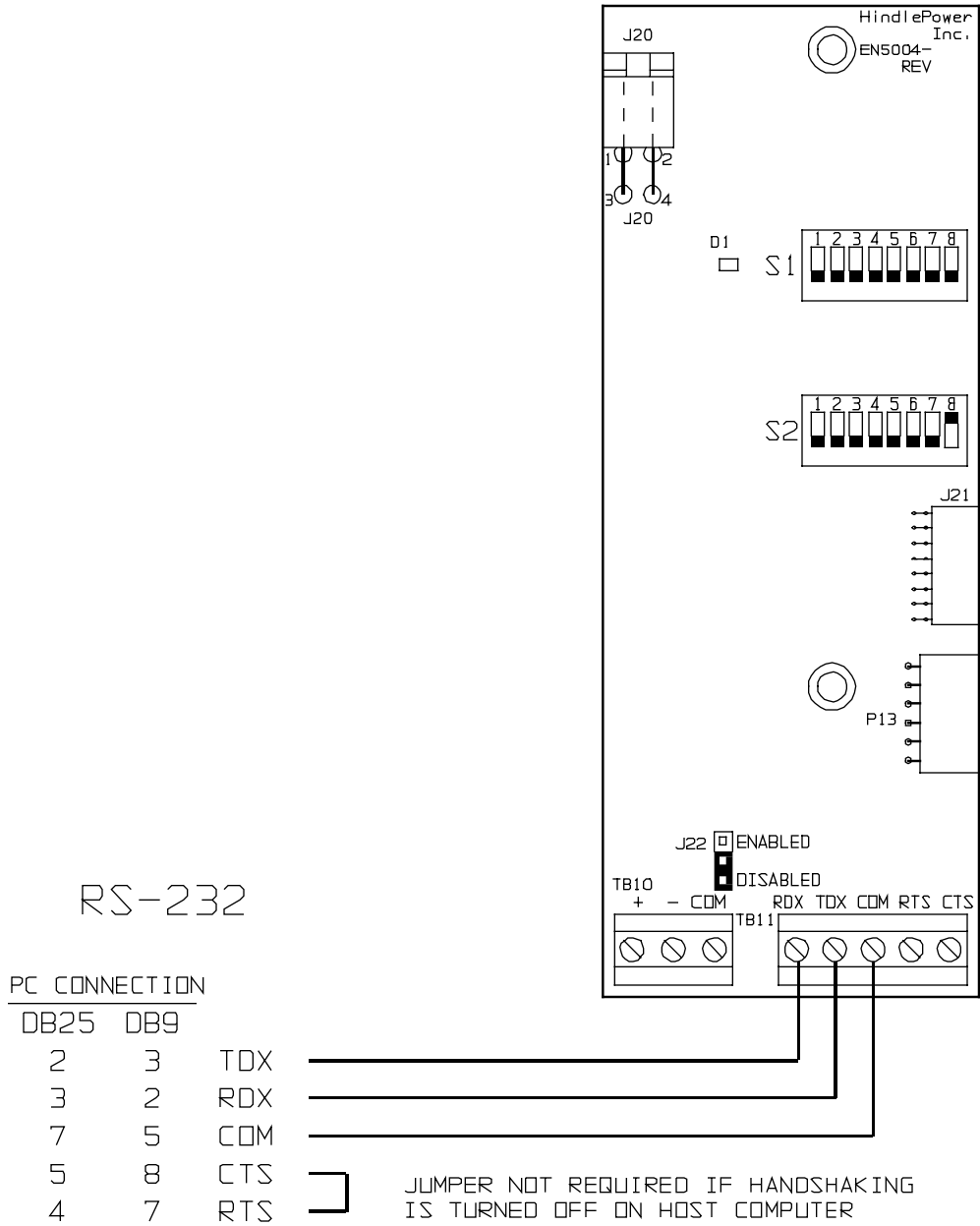

Figure 3
RS-232 3-Wire Connection

3.2.1   RS-232 5-Wire

For a RS-232 5-wire operation, the hardware handshaking lines are enabled. Enable the hardware handshaking lines by setting configuration switch S1-6 to the ON position.
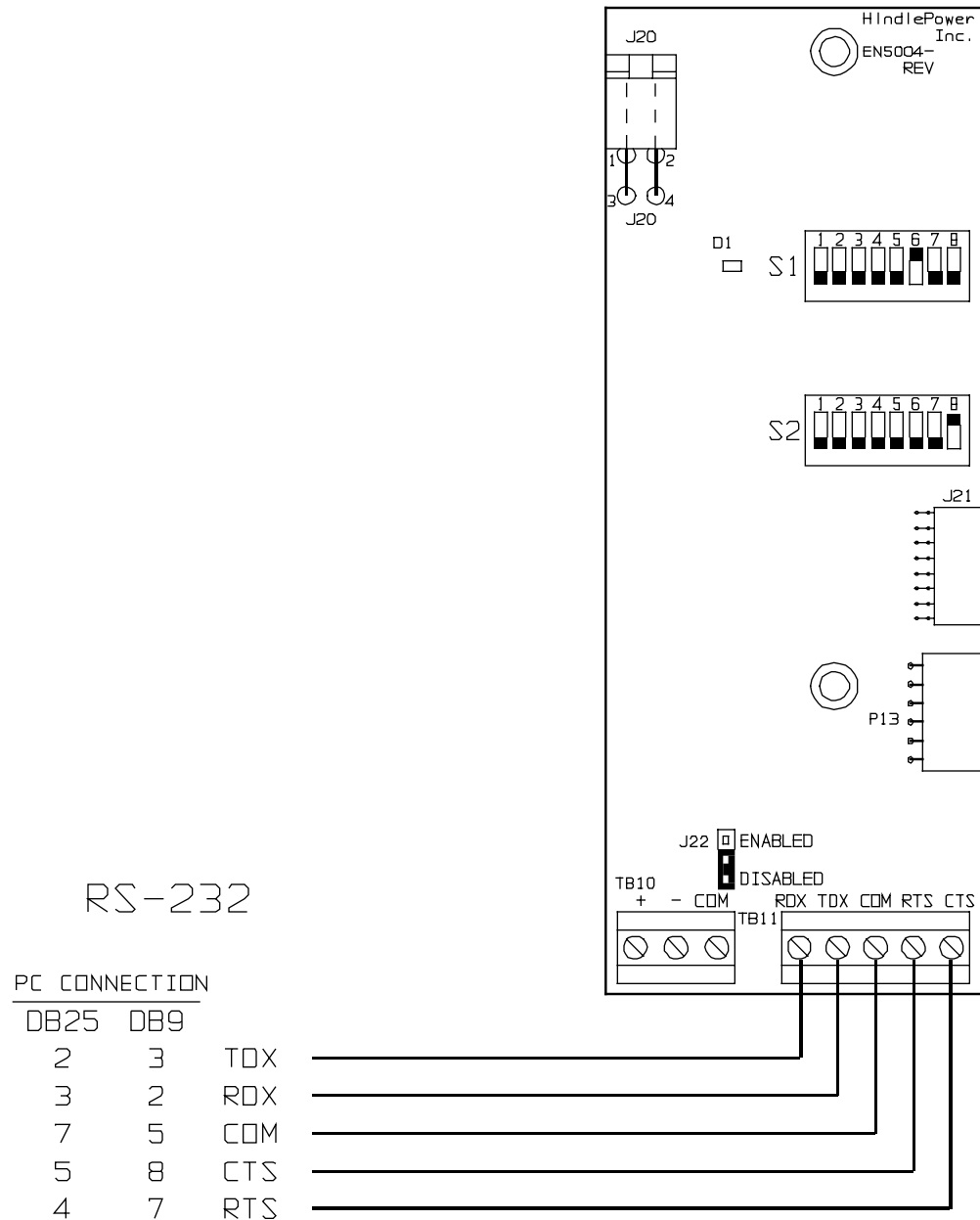

Figure 4
RS-232 5-Wire Connection

3.2.2 RS-485

The communications board supports half-duplex RS-485 communications. Set configuration switch S1-5 to ON to select RS-485. TB10 terminal block is for the RS-485 connections. The next two sections describe a single connection and multi-drop connection.

Some RS-485 networks may require terminating resistors at both ends of the serial network. The decision of whether or not to use termination resistors should be based on the BAUD rate, the cable distance, and the type of cable being used to build the network. In most cases for BAUD rates less than 19.2K, terminating resistors are not required. If termination resistors are used, the network must be designed with the appropriate biasing resistors to ensure reliable communications.

The biasing resistors are responsible for ensuring that the network remains in the idle state when all drivers are tri-stated. In order to guarantee that the receivers remain in a known state, +/- 200mV must always be maintained across the (+) and (-) or (A) and (B) RS-485 inputs. The use of termination resistors requires a significantly lower value of biasing resistors which results in greater dc loading of the network.

Network design and biasing resistor calculations depend on the number of nodes on the network, the type of drivers and receivers on the network, and any biasing already designed into other devices sharing the network. As a result, whether or not use termination resistors and biasing resistor calculation is beyond the scope of this manual. For more information on biasing and termination details see the following references:

1) EIA/TIA-485 Standard
    Telecommunication Industry Association
    http://www.tiaonline.org/standards/catalog/

2) RS-422/RS-485 Application Note
    Copyright: B&B Electronics
    http://www.bb-elec.com/tech_articles/rs422_485_app_note/table_of_contents.asp
        or
    http://www.ATSeries.net/PDFs/RS422+485AppNote.pdf

The communications board has a termination resistor built in. Jumper J22 enables or disables the terminating resistor. If the host computer is on one of the ends and does not have a built in terminating resistor, add the resistor at the connection across the plus (+) and minus (-). Each device needs to have a unique address number. Refer to Section 4 on page 14 for configuration information for either Modbus or DNP3 protocols.

TB10 User Connection		
Pin 1	Pin 2	Pin 3
(+) POS	(-) NEG	COM

3.2.2   RS-485 Single Connection

When a single device is connected using RS-485, and a terminating resistor is required, move the jumper on J22 to pins 1 and 2 to *enable* the terminating resistor.   The device communicating with the charger needs its own terminating resistor installed.
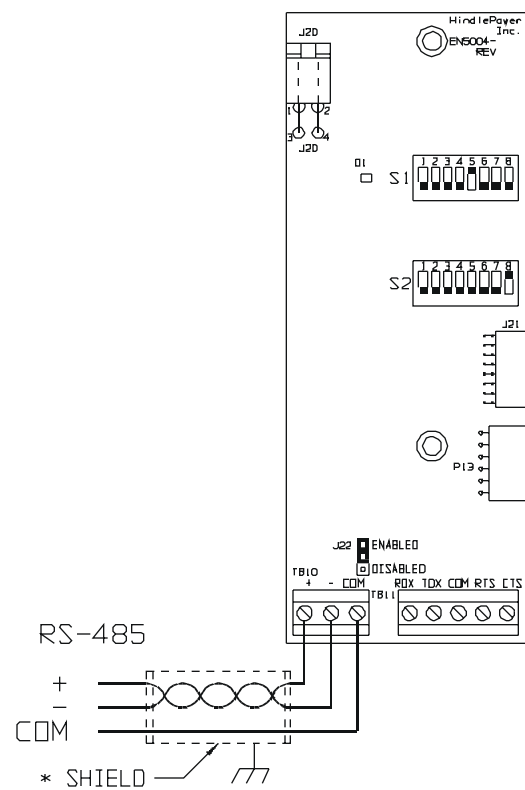

Figure 5
RS-485 Single Connection

* Typical RS-485 applications tie the shield to earth ground at only one location along the network. Consult your organization's standard network grounding practices.

3.2.2   RS-485 Multi-Drop

When multiple chargers are connected using RS-485, and termination resistors are required, the termination resistor should only be installed (enabled) on the end of the network. Move the jumper on J22 between pins 1 and 2 to *enable* the terminating resistor. The devices in the middle of the network do not require the terminating resistor. Move the jumper on J22 between pins 2 and 3 to *disable* the terminating resistor. Figure 6 and Figure 7 show examples of multiple chargers on a RS-485 serial network.

Figure 6
RS-485 Multi-Drop 2 Chargers

* Typical RS-485 applications tie the shield to earth ground at only one location along the network. Consult your organization's standard network grounding practices.
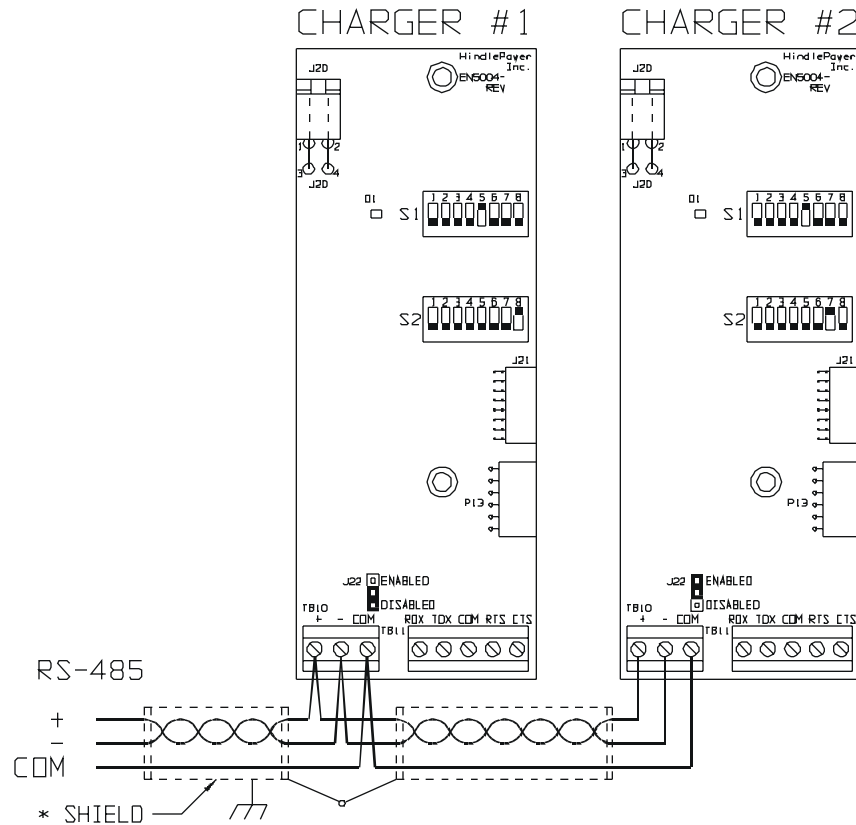
Figure 7
RS-485 Multi-Drop 3 Chargers

* Typical RS-485 applications tie the shield to earth ground at only one location along the network. Consult your organization's standard network grounding practices.
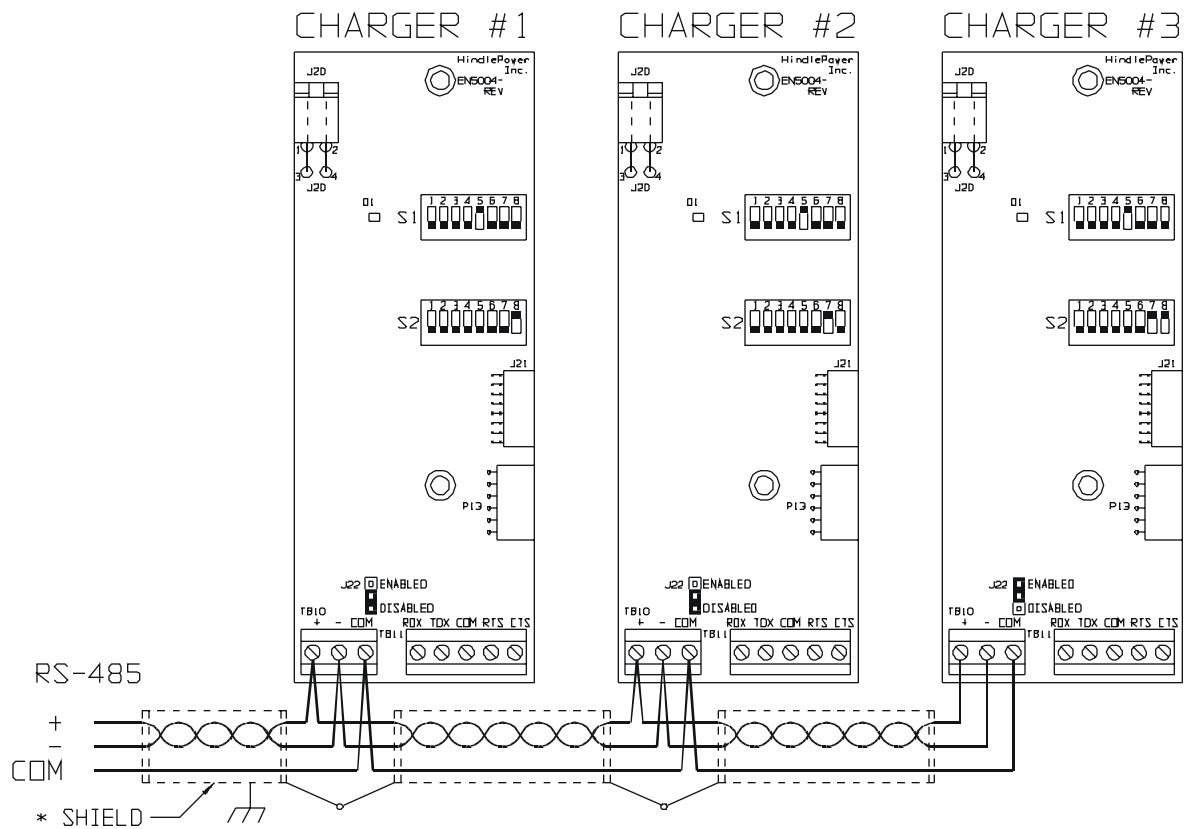
3.3 Using a Fiber Optics Modem

An optional fiber optic to serial converter is available for the AT Series Communications Module.   When ordered, this option (**EJ5230-##**) will be installed in the charger at the factory, and will allow direct connection of fiber connections compatible with standard "B&B" and "Dymec" type converters.   Please refer to the following supplemental documentation for the available Fiber Optics Interface options.

EJ5230-04	http://www.ATSeries.net/PDFs/EJ5230-04.pdf	"B&B" **Fiber Optics** Interface for **130Vdc** AT Comm
EJ5230-1X	http://www.ATSeries.net/PDFs/EJ5230-1X.pdf	"DYMEC RS485 " **Fiber Optics** Interface for AT Comm
EJ5230-2X	http://www.ATSeries.net/PDFs/EJ5230-2X.pdf	"DYMEC RS232 " **Fiber Optics** Interface for AT Comm

Ethernet connections over fiber optics wire are not supported at this time.

3.4 Using an Ethernet Gateway

An optional Ethernet Gateway for either DNP-3 *or* Modbus protocols is available for the AT Series Communications Module.   When ordered, these options (**EJ5226-##**) will be installed in the charger at the factory.   Please refer to the following supplemental documentation for the Ethernet Gateway options.

EJ5226-XX	http://www.ATSeries.net/PDFs/EJ5226-XX.pdf	Ethernet Gateway Option for AT Comm.
n/a	http://www.ATSeries.net/PDFs/EDNP-3UsersGuide.pdf	3rd Party Ethernet Gateway User's Guide (DNP-3)
n/a	http://www.ATSeries.net/PDFs/EMB-2UsersGuide.pdf	3rd Party Ethernet Gateway User's Guide (Modbus)

Further information regarding the Ethernet Gateway option is featured in the *Frequently Asked Questions* (FAQ) in Appendix A on page 32.

3.5 Using a Telephone Modem

An "industry-standard" V.92 56K modem is compatible with the AT Series Communications Module to connect it to an analog phone line.

The monitoring computer system will also need a modem. The computer system will dial out to the AT Series charger. The modem connected at the charger will answer the call and start communicating.   The following instructions are for a *U.S. Robotics* modem product # USR5686D (or equivalent) with the auto-answer feature enabled.

If using Modbus protocol, use ASCII mode. RTU mode has tighter timing requirements that might prevent communications while using the modem.   ASCII mode is enabled by configuration switch S1-4 in the ON position. Enable the RS-232 handshaking lines by setting the configuration switch S1-6 to the ON position. Connect the modem to TB11 as detailed in Figure 8. Set the baud rate to 9600 bps by setting the configuration switch S1-7 to the OFF position. Set the modem up for the settings listed on the following page.

The telephone cable plugs into a standard analog phone line. This modem will not work with office digital phone systems. The telephone line needs to be a dedicated analog phone line similar to most fax machines. Plug in the ac power supply. The host software needs to have the same protocol and serial parameters as the communications option.

Modem DIP Switch Settings

U.S. Robotics modem product # USR5686D (or equivalent)

Switch	Position	Setting
1	Down	Data Terminal Ready override
2	Up	Verbal result codes
3	Down	Display result codes
4	Up	Echo offline commands
5	Up	Auto answer on
6	Up	Carrier detect normal
7	Down	Load factory defaults
8	Down	Smart mode

AT Series Communications Module
PC Board (A12)
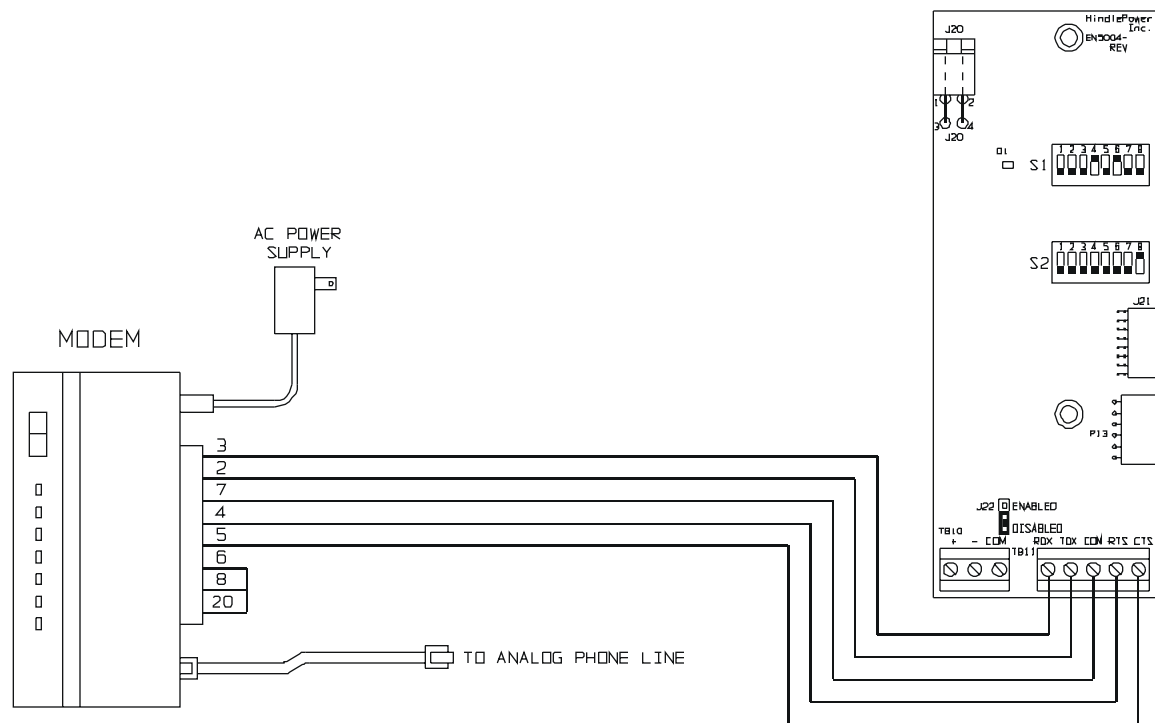
U.S. Robotics modem
product # USR5686D (or equivalent)

Figure 8
Modem Connection

4 Configuration

All user configurable items are controlled by two groups of switches and a setup program to modify additional configuration parameters. After changes have been made, the charger must have both the ac and dc circuit breakers turned OFF then back ON again for any changes to take affect.

S1 is used to configure the communications interface. S2 is used to set the device address for Modbus. Setting S1-1 to enable the Setup Program, allows modification to additional configuration parameters.

4.1 DIP Switch Settings

S1 Configuration

Position	Description	"ON" position	"OFF" position
DIP S1-1	Setup Program	Enabled	Disabled
DIP S1-2	Configuration Parameters*	User Values	Factory Default Values
DIP S1-3	Protocol	DNP	Modbus
DIP S1-4	Modbus Protocol	ASCII	RTU
DIP S1-5	Serial Port	RS-485	RS-232
DIP S1-6	RS-232 Handshaking	Enabled	Disabled
DIP S1-7	Baud Rate	19200 bps	9600 bps
DIP S1-8	Not Used		

*Note: See Configuration Parameters Below

S2 Modbus Network Address Selection

Switch Position	Address bit
DIP S2-1	Net addr b7
DIP S2-2	Net addr b6
DIP S2-3	Net addr b5
DIP S2-4	Net addr b4
DIP S2-5	Net addr b3
DIP S2-6	Net addr b2
DIP S2-7	Net addr b1
DIP S2-8	Net addr b0

Modbus Slave Address Table

Slave Address	DIP S2							
	1	2	3	4	5	6	7	8
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	1	1
4	0	0	0	0	0	1	0	0
5	0	0	0	0	0	1	0	1
6	0	0	0	0	0	1	1	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
255	1	1	1	1	1	1	1	1

4.2 Setup Program

The setup program may only be used with an RS-232 serial connection (see Figure 3). Use a terminal mode program such as HyperTerminal with the baud rate set to 9600 bps, 8 data bits, no parity, 2 stop bits, and no hardware handshaking. To enable the setup program, set switch S1-1 to ON. To use the user values for configuration parameters, set switch S1-2 to ON. The following screen will appear:

```
        -- EN5004 Setup --


1       DNP Device Address
2       DNP Unsol Destination Address
3       DNP Unsol Messaging Enabled
4       DNP Unsol Timeout
5       DNP Unsol Retries Amount
6       DNP Unsol Indefinite Retries
7       Comm Parity
8       Comm Stop Bits
9       RESTART Comm Board


To change a value, please select its item number:
```

To select an item to view and modify, enter the item number by typing the number and press ENTER. The sample below shows item 1 DNP Device Address is selected. The current value is set to 1. Entering a new value and pressing ENTER will accept the new value if it is within the acceptable range. `"Value written to memory"` will be displayed if accepted or `"VALUE ENTERED IS OUT OF RANGE!"` if not accepted. Pressing the ESC key will cancel modifying the parameter and return to main menu.

```
        To change a value or RESTART, please select its item number: 1
        DNP Device Address: 1 (Range 1 to 65,519),
        Enter new value (ESC to cancel): 1
        Value written to memory
```

If S1-2 is set to OFF for using factory default values, the parameters can be viewed. The parameters can be modified, but if S1-2 is still OFF (set to factory default values) when the Communications board is reset, all values will be changed back to factory defaults. Setting S1-2 ON will allow USER values to be used. If S1-2 is OFF the screen will look like this:

```
        -- EN5004 Setup --

USING DEFAULT VALUES. (SWITCH S1-2 IS OFF)
CHANGED VALUES WILL NOT BE STORED

1       DNP Device Address
2       DNP Unsol Destination Address
3       DNP Unsol Messaging Enabled
4       DNP Unsol Timeout
5       DNP Unsol Retries Amount
6       DNP Unsol Indefinite Retries
7       Comm Parity
8       Comm Stop Bits
9       RESTART Comm Board
To change a value or RESTART, please select its item number:
```

CONFIGURATION

After all parameters have been modified to the correct values, turn OFF switch S1-1. Select `"RESTART Comm Board"` on terminal main menu. Close your terminal program and reconnect the charger to the communications network. Make sure all switch settings are set correctly.

4.3 Factory Defaults

Configuration Parameter	Factory Default	Range
DNP Device Address:	1	1 to 65519
DNP Unsolicited Destination Address:	65519	1 to 65519
DNP Unsolicited Messaging Enabled:	0 (Off)	0 (Off), 1 (On)
DNP Unsolicited Timeout:	30 seconds	1 to 60 seconds
DNP Unsolicited Retries Amount:	2	0 to 255
DNP Unsolicited Indefinite Retries:	0 (Off)	0 (Limited), 1 (Indefinite)
Comm Parity:	0 (None)	0 (None), 1 (Odd), 2 (Even)
Comm Stop Bits:	1 for DNP	1 or 2
	2 for Modbus RTU	
	1 for Modbus ASCII	

4.4 Status LED (D1)

The EN5004-## communications module pc board (A12) features a Status LED (D1) built into the board, located to the left of the Configuration Switches (S1). See **Figure 2** on page 5 for location. During normal operations the LED will flash very quickly to indicate communications with the host computer. Use the following guide for LED troubleshooting:

4.4.1 Blinking LED

On power up the D1 will blink on and off at a steady rate of 1 sec. on and 1 sec. off to indicate that the Modbus Address selected by the DIP switches S2 is invalid. The acceptable Modbus address range is 1-247. For example, if all the switches for S2 are set to off for an address of 0, the LED will blink for an invalid address.

4.4.2 LED Always Off

The LED will flash when the communications board receives and processes data from a host computer. When the LED does not flash, then the communications board is not processing the data being sent to it by the computer. Check the following items to al items can be the cause of no communications.
- Verify that the connection P13 is aligned properly with J13 on the main control card.
- Make sure the power supply connection J20 is plugged in.
- Measure the voltage of J20 pins 2(+) and 4(-) with J20 plugged in. It should be between 7-10vdc.
- Check the communications wiring from the host computer to the communications board.
- If the communications board is wired for RS-232 make sure RS-232 is selected in the DIP switches.
- If the communications board is wired for RS-485 make sure RS-485 is selected in the DIP switches.
- Check all the communication configuration settings.
- Verify the host computer's communications settings match the charger communications board settings (protocol, address, baud rate, stop bits, data bits, etc.).

4.4.2 LED Always On

If the LED is always on then this indicates the communications board is not working. Check the following:
- Verify that the connection P13 is aligned properly with J13 on the main control card.
- Make sure the power supply connection J20 is plugged in.
- Measure the voltage of J20 pins 2(+) and 4(-) with J20 plugged in. It should be between 7-10vdc.

5 DNP V3.00

5.1 Introduction

This manual section describes the specific implementation of the DNP3 Level 2 protocol via the AT Series Battery Charger Communications Module interface (p/n EJ5037-##). This section, in conjunction with the DNP3 Basic 4 Document Set, and the DNP Subset Definitions Document, provides complete information on how to communicate.

This implementation of DNP3 is fully compliant with DNP3 Subset Definition Level 2, contains many Subset Level 3 features, and contains some functionality even beyond Subset Level 3.

5.2 Device Profile

The following table provides a "Device Profile Document" in the standard format defined in the DNP3 Subset Definitions Document. While it is referred to in the DNP3 Subset Definitions as a "Document," it is only a component of a total interoperability guide. This table, in combination with the following should provide a complete interoperability/ configuration guide for the AT Series Communications Module interface:

- The Implementation Table provided in Section 5.3 on page 20
- The Point List Tables provided in Section 5.4 on page 23

DNP V3.00	
DEVICE PROFILE DOCUMENT	
(Also see the Implementation Table in Section 5.3 on page 20.)	
Vendor Name: HindlePower, Inc. - 1075 Saint John Street - Easton, PA 18042	
Device Name: Communications Module interface (manufacturer's p/n EJ5037-##)	

Highest DNP Level Supported:
    For Requests: Level 2
    For Responses: Level 2
	Device Function:
	☐ Master
	☒ Slave

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):	

Maximum Data Link Frame Size (octets):
    Transmitted: 292
    Received   292
	Maximum Application Fragment Size (octets):
	    Transmitted: 2048
	    Received: 2048

Maximum Data Link Re-tries:
    ☒   None
    ☐   Fixed at 3
    ☐   Configurable range 0 to 255
	Maximum Application Layer Re-tries:
	    ☒ None
	    ☐ Configurable

Requires Data Link Layer Confirmation:
    ☒   Never
    ☐   Always
    ☐   Sometimes
    ☐ Configurable	

DNP V3.00

DEVICE PROFILE DOCUMENT

(Also see the Implementation Table in Section 5.3 on page 20.)

Requires Application Layer Confirmation:
- ☐ Never
- ☐ Always
- ☒ When reporting Event Data
- ☐ When sending multi-fragment responses
- ☐ Sometimes
- ☐ Configurable

Timeouts while waiting for:

Data Link Confirm:	☐ None	☒ Fixed at 2000	☐ Variable	☐ Configurable.
Complete Appl. Fragment:	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable
Application Confirm:	☐ None	☒ Fixed at 2000	☐ Variable	☐ Configurable,.
Complete Appl. Response:	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable

Others:

Inter-character Timeout:	☒	Fixed at 50 ms.
Select/Operate Arm Timeout:	☒	Fixed at 5000 ms.
Binary input change scanning period:	☒	Fixed at 5000 ms.
Analog input change scanning period:	☒	Fixed at 5000 ms.
Unsolicited offline interval:	☒	Fixed at 30000 ms if unsolicited messages is off Configurable if unsolicited messages is on. See setup.
Unsolicited response notification delay:	☒	Fixed at 15000 ms.
Delay Measurement:		100 ms.
Synchronization:		1000 ms.

Sends/Executes Control Operations:

WRITE Binary Outputs	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
SELECT/OPERATE	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE – NO ACK	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
Count > 1	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Pulse On	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Pulse Off	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Latch On	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
Latch Off	☐ Never	☐ Always	☒ Sometimes	☐ Configurable
Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable

Explanation of Sometimes: See the Binary Outputs point list in Section 5.4.2 on page 24 for a description of which control operations are supported for each point.

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DEVICE PROFILE DOCUMENT

(Also see the Implementation Table in Section 5.3 on page 20.)

Reports Binary Input Change Events when no specific variation requested: ☐ Never ☒ Only time-tagged ☐ Only non-time-tagged ☐ Configurable	Reports time-tagged Binary Input Change Events when no specific variation requested: ☐ Never ☒ Binary Input Change With Time ☐ Binary Input Change With Relative Time ☐ Configurable (attach explanation)
Sends Unsolicited Responses: ☐ Never ☒ Configurable, See hardware configuration section ☐ Only certain objects ☐ Sometimes (attach explanation) ☒ ENABLE/DISABLE UNSOLICITED Function codes supported	Sends Static Data in Unsolicited Responses: ☒ Never ☐ When Device Restarts ☐ When Status Flags Change No other options are permitted.
Default Counter Object/Variation: ☒ No Counters Reported ☐ Configurable ☐ Default Object: 20 and 21 Default Variation: ☐ Point-by-point list attached	Counters Roll Over at: ☒ No Counters Reported ☐ Configurable (attach explanation) ☐ 16 Bits ☐ 32 Bits ☐ Other Value: _____ ☐ Point-by-point list attached

Sends Multi-Fragment Responses:

    ☒ Yes

    ☐ No

Sequential File Transfer Support:

Append File Mode	☐ Yes	☒ No
Custom Status Code Strings	☐ Yes	☒ No
Permissions Field	☐ Yes	☒ No
File Events Assigned to Class	☐ Yes	☒ No
File Events Poll Specifically	☐ Yes	☒ No
File Events Send Immediately	☐ Yes	☒ No
Multiple Blocks in a Fragment	☐ Yes	☒ No
Max Number of Files Open	0	

5.3 Implementation Table

The following table identifies the variations, function codes, and qualifiers supported by the AT Series Communications Module PC Board (EN5004-00) in both request messages and in response messages.

For static (non-change-event) objects, requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. Static object requests sent with qualifiers 17 or 28 will be responded with qualifiers 17 or 28. For change-event objects, qualifiers 17 or 28 are always responded except in the case of object 70 change events which respond with qualifier 1B or 5B.

text shaded as Subset Level 3 (dark orange) indicates Subset Level 3 functionality (beyond Subset Level 2)

text shaded as beyond Subset Level 3 (magenta) indicates functionality beyond Subset Level 3

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
1	0	Binary Input (Variation 0 is used to request default variation)	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
1	1 (default – see note 1)	Binary Input	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
1	2	Binary Input with Status	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
2	0	Binary Input Change (Variation 0 is used to request default variation)	1 (read	06 (no range, or all) 07, 08 (limited qty)		
2	1	Binary Input Change without Time	1 (read	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index
2	2 (default – see note 1)	Binary Input Change with Time	1 (read	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index
10	0	Binary Output Status (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
10	2 (default – see note 1)	Binary Output Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
12	1	Control Relay Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir. op, noack)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)	129 (response)	echo of request
30	0	Analog Input (Variation 0 is used to request default variation)	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
30	1	32-Bit Analog Input	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response	00, 01 (start-stop) 17, 28 (index – see note 2)

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
30	2 (default – see note 1)	16-Bit Analog Input	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
30	3	32-Bit Analog Input without Flag	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
30	4	16-Bit Analog Input without Flag	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
32	0	Analog Change Event (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
32	1	32-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index
32	2 (default – see note 1)	16-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index
32	3	32-Bit Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index
32	4	16-Bit Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index
34	0	Analog Input Reporting Deadband (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
34	1 (default – see note 1)	16-Bit Analog Input Reporting Deadband	1 (read) 2 (write)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index) / 00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)	129 (response	00, 01 (start-stop) 17, 28 (index – see note 2
34	2	32-Bit Analog Input Reporting Deadband	1 (read) 2 (write) 2 (write)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index) / 00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index) / 00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)	129 (response	00, 01 (start-stop) 17, 28 (index – see note 2
40	0	Analog Output Status (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
40	1	32-Bit Analog Output Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response	00, 01 (start-stop) 17, 28 (index – see note 2
40	2 (default – see note 1)	16-Bit Analog Output Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2
41	1	32-Bit Analog Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir. op, noack)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)	129 (response)	echo of request
41	2	16-Bit Analog Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir. op, noack)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)	129 (response	echo of request

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<table>
<tr><th colspan="3">OBJECT</th><th colspan="2">REQUEST
(Library will parse)</th><th colspan="2">RESPONSE
(Library will respond with)</th></tr>
<tr><th>Object Number</th><th>Variation Number</th><th>Description</th><th>Function Codes (dec)</th><th>Qualifier Codes (hex)</th><th>Function Codes (dec)</th><th>Qualifier Codes (hex)</th></tr>
<tr><td>50</td><td>0</td><td>Time and Date</td><td>1 (read)</td><td>00, 01 (start-stop)
06 (no range, or all)
07, 08 (limited qty)
17, 28 (index)</td><td>129 (response)</td><td>00, 01 (start-stop)
17, 28 (index – see note 2)</td></tr>
<tr><td>50</td><td>1
(default – see note 1)</td><td>Time and Date</td><td>1 (read)</td><td>00, 01 (start-stop)
06 (no range, or all)
07 (limited qty=1)
08 (limited qty)
17, 28 (index)</td><td>129 (response)</td><td>00, 01 (start-stop)
17, 28 (index – see note 2)</td></tr>
<tr><td></td><td></td><td></td><td>2 (write)</td><td>00, 01 (start-stop)
07 (limited qty=1)
08 (limited qty)
17, 28 (index)</td><td></td><td></td></tr>
<tr><td>60</td><td>0</td><td>Class 0, 1, 2, and 3 Data</td><td>1 (read)
20 (enbl. unsol.)
21 (dsbl. unsol.)</td><td>06 (no range, or all)</td><td></td><td></td></tr>
<tr><td>60</td><td>1</td><td>Class 0 Data</td><td>1 (read)
22 (assign class)</td><td>06 (no range, or all)</td><td></td><td></td></tr>
<tr><td>60</td><td>2</td><td>Class 1 Data</td><td>1 (read)</td><td>06 (no range, or all)
07, 08 (limited qty)</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>20 (enbl. unsol.)
21 (dsbl. unsol.)
22 (assign class)</td><td>06 (no range, or all)</td><td></td><td></td></tr>
<tr><td>60</td><td>3</td><td>Class 2 Data</td><td>1 (read)</td><td>06 (no range, or all)
07, 08 (limited qty)</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>20 (enbl. unsol.)
21 (dsbl. unsol.)
22 (assign class)</td><td>06 (no range, or all)</td><td></td><td></td></tr>
<tr><td>60</td><td>4</td><td>Class 3 Data</td><td>1 (read)</td><td>06 (no range, or all)
07, 08 (limited qty)</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>20 (enbl. unsol.)
21 (dsbl. unsol.)
22 (assign class)</td><td>06 (no range, or all)</td><td></td><td></td></tr>
<tr><td colspan="3">No Object (function code only) –See Note 3</td><td>13 (cold restart)</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">No Object (function code only)</td><td>14 (warm restart)</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">No Object (function code only)</td><td>23 (delay meas.)</td><td></td><td></td><td></td></tr>
</table>

Note 1: A Default variation refers to the variation responded when variation 0 is requested and/or in class 0, 1, 2, or 3 scans. Default variations are configurable; however, default settings for the configuration parameters are indicated in the table above.

Note 2: For static (non-change-event) objects, qualifiers 17 or 28 are only responded when a request is sent with qualifiers 17 or 28, respectively. Otherwise, static object requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. (For change-event objects, qualifiers 17 or 28 are always responded except for object 70, which responds with qualifier 1B or 5B.)

Note 3: For the EJ5037-## Communications Module, a cold restart is implemented as a warm restart. The executable is not restarted, but the DNP process is restarted.

Note 4: Writes of Internal Indications are only supported for index 7 (Restart IIN1-7), and indices 16 and beyond (user-defined indications).

5.4 Point List

The tables in the following sections identify all the individual data points provided by this implementation of DNP3.

5.4.1 Binary Inputs

Binary Input Points

Static (Steady-State) Object Number:	**1**
Change Event Object Number:	**2**
Request Function Codes supported:	**1 (read)**
	22 (assign class)
Static Variation reported when variation 0 requested:	**1 (Binary Input without status)**
Change Event Variation reported when variation 0 requested:	**2 (Binary Input Change with Time)**
Change Event Scan Rate:	**As indicated below, the scan rate for binary input change events is 5000 ms)**

Point Index	Name/Description	Initial Change Event Class (1, 2, 3 or none)
0	HVDC Alarm (1 = active)	1
1	LVDC Alarm (1 = active)	1
2	DC Output Failure Alarm (1= active)	1
3	AC input Failure Alarm (1 = active)	1
4	Positive Ground Fault Alarm (1 = active)	1
5	Negative Ground Fault Alarm (1 = active)	1
6	CAR (Summary) Alarm (1 = active)	1
7	HVDC Shutdown (1 = enabled)	1
8	LVAC Shutdown (1 = enabled)	1
9	Forced load sharing enabled (1 = enabled)	1
10	Temperate probe installed (1 = installed)	1
11	Defective temperate probe (1 = defective)	1
12	Equalize Mode - status of Binary Output: 0 (0 = float; 1 = equalize)	1
13	Manual Timer Method - status of Binary Output 1 (1 = enabled)	1
14	Manual Equalize Method - status of Binary Output 2 (1 = enabled)	1
15	Auto-Equalize Timer Method - status of Binary Output 3 (1 = enabled)	1
16	HVDC Shutdown Enabled - status of Binary Output 4 (1 = enabled)	1
17	Battery Type - status of Binary Output 5 (0= Lead; 1 = NiCD)	1

5.4.2 Binary Output Status Points

The following table lists both the Binary Output Status Points (Object 10).

Binary Output Status Points		
Object Number:	**10**	
Request Function Codes supported:	**1 (read)**	
Default Variation reported when variation 0 requested:	**2 (Binary Output Status)**	
Control Relay Output Blocks		
Object Number:	**12**	
Request Function Codes supported:	**3 (select), 4 (operate)**	
	5 (direct operate), 6 (direct operate, noack)	

Point Index	Name/Description	Methods	
0	Equalize Mode	Latch On, Latch Off	(0 = float; 1 = equalize)
1	Manual Timer Method	Latch On	(1 = enabled)
2	Manual Equalize Method	Latch On	(1 = enabled)
3	Auto-Equalize Timer Method	Latch On	(1 = enabled)
4	HVDC Shutdown Enable	Latch On, Latch Off	(1 = enabled)
5	Battery Type	Latch On, Latch Off	(0 = lead; 1 = NiCD)

Note: Only one equalize method can be on at a time. The equalize method cannot be turned off. By turning on one of the equalize methods (point index 1, 2, or 3) the charger will automatically turn off the other two equalize methods.

5.4.3 Analog Inputs

The following table lists Analog Inputs (Object 30).

It is important to note that 16-bit and 32-bit variations of Analog Inputs, Analog Output Control Blocks, and Analog Output Statuses are transmitted through DNP as signed numbers. Even for analog input points that are not valid as negative values, the maximum positive representation is 32767.

For each point, the "Scaling and Units" column indicates the value of a transmitted 32767. This also implies the value of a transmitted –32767. The entry in the column *does not* imply a valid value for the point.

Two examples are provided: In example 1, the point is un-scaled, represents kilo-Watts (a transmitted number 5 represents 5kW), and its valid range is from 0 to 10,000kW (meaning that the transmitted number will never exceed 10,000).

In example 2, the point transmits A/D counts from a measurement of voltage. The valid range is –2048 to 2047 counts (the limits of the physical A/D converter), which represents -12V to +12V. For this point, the representation of 32767 A/D counts, even though it is not a valid value for the point, is:

$$(12/2047)*32767 = 192V.$$

Always indicating the representation of 32767 in the tables below is a consistent method for representing scale, applicable to all scaling possibilities.

The "Default Deadband" column is used to represent the absolute amount by which the point must change before an analog change event will be generated. The "Default Change Event Assigned Class" column is used to represent the class (1, 2, 3, or none) in which detected change events will be reported. Only the default values for these columns are documented here because the values may change in operation due to either local (user-interface) or remote (through DNP) configuration control.

Analog Inputs

Static (Steady-State) Object Number:	**30**
Change Event Object Number:	**32**
Reporting Deadband Object Number:	**34**
Request Function Codes supported:	**1 (read), 2 (write, deadbands only), 22 (assign class)**
Static Variation reported when variation 0 requested:	**2 (16-Bit Analog Input)**
Change Event Variation reported when variation 0 requested:	**2 (Analog Change Event without Time)**
Reporting Deadband Variation reported when variation 0 requested:	**1 (16-Bit Reporting Deadband)**
Change Event Scan Rate:	

Point Index	Name/Description	Scaling and Units (representation of 32767)	Reporting Deadband	Initial Change Event Class (1, 2, 3 or none)
0	Communication Firmware Rev.	327.67	1	2
1	DNP Rev.	3.2767	1	2
2	AT Firmware Rev.	327.67	1	2
3	Voltage Rating	32767 Volts	1	2
4	Current Rating	32767 Amps	1	2
5	Voltage	3276.7 Volts	10	2
6	Current	3276.7 Volts	20	2
7	Equalize Time Remaining	32767 Hrs	1	2
8	Error Number	32767	1	2
9	Battery temperature	32767 °C	1	2

5.4.4 Analog Output Status Points

Analog Output Status Points
Object Number: **40**
Request Function Codes supported: **1 (read)**
Default Variation reported
  when variation 0 requested: **2 (16-Bit Analog Output Status)**
Analog Output Blocks
Object Number: **41**
Request Function Codes supported: **3 (select), 4 (operate),**
    5 (direct operate), 6 (direct operate, noack)

Point Index	Name/Description	Scaling and Units (representation of 32767)	Valid Range
0	Float Voltage Setpoint	3276.7 Volts	See Range Section
1	Equalize Voltage Setpoint	3276.7 Volts	See Range Section
2	Equalize Time	32767 Hrs	See Range Section
3	Current Limit	3276.7 Amps	See Range Section
4	HVDC Setpoint	3276.7 Volts	See Range Section
5	LVDC Setpoint	3276.7 Volts	See Range Section

5.4.5 Internal Indications

Internal Indications		
Object Number:	**80**	
Request Function Codes supported:	**1 (read), 2 (write)**	
Default Variation reported 　　when variation 0 requested:	**1**	

Point Index	Descriptions and Conditions		Writable?
0	IIN1-0	All Stations – set after a broadcast message (any message using a destination address of 0xfff0 or above) has been received. Does not indicate an error condition.	No
1	IIN1-1	Class 1 event data available. Can be set at any time and does not indicate an error condition.	No
2	IIN1-2	Class 2 event data available. Can be set at any time and does not indicate an error condition.	No
3	IIN1-3	Class 3 event data available. Can be set at any time and does not indicate an error condition.	No
4	IIN1-4	Time synchronization required. Can be set at any time and does not indicate an error condition.	No
5	IIN1-5	Local mode. Set if some points are uncontrollable via DNP.	No
6	IIN1-6	Device Trouble.	No
7	IIN1-7	Device restart. Set only under specific conditions. Does not indicate an error condition.	No
8	IIN2-0	Function Unknown. Generally means that the function code (octet 2 of the request header) cannot be processed.	No
9	IIN2-1	Object Unknown. Generally means that the function code could be processed but the object group / variation could not be processed.	No
10	IIN2-2	Parameter Error. Generally indicates that both the function code and object group / variation could be processed but that the qualifier / range field is in error.	No
11	IIN2-3	Buffer Overflow. Indicates that an event buffer has overflowed, and that change events, of at least one type, have been lost.	No
12	IIN2-4	Already Executing	No
13	IIN2-5	Bad configuration.	No
14	IIN2-6	Reserved. Always 0.	No
15	IIN2-7	Reserved. Always 0.	No

6 Modbus

6.1 Introduction

This manual section describes the specific implementation of the Modbus protocol via the AT Series Battery Charger Communications Module interface (p/n EJ5037-##). The Modbus protocol was implemented using the Modicon Modbus Protocol Reference Guide PI-MBUS-300 Rev. J.

6.2 Supported Function Codes

Below is the list of supported function codes.

      01 - Read Coil Status
      02 - Read Input Status
      03 - Read Holding Registers
      04 - Read Input Registers
      05 - Force Single Coil
      06 - Preset Single Register
      15 - Force Multiple Coils
      16 - Preset Multiple Registers

6.3 Register Definitions

6.3.1 Binary Outputs

Address	Name	Description
00001	Equalize Mode	1=Equalize Mode, 0=Float Mode
00002	Manual Timer Method	Equalize Method (see note below)
00003	Manual Equalize Method	Equalize Method (see note below)
00004	Auto-Equalize Timer Method	Equalize Method (see note below)
00005	HVDC Shutdown Enable	Enables High Voltage DC Shutdown
00006	Battery Type	0=Lead, 1=NiCd, Used for TempCo

Note: Only one equalize method can be active at a time. The equalize method cannot be turned off. By turning on one of the equalize methods the charger will turn off the other two equalize methods automatically.

6.3.2 Binary Inputs

Address	Name	Description
10001	HVDC	High Voltage DC Alarm
10002	LVDC	Low Voltage DC Alarm
10003	DC Output Failure	Charger Failure Alarm
10004	AC Input Failure	AC Input Failure Alarm
10005	Positive Ground Fault	Positive Ground Fault Alarm
10006	Negative Ground Fault	Negative Ground Fault Alarm
10007	CAR	Summary (Common) Alarm Relay
10008	HVDC Shutdown	High Voltage DC Shutdown Enabled
10009	LVAC Shutdown	Low Voltage AC Shutdown Enabled
10010	FLS Enabled	Forced Load Share Enabled
10011	Temperature Probe Installed	Temperature Probe Installed
10012	Defective Temperature Probe	Defective Temperature Probe Alarm

6.3.3 Input Registers

Address	Name	Description	Multiplier
30001	Communication Firmware Rev.	Software Revision	100
30002	DNP Rev	Software Revision	100
30003	AT10.1 Firmware Rev	Software Revision	100
30004	Voltage Rating	Charger Voltage Rating	1
30005	Current Rating	Charger Current Rating	1
30006	Voltage	Output Voltage	10
30007	Current	Output Current	10
30008	Equalize Time Remaining	Equalize Time Remaining in Hours	1
30009	Error Number	Self Diagnostic Error Codes	1
30010	Battery Temperature	Temperature in Celsius	1

6.3.4 Holding Registers

Address	Name	Description	Multiplier
40001	Float Voltage Setpoint	Float Voltage Setpoint	10
40002	Equalize Voltage Setpoint	Equalize Voltage Setpoint	10
40003	Equalize Time	Equalize Time in Hours	1
40004	Current Limit	Current Limit in Amps	10
40005	HVDC Setpoint	High Voltage DC Alarm Setpoint	10
40006	LVDC Setpoint	Low Voltage DC Alarm Setpoint	10

6.3.5 Scaling Sample

Reading address 30006 Voltage returns a value of 1300. The multiplier for that address is 10 (1300 / 10 = 130.0). Setting the Float Voltage Setpoint 40001 to 125.0 Vdc requires setting the address 40001 to 1250 because the multiplier is 10. 125.0 x 10 = 1250.

7   AT Series Charger Data Ranges

7.1   Voltage Ranges

Voltage Rating (Volts)	Float Voltage		Equalize Voltage		HVDC		LVDC	
	Min	Max	Min	Max	Min	Max	Min	Max
12	11.5	14.5	11.7	16.0	12.0	19.0	7.0	13.0
24	22.0	29.5	23.4	32.0	24.0	38.0	15.0	25.0
48	44.0	58.0	46.8	61.0	48.0	76.0	30.0	50.0
130	110.0	141.0	117.0	149.0	120.0	175.0	80.0	126.0

7.2   Current Ranges

Current Rating (Amps)	Current Limit	
	Min	Max
6	3.0	6.6
12	6.0	13.2
16	8.0	17.6
20	10.0	22.0
25	12.5	27.5
30	15.0	33.0
40	20.0	44.0
50	25.0	55.0
75	37.5	82.5
100	50.0	110.0
125	62.0	138.0
150	75.0	165.0
200	100.0	220.0
250	125.0	275.0
300	150.0	330.0
400	200.0	440.0
500	250.0	550.0
600	300.0	660.0
800	400.0	880.0
1000	500.0	1100.0

7.3   Equalize Time

Equalize time range is 0 to 255 hours.

APPENDIX A

AT Series Communications Module
FREQUENTLY ASKED QUESTIONS
http://www.ATSeries.net/PDFs/JF5026-00.pdf

What is the AT Communications Module?

The AT Communications Module (ordering p/n **EJ5037-##**) allows an AT10.1 or AT30 Series microprocessor-controlled battery charger to interact with a computer system. With this option, a remote operator can read and change the parameters of the charger. Everything a user can do at the charger's front panel display is accessible remotely. Refer to the AT Series Communications Module operation manual (**JA0102-04**) for further details.

Why would I want to use the remote communications?

The AT Series battery charger is equipped with a summary (common) alarm relay that is activated with any other alarm. However, the common alarm does not indicate which alarm was activated. The communications option allows a computer system to remotely monitor all alarm conditions and monitor all parameters of the charger including the output voltage and current. It also allows the user to change set points and charger modes remotely.

What features are available to me from a remote location?

Meters
Voltage
Current
Equalize Time Remaining
Battery Temperature

Setpoints
Float Voltage
Equalize Voltage
Equalize Time
Current Limit
High DC Voltage Alarm
Low DC Voltage Alarm
High DC Shutdown Enable

Status
Temperature Probe Installed
Forced Load Share Enabled

Charger Mode
Float
Equalize

Equalize Method
Manual
Timer
Auto

Alarms
High DC Voltage
Low DC Voltage
DC Output Failure
AC Input Failure
Positive Ground Fault
Negative Ground Fault
High DC Voltage Shutdown
Common Alarm Relay
Error Number Code

Will the AT Series Communications work with my existing SCADA system?

The computer system can be a SCADA (supervisory control and data acquisition) system. SCADA will monitor or log the parameters of the charger and other devices in the facility. There are many different versions of SCADA software available for different types of industries and features. They communicate using industrial communication protocols such as Modbus and DNP3. The SCADA software is configured for the charger's data and a display screen is designed to display the information for the operator. The screen can be setup to display and allow control over the operation of the charger. The manufacturer of the AT Series Communications Module does not sell or maintain SCADA systems.

How do I configure the AT Communications Module control board?

For simple applications, the Communications pc board (A12) can be configured using DIP switches. The DIP switches set the Protocol, serial type (RS-232 or RS-485), serial speed (baud rate), Modbus protocol, and the Modbus slave address. For the more advanced configuration parameters used for the DNP3 protocol, a computer is required to configure the parameters. For further details, refer to Section 4.2 on page 15.

Can the AT Communications Module be added to an old charger in the field?

Yes. The communications option can be added to a charger in the field.

How do I know if AT Communications is compatible with my charger?

AT Series chargers manufactured before January 1, 2003 will require the main control pc board (A1) to be replaced or reprogrammed to add the update software to support the communications option. Chargers that have the older EN0024-00 main control pc board (A1) will need a replacement. Chargers that have an EN5002-00 Rev. 0, 1, or 2 main control pc board (A1) will also need replacement. Chargers that have an EN5002-00 Rev. 3 or higher but do not have software Rev. 3.00 or higher need to be reprogrammed. Chargers that have an EN5002-00 Rev. 3A or higher and have software Rev. 3.00 or higher already support the AT Series Communications Module option.

How do you connect to the AT Communications Module?

The AT Communication Module supports a serial connection using either RS-232 or RS-485. RS-232 is a standard serial connection used on computer systems and is limited to a maximum cable length of 50ft/15.4m. For industrial applications RS-485 is recommended. RS-485 is designed to be immune to electrically noisy environments and can have up to a maximum cable length of 4,000ft/1.2km.

What wiring variation of RS-485 is supported?

Two wire, half-duplex

Can I communicate to more than one AT Series charger?

Yes. RS-485 communications allows multiple chargers to be connected to the same serial network. Up to thirty-two (32) AT Series chargers can be connected together. Each charger will be assigned an address so that the computer system knows which charger it is communicating with. RS-232 does not support multiple chargers on a serial network.

What speed does the AT Communications Module support?

The AT Communications Module can be configured for either 9,600 or 19,200 bits per second (baud rate).

What language (protocol) does the AT Communications Module use?

The AT Communications Module utilizes two (2) protocols (languages): Modbus and DNP3.

APPENDIX A

What is the difference between Modbus and DNP3?

Modbus is an industrial protocol that has been used for many years. There are two variations of the Modbus protocol: ASCII and RTU.

DNP3 is a newer protocol developed specifically for the utility industry. DNP3 can be configured so that if an event occurs, the charger will send a message to the computer system of any changes. This is called unsolicited messaging. DNP3 with unsolicited messaging enabled detects the alarm and notifies the computer system immediately instead of waiting for the computer system to poll for the status of the alarm.

Both protocols allow the computer system to query the charger for the current status.

What level of DNP3 does the AT Communications support?

The AT Communications Module supports DNP3 Level 2 with some advanced features. Refer to the AT Communications Module operation manual (**JA0102-04**) for the implementation of DNP3.

Can I communicate over the telephone?

Yes. A modem can be used to connect the AT Communications Module to an analog phone line. The modem is should be set to auto-answer. The computer system will also need a modem. The computer system will dial out to the AT Series charger. The modem connected at the charger will answer the call and start communicating. Refer to the special User Instructions (**JA5070-00**) for analog modem connection details.

Can I communicate to an AT Series Charger via a fiber optic connection?

Yes. An optional fiber optic to serial converter is available. This option, when ordered, will be installed in the charger at the factory and will allow direct connection of fiber connections compatible with standard "B&B" and "Dymec" type converters. Ethernet connections over fiber optics wire are not supported at this time.

Can I connect the AT Series charger to Ethernet network?

Yes. This connection requires an additional AT Series Communications Ethernet Gateway assembly. Two variations of the AT Communications Gateway exist, one version is for Modbus connections, and the other is for DNP3.

What specific types of DNP3 over Ethernet are supported?

The AT Communications Module, when combined with the AT Communications DNP3 Gateway will support both DNP/TCP and DNP/UDP.

What specific types of Modbus over Ethernet are supported?

The AT Communications Module, when combined with the AT Communications Modbus Gateway will support Modbus TCP\IP.

What types of Ethernet media are supported?

Both AT Communications Gateways have a 10/100 Base-T port (support 10 or 100 Mbps over copper). Fiber Ethernet connections are not supported at this time.

How do I configure the AT Communication Gateways?

The IP address, Gateway IP Address, Network Mask, and various other protocol specific parameters can be configured and managed with a pc, using a standard web browser or via terminal emulation software.

Do the AT Communication Gateways incorporate any security measures?

Yes. Each AT Communications Gateway can be configured to only allow changes from up to four (4) specific Manager IP Addresses.

Do the AT Communication Gateways incorporate any SNMP Configuration?

Yes. Each AT Communication Gateway permits the user to assign "Contact Person", "Device Name", and "Physical Location" parameters.

Can a previously-purchased AT Series charger be field-upgraded with Ethernet Communications capability?

Yes. In most cases a kit can be provided. You will need to contact the factory with the AT Series battery charger serial number, so we can determine what components are required, and if any components need to be upgraded.
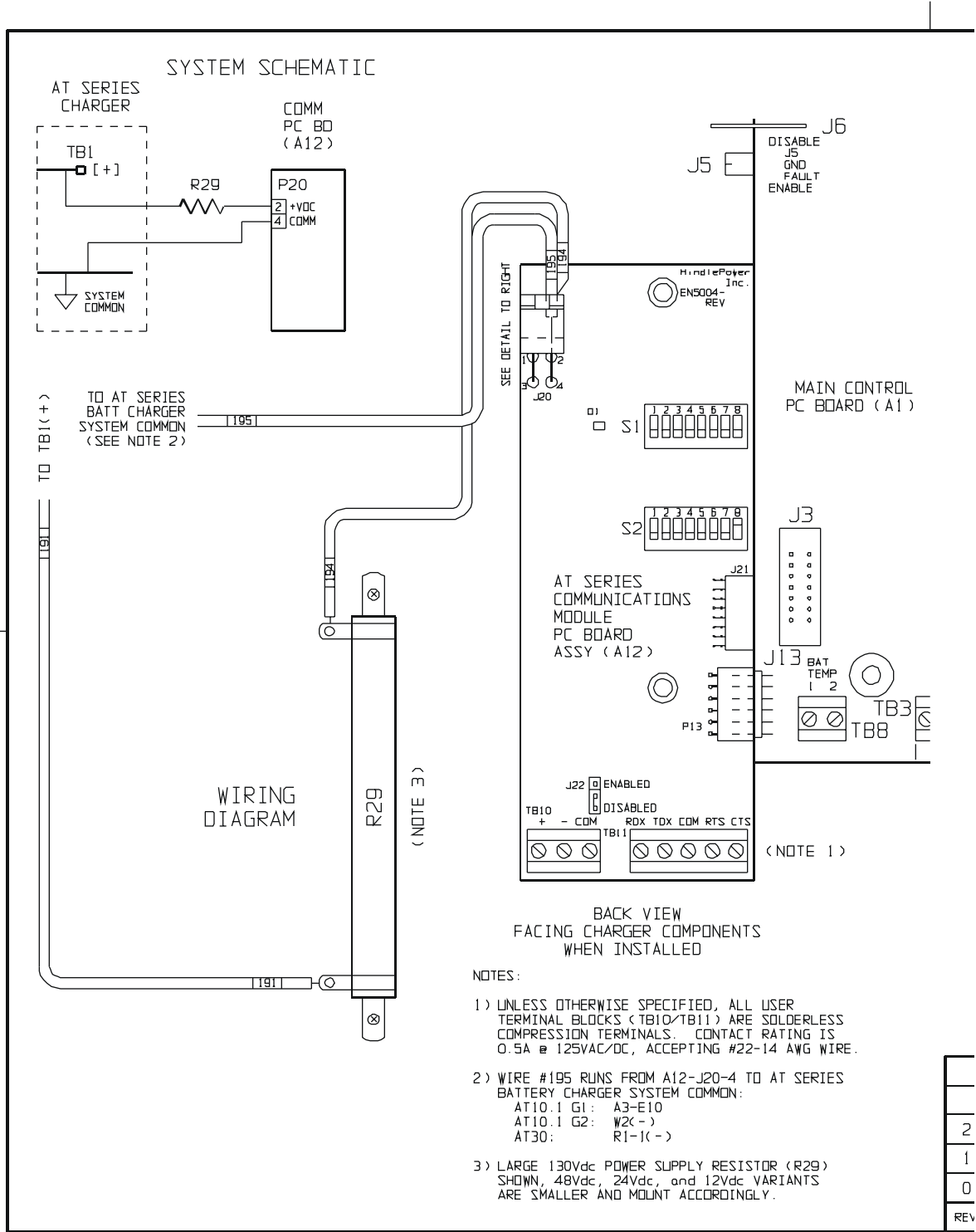
Can I access additional resources for AT Communications online?

Yes. A number of supplemental documents for the AT Series Communications Module option are available online, and may be used in conjunction with this FAQ:

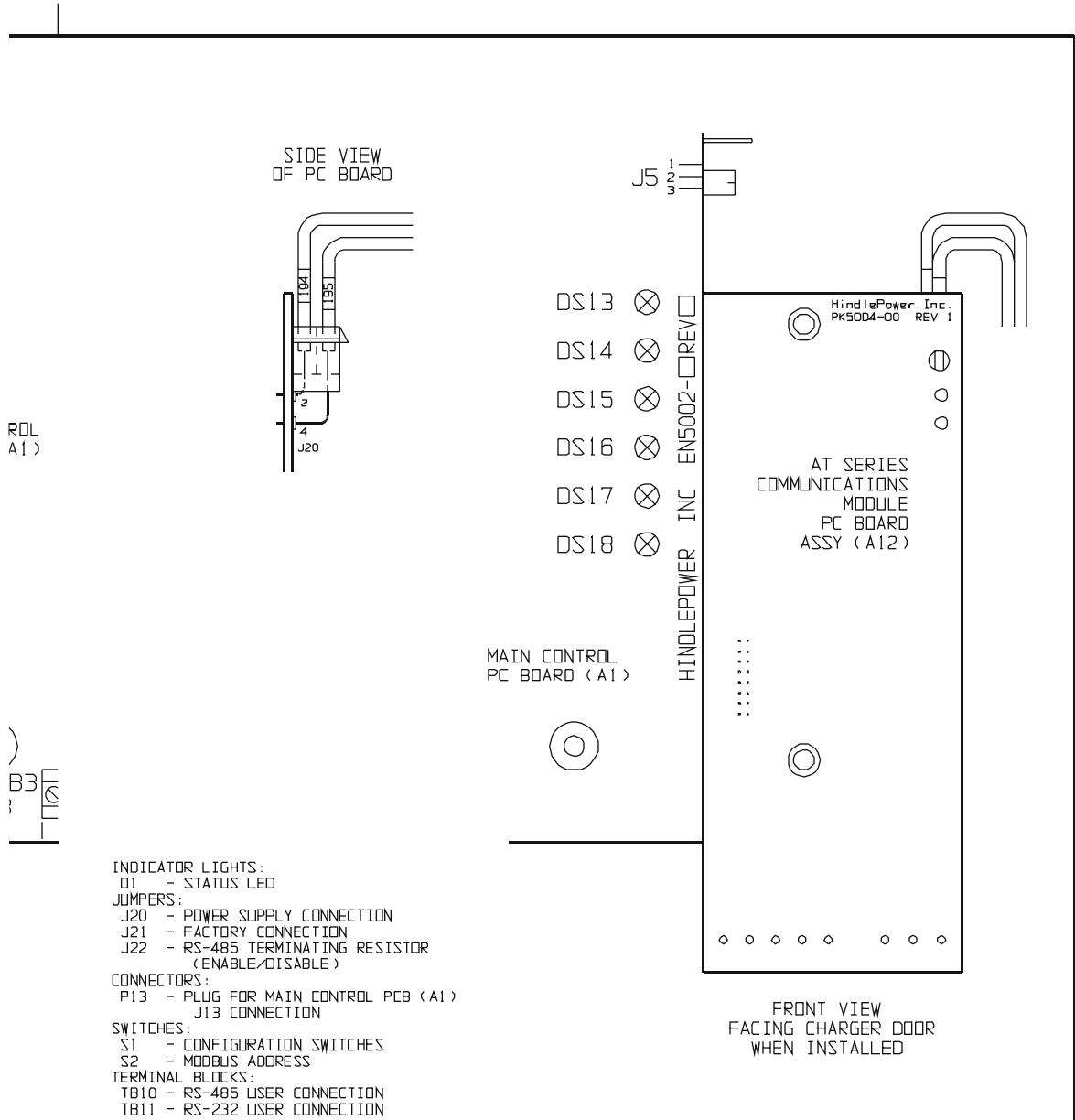| Doc. No	Online Hyperlink	Description
JF5026-00	http://www.ATSeries.net/PDFs/JF5026-00.pdf	AT Communications FAQs (*this text*, stand-alone)
JA0102-04	http://www.ATSeries.net/PDFs/JA0102-04.pdf	AT Communications Module Operating Manual
JD5008-00	http://www.ATSeries.net/PDFs/JD5008-00.pdf	AT Communications Module Field Installation
JD5012-00	http://www.ATSeries.net/PDFs/JD5012-00.pdf	AT Series Main Ctrl PC Board (A1) Replacement
JE5107-00	http://www.ATSeries.net/PDFs/JE5107-00.pdf	AT Communications Module Assembly / Wiring
n/a	http://www.ATSeries.net/PDFs/RS422+485AppNote.pdf	3rd Party RS-422 and RS-485 Application Note
EJ5230-04	http://www.ATSeries.net/PDFs/EJ5230-04.pdf	130Vdc "B&B" **Fiber Optics** Interface for AT Comm
EJ5230-1X	http://www.ATSeries.net/PDFs/EJ5230-1X.pdf	"DYMEC RS485 " **Fiber Optics** Interface for AT Comm
EJ5230-2X	http://www.ATSeries.net/PDFs/EJ5230-2X.pdf	"DYMEC RS232 " **Fiber Optics** Interface for AT Comm
EJ5226-XX	http://www.ATSeries.net/PDFs/EJ5226-XX.pdf	Ethernet Gateway Option for **AT Communications**
n/a	http://www.ATSeries.net/PDFs/EDNP-3UsersGuide.pdf	3rd Party Ethernet Gateway User's Guide (DNP-3)
n/a	http://www.ATSeries.net/PDFs/EMB-2UsersGuide.pdf	3rd Party Ethernet Gateway User's Guide (Modbus)
JA5070-00	http://www.ATSeries.net/PDFs/JA5070-00.pdf	Analog Modem for AT Communications

AT Series Battery Charger Communications PC Board
Assembly Detail (**JE5107-00**)

AT Series Battery Charger Communications PC Board
Assembly Detail (**JE5107-00**)

SIDE VIEW
OF PC BOARD

J5

ROL
A1)

J20

B3

DS13
DS14
DS15
DS16
DS17
DS18

HINDLEPOWER INC EN5002-□REV□

HindlePower Inc.
PK5004-00 REV 1

AT SERIES
COMMUNICATIONS
MODULE
PC BOARD
ASSY (A12)

MAIN CONTROL
PC BOARD (A1)

FRONT VIEW
FACING CHARGER DOOR
WHEN INSTALLED

INDICATOR LIGHTS:
  D1   – STATUS LED
JUMPERS:
  J20 – POWER SUPPLY CONNECTION
  J21 – FACTORY CONNECTION
  J22 – RS-485 TERMINATING RESISTOR
         (ENABLE/DISABLE)
CONNECTORS:
  P13 – PLUG FOR MAIN CONTROL PCB (A1)
         J13 CONNECTION
SWITCHES:
  S1   – CONFIGURATION SWITCHES
  S2   – MODBUS ADDRESS
TERMINAL BLOCKS:
  TB10 – RS-485 USER CONNECTION
  TB11 – RS-232 USER CONNECTION

THIRD
ANGLE
PROJECTION

REV	ECN No	DATE	APP			
2	22197	070110	ND	DRAWN BY MCR	051705	
1	E2092	070805	TWH	APPROVED TWH	060805	
0	E2044	051705	TWH	UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:		

TITLE AT SERIES BATT CHGR COMMUNICATIONS MODULE
       PC BOARD ASSEMBLY DETAIL

DRAWING No	JE5107-00	REV 2	B
SCALE NTS	PART No JE5107-00	SHEET 1 OF 1	

http://www.ATSeries.net/PDFs/JE5107-00.pdf

APPENDIX C

BACKGROUND

The AT Series Communications Module is a product accessory, compatible with AT10.1 Group I, AT10.1 Group II, and AT30 Series microprocessor-controlled float battery chargers. This document (**JD5008-00**) is a service procedure for **FIELD INSTALLATION** of the communications kit (EJ5037-1#) into an existing charger. For full operation of the installed kit, please refer to the separate AT Series Communications Module user's manual (**JA0102-04**).

RECEIVING / SETUP

1. The AT Series Communications Module is not compatible with older AT Series battery chargers. Please confirm the revision of the Main Control PC Board (A1) is **EN5002-00 - Rev. 6** or higher. If not, please order a new pc board from your Sales Representative.

2. Verify you have received ALL the required and correct parts in your field retrofit kit.

Item	Part No.	Description
A)	EN5004-00	AT Series Communications Module PC Board (A12)
B)	n/a	AT Series Communications Power Supply Resistor (R29) Assembly
C)	n/a	nylon wire ties for securing harness
D)	**JD5008-00**	Field Installation Instructions
E)	**JE5107-00**	AT Series Communications Module Assembly Detail Drawing
F)	**JA####-04**	Private-labeled AT Comm Module *Operating Instructions* (manual)

3. Verify the resistance of the R29 assembly per the table below. If the resistance is not correct, the EN5004-00 Communications Module PC Board (A12) may incur damage upon start-up.

Charger Output	12 Vdc	24 Vdc	48 Vdc	130 Vdc
Field Install Kit	EJ5037-11	EJ5037-12	EJ5037-13	EJ5037-14
R29 Rating	11W 15 Ohm	25W 50 Ohm	50W 150 Ohm	100W 500 Ohm
R29 Resistor Assembly Type	one (1) R29 on "picket fence"	one (1) R29 with mounting brackets	one (1) R29 with mounting brackets	* one (1) R29 with mounting brackets
* For the AT10.1 130Vdc 6Adc unit in Style-586 enclosures, R29 is an assembly of two (2) 50W 1000 Ohm resistors.				

4. Verify the AT Series product and cabinet "style" of your charger, based upon the model, and refer to the table below. Images of cabinet styles are featured in the operating manual.

Product	AT10.1 G1 **Style-586**	AT10.1 G1 **Style-594**	AT10.1 G2 **Style-5017**	AT10.1 G2 **Style-5018**
Location of R29	mounted along right leg of I/O panel mounting bracket	mounted along right leg of I/O panel mounting bracket	mounted to back galvanized mounting base (near R3)	mounted to back galvanized mounting base (near R3)
Connection of Wire # 195	A3-E10 GD PCB (see wiring diagram)	A3-E10 GD PCB (see wiring diagram)	W2(-) bus bar (see wiring diagram)	W2(-) bus bar (see wiring diagram)
Product	AT30 **Style-5018**	AT30 **Style-5030**	AT30 **Style-163**	AT30 **Style-198**
Location of R29	mounted to back galvanized mounting base (near R3)	mounted to outside surface of breaker mtg. bracket (near R3)	mounted to back phenolic mounting panel (near R3)	mounted to back phenolic mounting panel (near R3)
Connection of Wire # 195	R1-1(-) dc shunt (see wiring diagram)	R1-1(-) dc shunt (see wiring diagram)	R1-1(-) dc shunt (see wiring diagram)	R1-1(-) dc shunt (see wiring diagram)

PRECAUTIONS

⚠ **WARNING**

DISCONNECT ALL AC AND DC POWER SOURCES FROM THE BATTERY CHARGER BEFORE PROCEEDING. ONLY QUALIFIED SERVICE TECHNICIANS SHOULD PERFORM THIS PROCEDURE. FOLLOW THE SITE AND YOUR EMPLOYER'S STANDARD SAFETY PROCEDURES.

⚠ **WARNING**

OPENING CIRCUIT BREAKERS DOES NOT REMOVE ALL DANGEROUS VOLTAGES FROM INSIDE THE CHARGER. AFTER AC AND DC POWER ARE REMOVED, VERIFY THAT DC FILTER CAPACITORS (C1 AND/OR C2) ARE DISCHARGED BEFORE PROCEEDING.

NOTICE

GROUND YOURSELF WITH A WRIST STRAP. STATIC ELECTRICITY MAY CAUSE DAMAGE TO PRINTED CIRCUIT BOARDS.

PROCEDURE

1. Shut down the AT Series battery charger per the *Operating and Service Instructions*.
2. Open the charger front panel (door) and remove any supplied plexiglas safety shields.
3. Refer to the table on the previous page, and mount the Communications Module Power Supply Resistor (R29) Assembly inside the battery charger (normally located near R3).
4. Remove the CU-AL compression lug from TB1(+) on the charger I/O panel. Connect the flying lead of wire # 191 coming from the R29 resistor assembly to the TB1(+) stud terminal, and remount the CU-AL compression lug.
5. Refer to the table on the previous page, and connect the flying lead of wire # 195 of the R29 resistor assembly to the AT Series battery charger "system common" contact point.
6. Route the remaining wires # 194 & 195 (which end at the 4-pin Molex-type plug) along the charger's main signal harness. The wires will lead to the left side of the Main Control PC Board (A1), mounted on the charger's front panel. Tie-wrap the new wires in place.
7. Handling all pc boards by their edges, remove the existing Main Control PC Board (A1) and Gate Driver PC Boards (A11/A15) if applicable, off of the nylon stand-offs.
8. If a terminator plug (p/n EJ5201-00) is present and attached to A1-J13, remove and discard it.
9. Carefully insert the Communications Module PC Board (A12) onto the Main Control PC Board (A1) by inserting **A12-P13** onto **A1-J13**. See detail drawing (**JE5107-00**).
10. Return the connected pc boards (A1/A12) to the back of the front instrument panel, and carefully snap them onto the nylon stand-offs. Confirm all pc boards are firmly seated.
11. Insert the white nylon 4-pin Molex-type plug from the R29 resistor assembly into socket (J20) in the upper-left corner of the AT Series Communications Module PC Board (A12).
12. Close the AT Series battery charger front panel (door).
13. Turn on the charger's dc output circuit breaker (CB2) first, followed by the ac input circuit breaker (CB1) second.
14. Restart the AT Series battery charger per the *Operating and Service Instructions*.
15. Field Installation of the AT Series Communications Module is now complete. For full operation of the installed module, please refer to the supplied AT Series Communications Module user's manual (**JA0102-04**).

MANUAL SPECIFICATIONS

DOCUMENT NUMBER

The text and graphics contained within this manual are controlled by the battery charger manufacturer's internal part number (**JA5026-00**). The revision level and dates of this manual's text and graphics are listed below. These controls supercede all other available dates. The first two and last two pages of this manual are reserved for company-specific front and back cover artwork. Any revision levels, revision dates, or document numbers featured on the first two and last two pages of this manual refer to the cover artwork only.

DOCUMENT INFORMATION

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Last Date Printed:	[1/7/2015 3:52 PM]

PARTS DATA PACKAGE

Any job-specific customized Parts Data Package report supplied with this battery charger communications module, the corresponding battery charger, and/or this manual, supercede any standard parts listed in this manual.

DRAWINGS

A customized record drawing package is available for your **AT Series Communications Module** and/or your corresponding **AT10.1** or **AT30 Series** battery charger, featuring a unit-specific drawing list / data nameplate detail, outline drawing, itemized internal component layout, electrical schematic with component ratings, and a full connection diagram. If the standard drawings featured in this manual are not sufficient, please contact your Sales Representative for drawing availability from the battery charger manufacturer.

Any job-specific custom drawings supplied with your **AT Series Communications Module** and/or your corresponding **AT10.1** or **AT30 Series** battery charger, supercede the standard drawing featured in Appendix B.

ONLINE AVAILABILITY

An unlabeled version of this operating and service instruction manual is available online at http://www.ATSeries.net/PDFs/JA0102-04.pdf. Other related product operating manuals, feature and accessory special instructions, standard drawings (including the ones listed in this manual), field service instructions, and product application notes for the AT Series microprocessor-controlled battery chargers and battery charger products are available online at http://www.ATSeries.net/. Saved in Adobe Acrobat Portable Document Format (PDF), they are readily available for downloading and printing

If revision levels differ between the drawings embedded in this manual and the full online PDF drawings, refer to document with the higher revision level. For document availability of private-labeled manuals and/or standard drawings, please contact your sales representative or visit the web site listed on the **back cover** of this manual.

RELATED DOCUMENTS

Doc. No	Online Hyperlink	Description
JA0102-01	http://www.ATSeries.net/PDFs/JA0102-01.pdf	AT10.1 G1 Manual (unlabeled)
JA0102-02	http://www.ATSeries.net/PDFs/JA0102-02.pdf	AT10.1 G2 Manual (unlabeled)
JA0102-03	http://www.ATSeries.net/PDFs/JA0102-03.pdf	AT30 Manual (unlabeled)
JA0102-04	http://www.ATSeries.net/PDFs/JA0102-04.pdf	AT Comm. Module Manual (unlabeled)
JA0102-05	http://www.ATSeries.net/PDFs/JA0102-05.pdf	AT-DC Dist. Panel Manual (unlabeled)
JA5015-00	http://www.ATSeries.net/PDFs/JA5015-00.pdf	AT TempCo Probe Acsy. Instructions
JA5054-00	http://www.ATSeries.net/PDFs/JA5054-00.pdf	AT Forced Load Sharing Instructions
JA5098-00	http://www.ATSeries.net/PDFs/JA5098-00.pdf	AT Latching Alarm Relays Instructions
JC5020-00	http://www.ATSeries.net/PDFs/JC5020-00.pdf	AT Series Charger Quick Setup Sheet
EJ5088-XX	http://www.ATSeries.net/PDFs/EJ5088-XX.pdf	AT Series Ground Detection Voltmeter
EJ5130-XX	http://www.ATSeries.net/PDFs/EJ5130-XX.pdf	AT Series Barrier Type Alarm Terminals
EJ5136-XX	http://www.ATSeries.net/PDFs/EJ5136-XX.pdf	AT Series Battery Discharge Alarm
EJ5137-XX	http://www.ATSeries.net/PDFs/EJ5137-XX.pdf	AT Series End Of Discharge Alarm
JD0064-00	http://www.ATSeries.net/PDFs/JD0064-00.pdf	Preventative Maintenance Procedure
JD0064-01	http://www.ATSeries.net/PDFs/JD0064-01.pdf	AT Series Charger Start-up Procedure
JD5003-00	http://www.ATSeries.net/PDFs/JD5003-00.pdf	TempCo Probe Application Note
JD5008-00	http://www.ATSeries.net/PDFs/JD5008-00.pdf	AT Comm. Module Field Installation
JD5010-00	http://www.ATSeries.net/PDFs/JD5010-00.pdf	AT Power Res. (R3) Field Installation
JD5012-00	http://www.ATSeries.net/PDFs/JD5012-00.pdf	Main Ctrl PC Board (A1) Field Installation
DC5016-00	http://www.ATSeries.net/PDFs/DC5016-00.pdf	AT Series AC Input Current Tables
JD5032-00	http://www.ATSeries.net/PDFs/JD5032-00.pdf	Ground Fault Detection Application Note
JF5039-00	http://www.ATSeries.net/PDFs/JF5039-00.pdf	AT10.1/AT30 3rd Party Agency Approvals
JF5045-00	http://www.ATSeries.net/PDFs/JF5045-00.pdf	Proper Sizing of Industrial Battery Chargers
JE5107-00	http://www.ATSeries.net/PDFs/JE5107-00.pdf	AT Comm. Module Assembly Detail
JF5026-00	http://www.ATSeries.net/PDFs/JF5026-00.pdf	AT Communications Module FAQs
n/a	http://www.ATSeries.net/PDFs/RS422+485AppNote.pdf	3rd Party **RS-422** & **RS-485** Appl. Note
EJ5230-04	http://www.ATSeries.net/PDFs/EJ5230-04.pdf	130Vdc "B&B" **Fiber Optics** Interface for AT Comm.
EJ5230-1X	http://www.ATSeries.net/PDFs/EJ5230-1X.pdf	"DYMEC RS485" **Fiber Optics** Interface for AT Comm.
EJ5230-2X	http://www.ATSeries.net/PDFs/EJ5230-2X.pdf	"DYMEC RS232" **Fiber Optics** Interface for AT Comm.
EJ5226-XX	http://www.ATSeries.net/PDFs/EJ5226-XX.pdf	Ethernet Gateway Option for AT Comm.
n/a	http://www.ATSeries.net/PDFs/EDNP-3UsersGuide.pdf	3rd Party Ethernet Gateway User's Guide (DNP-3)
n/a	http://www.ATSeries.net/PDFs/EMB-2UsersGuide.pdf	3rd Party Ethernet Gateway User's Guide (Modbus)
JA5070-00	http://www.ATSeries.net/PDFs/JA5070-00.pdf	Analog Modem for AT Communications

TYPICAL APPLICATIONS FOR SCADA SYSTEMS
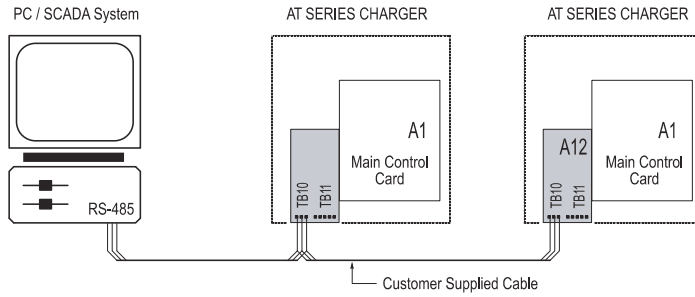
Figure 1. RS-485 Half-duplex Multi-Drop

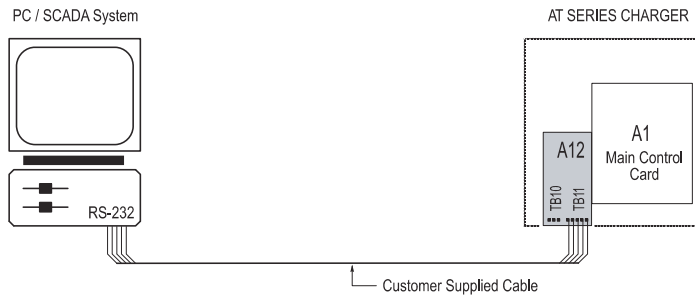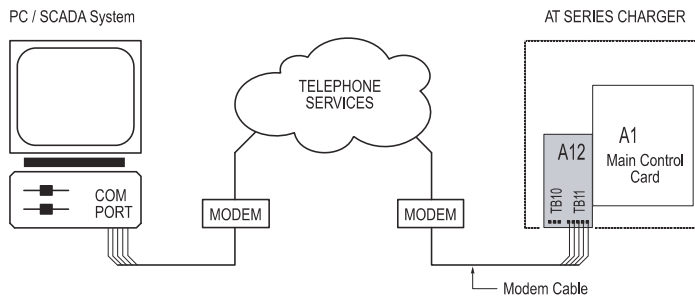## Figure 2. Standard RS-232 connection with or without hardware handshaking

Figure 3. Remote communications using a modem

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Online: alpinepowersystems.com