Operating Instructions

AT10.1/AT30 SERIES

MICROPROCESSOR-CONTROLLED FLOAT BATTERY CHARGER

COMMUNICATIONS MODULE

(DNP3 Level 2 / Modbus Protocols)

JA0102-04

DNP3 LEVEL 2 / MODBUS COMMUNICATIONS
FOR 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.
- All features of the AT Series front control 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.
- The option can be used with optional Ethernet communications.
- The option can be used with a modem for telephone communications.

SUPPLIED COMPONENTS

The AT Series Communications Module option (p/n **EJ5037-0#**) includes the AT Series Communications PC Board (A12), external power supply resistor(s) (R29), this Operating Instructions manual (**JA0102-04**), and a field-retrofit *Service 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
- ☐ Communications Module w/Ethernet Connection (J1)   EJ5037-2#

OPTIONAL ACCESSORIES   Part No

- ☐ Fiber Optic Modem Interface (Modbus / DNP3 L2)   EJ5230-##

SUPPLEMENTAL DOCUMENTATION

Several 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. Wiring
JF5026-00	http://www.ATSeries.net/PDFs/JF5026-00.pdf	AT Series Comm. Module FAQs

TABLE OF CONTENTS

SECTION	PAGE

1 Introduction

The AT Series Communications Module option allows users 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 AT Communications option supports DNP3 Level 2 and Modbus protocols over RS-232, RS-485, and Ethernet (when Ethernet option is ordered). Configuration is performed 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** on Page 34.

2 Protocols

2.1 Modbus

The communications option can be setup to communicate on standard Modbus networks using either of two (2) 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, 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 Modbus Section 8 on page 30 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 7 on page 19 for information on its implementation.

3 Hardware

3.1 Installation

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

Disconnect and lock out all power to the AT10.1/AT30 battery charger before starting any maintenance procedures. Turn off power at the ac distribution panel, upstream from the charger. Disconnect the battery from the charger dc output terminals. This includes remote sense wires if they were installed.

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

The AT Communications Module pc board (A12) 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 all printed circuit boards *only* by their edges.
- Ground yourself again before replacing 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 AT 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 POS(+) & NEG(-).

Step 2 Locate the stand-offs that hold the Main Control pcb and the Communications Module pcb to the door. Use needle nose pliers to pinch the retaining ears on all the stand-offs. Gently pull the Main Control pcb and Communications Module pcb back off the stand-offs, roughly 0.25in. It is best to unlatch all stand-offs first, with the both boards still resting on them. Finally, remove **both** boards in one motion.

Step 3 See **Figure 1** on Page 4. The EN5004-0# Communications Module pc board (A12) mounts to the left of the EN5002-00 Main Control pcb (A1), with connector **P13** plugged into **J13**. Make sure all pins on the connector line up.

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.
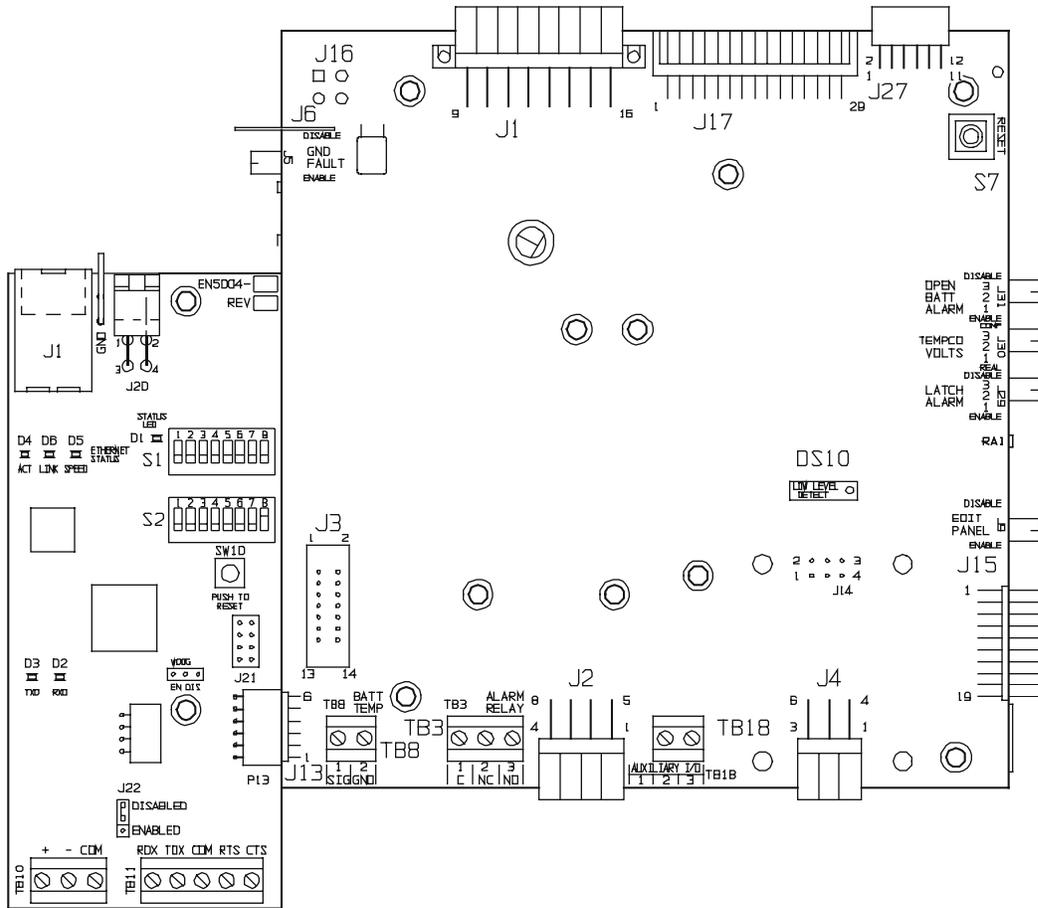
HARDWARE

Figure 1

EN5004-0# AT Series Communications PC Board (A12) - *left*
connected to EN5002-00 Main Control PC Board (A1) - *right*

Step 5 Connect the communications module ballast resistor(s) (R29) to the power supply connection plug (J20). Pin 2 on J20 is +Vdc, and pin 4 is common. For wiring details, see assembly drawing (**JE5107-00**).

Step 6 For *optional* Ethernet feature, connect **GROUND** wire # **244** to spade terminal, next to connection plug (J20). See assembly drawing (**JE5107-20**).

Step 7 Connect the serial communications connection:
        a) use TB11 for RS-232   (see Section 3.2.1)
        b) use TB10 for RS-485   (see Section 3.2.2)
        c) use *optional* J1 for Ethernet   (see Section 3.3)

Step 8 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.

4

COMPONENT LISTING
AT Communications PC Board (A12)

INDICATOR LIGHTS:
D1   Status LED - SPI Communication
D2   RXD - Serial Receive LED
D3   TXD - Serial Transmit LED
D4   ACT - Ethernet Activity LED
D5   SPEED - Ethernet 10/100 LED
D6   LINK - Ethernet Link Status LED

CONNECTORS / JUMPERS:
J20   Power Supply Connection
J21   Factory Connection
J22   RS-85 Terminating Resistor (enable/disable)
P13   Plug for Main Control Board (A1)

SWITCHES:
S1   Configuration Switches
S2   Modbus Address
SW10   RESET Push Button

USER CONNECTIONS:
J1   RJ45 Ethernet Connection (*opt*)
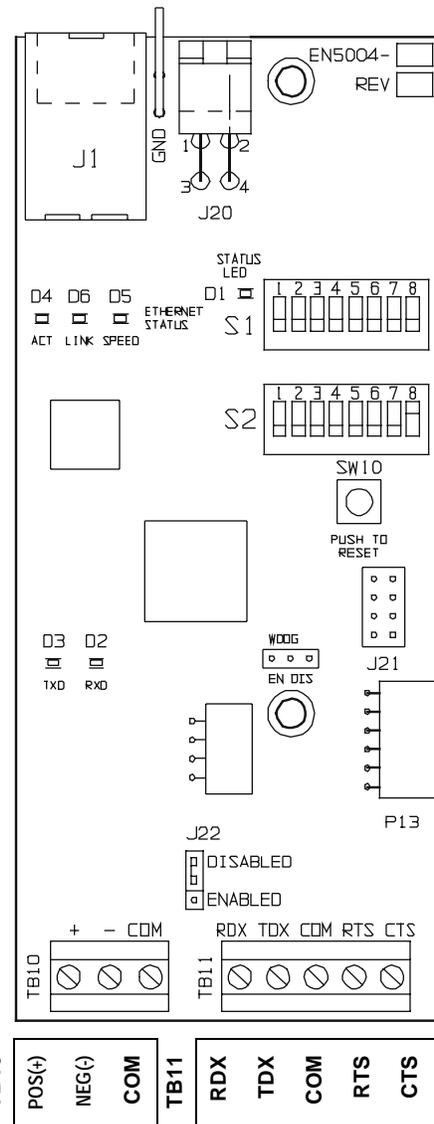TB10   RS-485 Serial Connection
TB11   RS-232 Serial Connection

Figure 2
EN5004-0# 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 communication, 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. Terminal Block (TB10) is for the RS-485 connections, and Terminal Block (TB11) 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

3.2.1.1   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

3.2.1.2   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.
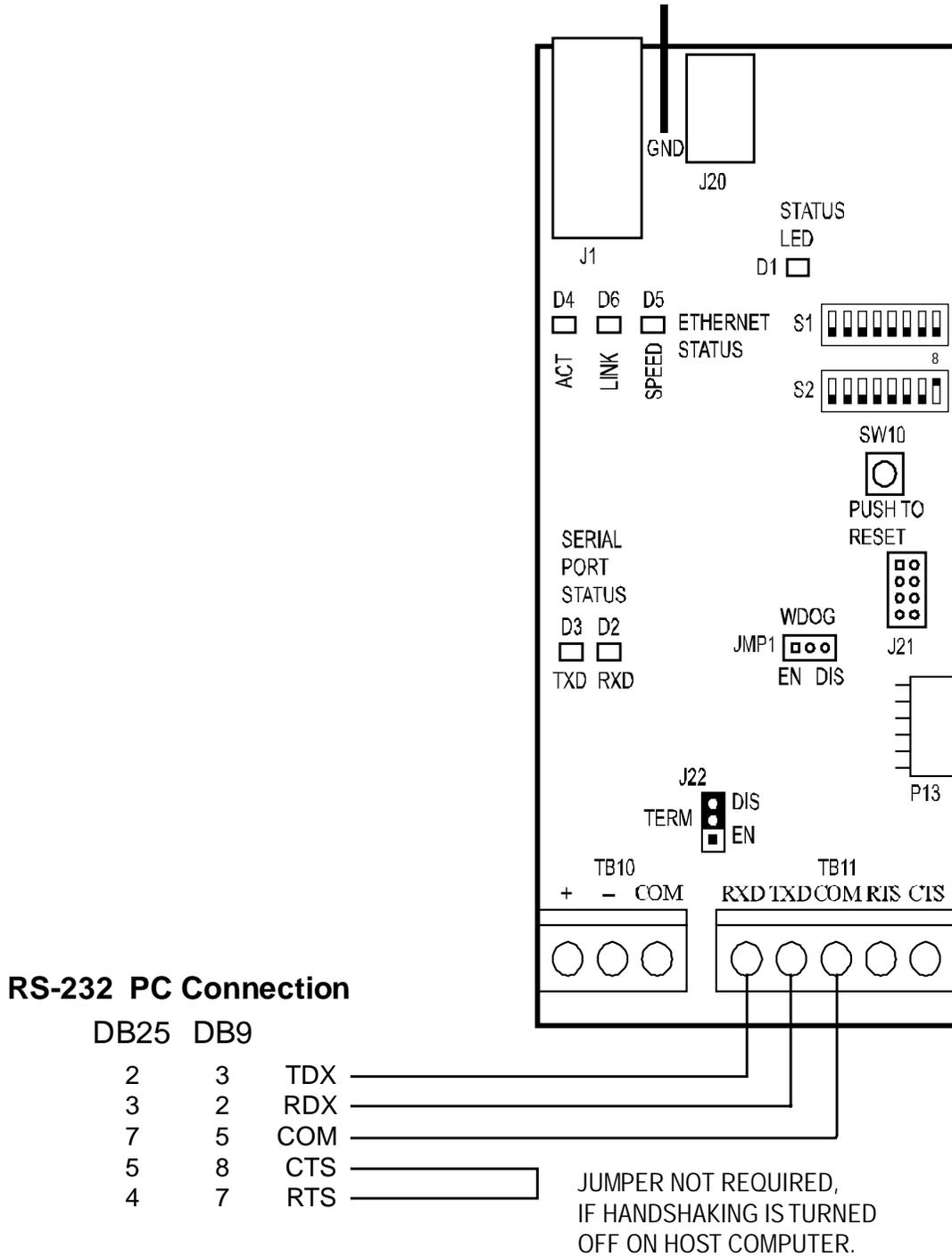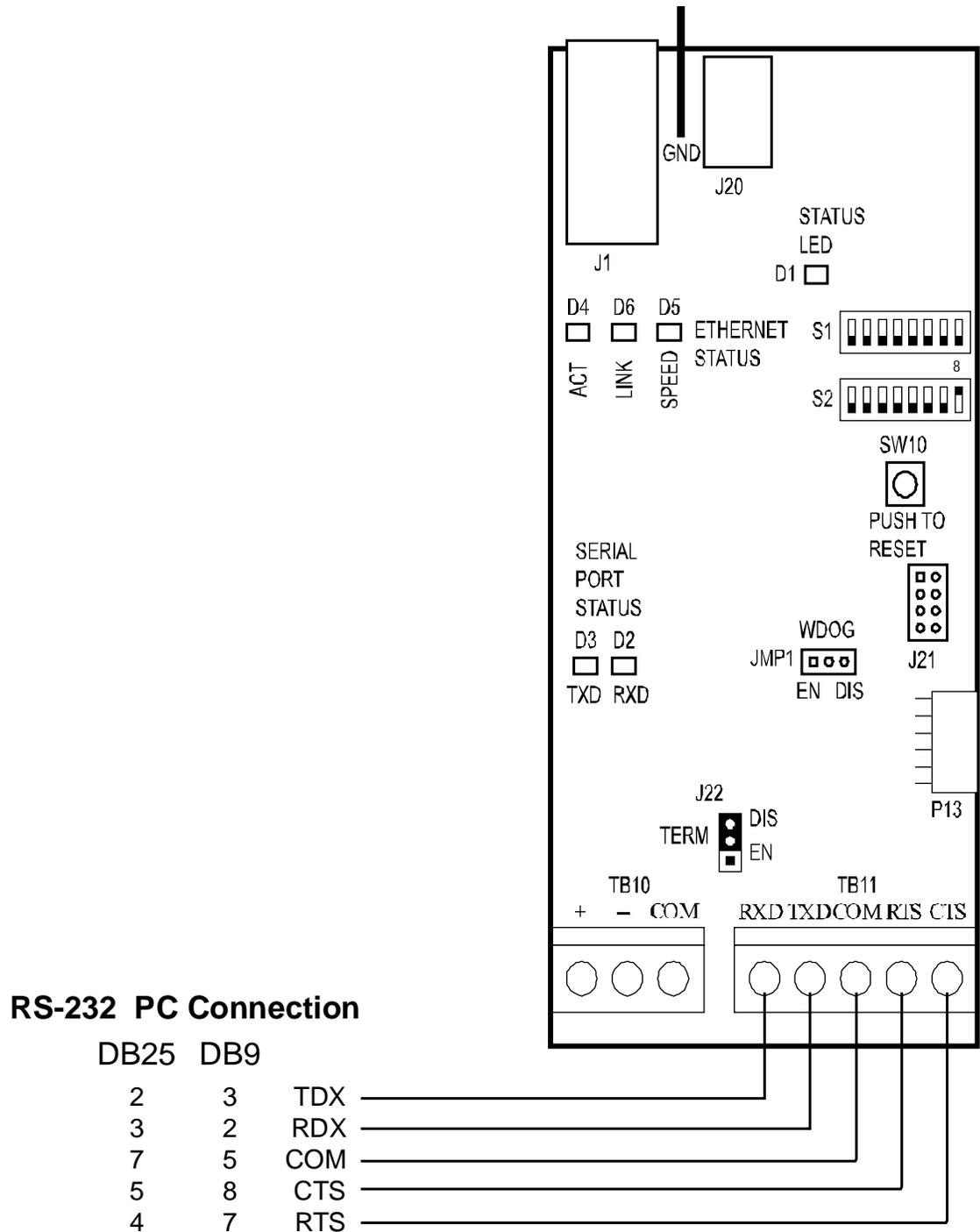

RS-232 PC Connection

DB25	DB9		
2	3	TDX	
3	2	RDX	
7	5	COM	
5	8	CTS	
4	7	RTS	

Figure 4
RS-232 5-Wire Connection

3.2.2 RS-485

The AT Communications Board (A12) 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 (2) sections describe a single connection and multi-drop connection.

Some RS-485 networks may require terminating resistors at ***both*** ends of the serial connections. 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) to 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/index.cfm

    2) RS-422/RS-485 Application Note
        Copyright: B&B Electronics
        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 (1) 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**

3.2.2.1 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.
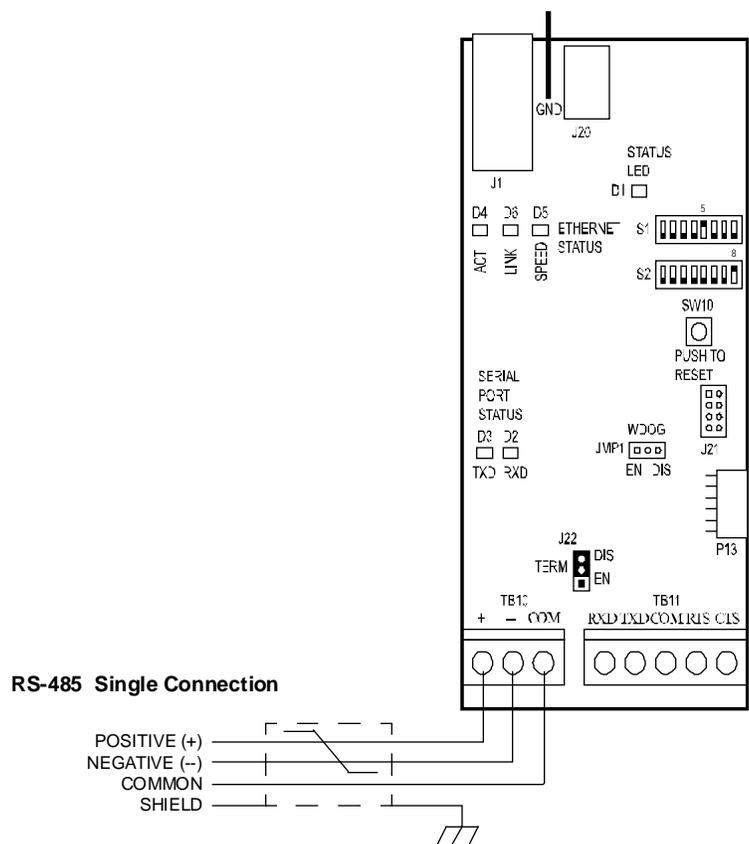

Figure 5
RS-485 Single Connection

* Typical RS-485 applications tie the shield to earth ground at only one (1) location along the network. Consult your organization's standard network grounding practices.

3.2.2.2 RS-485 Multi-Drop

When multiple chargers are connected using RS-485, and termination resistors are required, the termination resistors should only be installed (enabled) on the ends 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 (1) location along the network. Consult your organization's standard network grounding practices.

Charger No. 1   **Charger No. 2**   **Charger No. 3**

Figure 7
RS-485 Multi-Drop 3 Chargers

* Typical RS-485 applications tie the shield to earth ground at only one (1) location along the network. Consult your organization's standard network grounding practices.
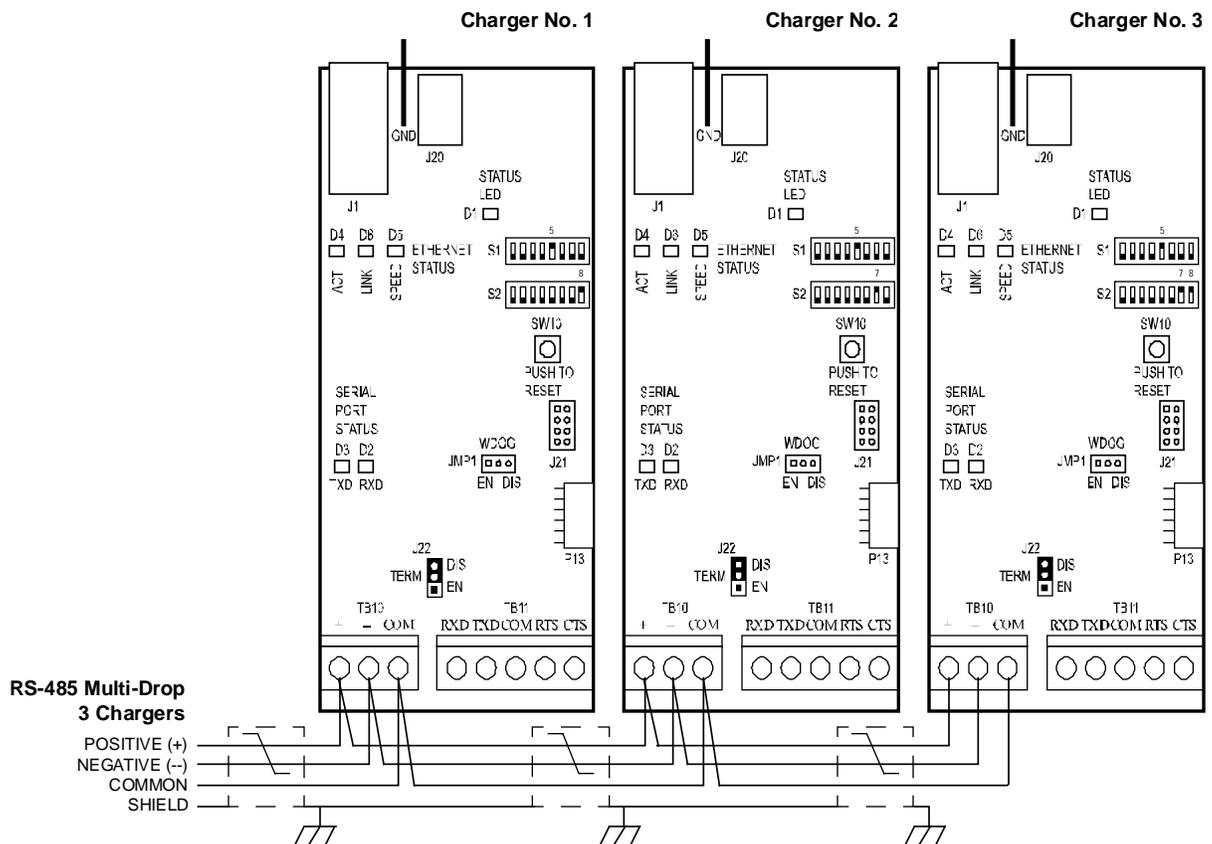
3.3   Ethernet Connection *(optional)*

A special AT Series Communications Module (p/n EJ5037-2#) can also be supplied, which supports both 10/100 MB copper Ethernet connections. These options have an RJ45 Ethernet socket (**J1**) installed onto a special A12 Communications PC Board (p/n EN5004-01). See **Figure 2** on page 5 for details.

To enable the Ethernet interface, set configuration switch (**S1-8**) to the **ON** position. The Ethernet interface will automatically detect and select the correct BAUD rate. To connect the Communications Module to your network, simply connect standard Cat 5/6 cable with RJ45 plug, from your network into Ethernet Socket (**A12-J1**). Turn on dipswitch (**S1-8**).

Refer to Factory Defaults Section 4.3 on page 16 for instructions on how to use the Set Up terminal emulator. This section describes how to configure the IP address, netmask, and gateway settings and how to enable Modbus and DNP protocols to use the Ethernet interface.

| **NOTICE** | Older AT Series Communications Modules were sometimes supplied with a *separate* Ethernet Gateway (p/n EJ5226-##), which is no longer produced. See User Instruction (**JA5109-00**) for legacy details.

3.4   Serial Fiber Optics Modem

An optional fiber optic to serial converter is available for the AT Series Communications Module. When ordered, this option (p/n **EJ5230-##**) will be installed at the factory. It 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 RS-485 " **Fiber Optics** Interface for AT Comm
EJ5230-2X	http://www.ATSeries.net/PDFs/EJ5230-2X.pdf	"DYMEC RS-232 " **Fiber Optics** Interface for AT Comm

3.5   Ethernet over Fiber

An optional Ethernet fiber optic module is available for the AT Series Communications Module. When ordered, this option (p/n **EJ5284-##**) will be installed at the factory. It will allow direct connection of various standard Ethernet fiber topologies. The Ethernet fiber optics module incorporates a standard Small Form Pluggable (SFP) module socket, such that various BAUD rates, fiber types, and connectors can be supported. Contact the factory for the specific needs of your interface requirements.

3.6   Using a Legacy 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. Refer to the special User Instructions (**JA5070-00**) for analog modem connection details.

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)

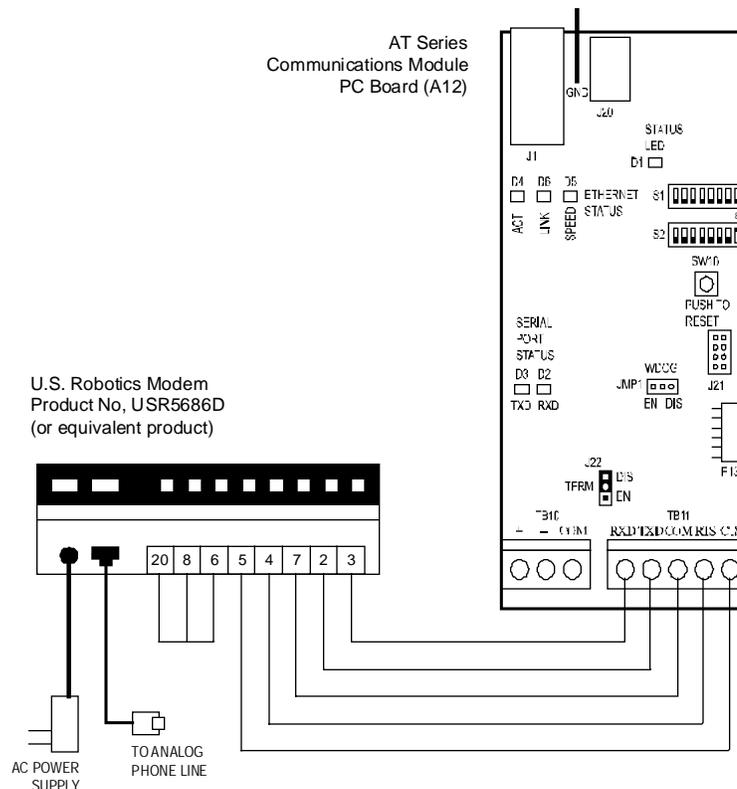| Switch	Position	Setting
1	Down	Data Terminal Ready override
2	Up	Verbal result codes
3	Down	Display result codes
4	Up	Echo offline commands
5	Up	Auto answer on
6	Up	Carrier detect normal
7	Down	Load factory defaults
8	Down	Smart mode

Figure 8
Modem Connection

4   Configuration

All user configurable items are controlled by two (2) groups of switches, and a setup program to modify additional configuration parameters. The AT Series Communications Module must be reset, after changes have been made, for them to take effect. To reset communications, either *press* the RESET button (**SW10**) on the A12 pc board, or turn *off* then turn *on*, both the ac input (**CB1**) and dc output (**CB2**) circuit breakers.

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	Ethernet Enable	Enabled	Disabled

*   **NOTICE**   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 (1)
2       DNP Unsol Destination Address (65519)
3       DNP Unsol Messaging Enable (0=disabled)
4       DNP Unsol Timeout (30)
5       DNP Unsol Retries Amount (2)
6       DNP Unsol Indefinite Retries (0)
7       Comm Parity (0=none)
8       Comm Stop Bits (1)
9       IP Address (192.168.1.100)
10      Netmask (255.255.255.0)
11      Gateway (0.0.0.0)
12      Enable Modbus over TCP/IP (0=disabled)
13      Modbus TCP Port (502)
14      Enable DNP over TCP/IP (0=disabled)
15      DNP TCP Port (20000)
16      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
```

CONFIGURATION

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 to **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 (1)
2       DNP Unsol Destination Address (65519)
3       DNP Unsol Messaging Enable (0=disabled)
4       DNP Unsol Timeout (30)
5       DNP Unsol Retries Amount (2)
6       DNP Unsol Indefinite Retries (0)
7       Comm Parity (0=none)
8       Comm Stop Bits (1)
9       IP Address (192.168.1.100)
10      Netmask (255.255.255.0)
11      Gateway (0.0.0.0)
12      Enable Modbus over TCP/IP (0=disabled)
13      Modbus TCP Port (502)
14      Enable DNP over TCP/IP (0=disabled)
15      DNP TCP Port (20000)
16      RESTART Comm Board
To change a value or RESTART, please select its item number:
```

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	1 or 2
IP Address:	192.168.1.100	255.255.255.255
Netmask:	255.255.255.0	255.255.255.255
Gateway:	0.0.0.0	255.255.255.255
Enable Modbus over TCP/IP:	0 (disable)	0(disable),1(enable)
Modbus TCP Port:	502	0 to 65535
Enable DNP over TCP/IP:	0 (disabled)	0(disable),1(enable)
DNP TCP Port:	20000	0 to 65535

5 Communication LEDs - Troubleshooting

The AT Communications Module pc board (**A12**) features LEDs to indicate the status of communications with the Main Control board (A1), the serial ports, and the *optional* Ethernet port. Reference **Figure 2** on Page 5 for the location of the following LEDs.

5.1 Main Control Board STATUS LED

The STATUS LED (**D1**) is a red indicator located to the left of dipswitch (**S1**). This LED will blink when the main control board and communications module exchange data. This LED should blink several times a second.

If the STATUS LED is always *on* or *off*, this indicates that the main control board and communications module are not communicating. This may indicate a problem with either the main control board or the communications module.

5.2 TXD & RXD Serial Port LEDs

The yellow TXD LED (**D3**) and green RXD LED (**D2**) are located along the left edge of the communications module about 2 inches from the bottom of the board. The RXD LED will flash green every time the communication module detects activity on the serial network. The TXD LED will flash yellow every time the communication module sends data to the serial network. Under normal operation the TXD LED will be flashing at the charger poll rate, and the RXD LED will be flashing at the poll rate or faster.

Note that the RXD LED flashes any time activity is detected on the network. This activity may be messages to/from other devices on the network. In addition, the flashing RXD LED only indicates that there are transitions on the network. It does not indicate valid framed command messages are being received that are addressed to the communication module.

A flashing yellow TXD LED indicates that a valid correctly formatted message was received by the communication module and the communication module responded to the received message. The yellow TXD LED flashing at the charger poll rate typically indicates that the network connection is working, however since it located on the charger side of the isolation barrier, their still could be a problem on the network side of the isolation barrier.

If either or both the RXD and TXD LEDs are always *on* or *off*, this may indicate a networking wiring error, a network problem, or incorrect configuration.

5.3 ACT, LINK, and SPEED Ethernet Port LEDs

These three (3) Ethernet status LEDs are located below Ethernet connection port (**J1**). These LEDs will only be relevant if the AT Communications module features the Ethernet option.

The green LINK LED (**D6**) when lit indicates that a good link has been established. The yellow ACT LED (**D4**) flashes when there is activity on the network. The orange SPEED LED (**D5**) indicates the network BAUD rate. If the communication module is connected to a 10Mb/s network, the SPEED LED will be *off*. The SPEED LED will be lit if the communications module is connected to a 100Mb/s network.

6 RESET Button

The RESET switch (**SW10**) is a small push-button, located directly below dipswitch (**S2**). See the image to the right, and/or **Figure 2** on page 5 for location of the RESET button.

The RESET switch, when pushed, will restart the AT Series Communication Module without resetting the charger's Main Control PC Board (A1). This is useful when configuration changes are made via the dipswitches (**S1** and **S2**), or the setup program (terminal emulator). Any changes made to the configuration will not take effect until after the communication module is reset.
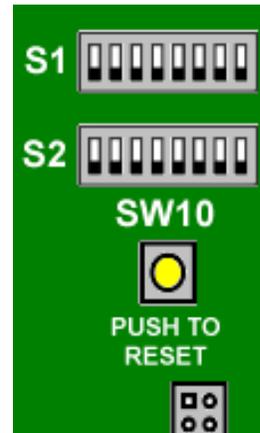
7   DNP V3.00

7.1 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.

7.2   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 7.3 on page 22
- The Point List Tables provided in Section 7.4 on page 25

DNP V3.00	
DEVICE PROFILE DOCUMENT	
(Also see the Implementation Table in Section 7.3 on page 22.)	
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 7.3 on page 22.)

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 7.4.2 on page 26 for a description of which control operations are supported for each point.

DNP V3.00

DEVICE PROFILE DOCUMENT

(Also see the Implementation Table in Section 7.3 on page 22.)

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	

7.3   Implementation Table

The following table identifies the variations, function codes, and qualifiers supported by the AT Series Communications Module PC Board (**A12**) 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)	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 (write)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)		
34	2	32-Bit Analog Input Reporting Deadband	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
			2 (write)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)		
			2 (write)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)		
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

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)
50	0	Time and Date	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)
50	1 (default – see note 1)	Time and Date	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07 (limited qty=1) 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
			2 (write)	00, 01 (start-stop) 07 (limited qty=1) 08 (limited qty) 17, 28 (index)		
60	0	Class 0, 1, 2, and 3 Data	1 (read) 20 (enbl. unsol.) 21 (dsbl. unsol.)	06 (no range, or all)		
60	1	Class 0 Data	1 (read) 22 (assign class)	06 (no range, or all)		
60	2	Class 1 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.) 21 (dsbl. unsol.) 22 (assign class)	06 (no range, or all)		
60	3	Class 2 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.) 21 (dsbl. unsol.) 22 (assign class)	06 (no range, or all)		
60	4	Class 3 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.) 21 (dsbl. unsol.) 22 (assign class)	06 (no range, or all)		
		No Object (function code only) see note 3	13 (cold restart)			
		No Object (function code only)	14 (warm restart)			
		No Object (function code only)	23 (delay meas.)			

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 AT 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).

7.4 Point List

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

7.4.1 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 = active)	1
8	LVAC Shutdown (1 = active)	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

7.4.2 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)

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

7.4.3 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 (2) examples are provided: In example 1, the point is un-scaled, represents kilowatts (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 Amperes	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

7.4.4 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 Amperes	See Range Section
4	HVDC Setpoint	3276.7 Volts	See Range Section
5	LVDC Setpoint	3276.7 Volts	See Range Section

7.4.5 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 (1) 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

8 Modbus

8.1 *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.

8.2 *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

8.3   Register Definitions

8.3.1 Binary Outputs

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

NOTICE   Only one (1) equalize method can be active at a time. The equalize method cannot be turned off. By turning on one (1) of the equalize methods the charger will turn off the other two (2) equalize methods automatically.

8.3.2 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

8.3.3 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

8.3.4 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 Amperes	10
40005	HVDC Setpoint	High Voltage DC Alarm Setpoint	10
40006	LVDC Setpoint	Low Voltage DC Alarm Setpoint	10

8.3.5 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.

9 AT Series Charger Data Ranges

9.1 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

9.2 Current Ranges

Current Rating (Amperes)	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

9.3 Equalize Time

Equalize time range is 0 to 255 hours.

APPENDIX A

What is the AT Communications Module?

The AT Communications Module (ordering p/n **EJ5037-##**) allows an AT10.1 or AT30 Series microprocessor-controlled 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, media type (RS-232, RS-485, or Ethernet), serial speed (baud rate), Modbus protocol type (ASCCI or RTU), and the Modbus slave address. For the more advanced configuration parameters used for the DNP3 protocol and Ethernet, a computer is required to configure the parameters. For further details, refer to Factory Defaults Section 4.3 on page 16.

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 RS-232, RS-485, or Ethernet (requires RJ45 socket option). 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 serial 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. The Ethernet interface is optional, and will support standard 10/100 copper networks.

What wiring variation of RS-485 is supported?

Two (2) wire, half-duplex

Can I communicate to more than one (1) AT Series charger?

Yes, both Ethernet and RS-485 communications allows multiple chargers to be connected to the same network. Up to thirty-two (32) AT Series chargers can be connected together via RS-485. Each charger will be assigned an address so that the system knows which charger it is communicating with. The Ethernet interface supports standard Ethernet addressing via IP address, netmask and gateway configuration. RS-232 does not support multiple chargers on a serial network.

What speed does the AT Communications Module support?

The AT Communications Modules supports BAUD rates of 9600 and 19,200 for RS-232 or RS-485 and 10/100 Mb/s for Ethernet.

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

The AT Comm 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 (2) 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 an Ethernet network?

Yes. This connection requires the AT Series Communications module Ethernet option (p/n EJ5037-2#).

What specific types of DNP3 over Ethernet are supported?

The AT Communications Module, when combined with the Ethernet option will support DNP/TCP.

What specific types of Modbus over Ethernet are supported?

The AT Communications Module, when combined with Ethernet option will support Modbus TCP\IP.

What types of Ethernet media are supported?

The AT Communications Module, when combined with the Ethernet option have a 10/100 Base-T port (supports 10 or 100 Mbps over copper). An Ethernet over Fiber option is also available.

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

Yes, a field kit (ordering p/n EJ5037-3#) can be provided. Please contact the factory with the AT Series battery charger serial number. That way, 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 Main Ctrl PC Board (A1) Field Installation
JE5107-00	http://www.ATSeries.net/PDFs/JE5107-00.pdf	AT Communications Module Assembly / Wiring
JE5107-20	http://www.ATSeries.net/PDFs/JE5107-20.pdf	AT Comm Module (w/Ethernet) Assy / 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 RS-485" **Fiber Optics** Interface for AT Comm
EJ5230-2X	http://www.ATSeries.net/PDFs/EJ5230-2X.pdf	"DYMEC RS-232" **Fiber Optics** Interface for AT Comm
JA5109-00	http://www.ATSeries.net/PDFs/JA5109-00.pdf	Ethernet Gateway for AT Comm (*legacy*)
JA5070-00	http://www.ATSeries.net/PDFs/JA5070-00.pdf	Analog Modem for AT Communications

APPENDIX B

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 (p/n 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)	EN5004-0#	AT Series Communications Module PC Board (A12)
B)	RJ00##-##	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 / Wiring Detail
F)	**JA0102-04**	AT Communications Module *Operating Instructions* (manual)

3. Verify the resistance of the R29 assembly per the table below. If the resistance is not correct, the EN5004-0# 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 acrylic safety shields.
3. Refer to the table on the previous page. 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. Connect the flying lead of wire # 195 of the R29 resistor assembly to the AT Series battery charger "system common" contact point.
6. Connect the new Ground Wire.
7. 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.
8. 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 the nylon stand-offs.
9. If a terminator plug (p/n EJ5201-00) is present and attached to A1-J13, remove & discard it.
10. 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**).
11. Return the connected pc boards (A1/A12) to the back of the front control panel, and carefully snap them onto the nylon stand-offs. Confirm all pc boards are firmly seated.
12. 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).
13. Close the AT Series battery charger front panel (door).
14. Turn on the charger's dc output circuit breaker (CB2) first, followed by the ac input circuit breaker (CB1) second.
15. Restart the AT Series battery charger per the *Operating and Service Instructions*.
16. 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 (2) and last two (2) 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 (2) and last two (2) pages of this manual refer to the cover artwork only.

DOCUMENT INFORMATION

Document Number: **JA5026-00**
Revision Level: **7F**
Filename: [JA5026-00.Rev7F.ATComm.manual.doc]
Last Date Saved: [6/17/2021 5:15 AM]
Last Date Printed: [6/17/2021 5:15 AM]

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 Wiring Detail**
JE5107-20	http://www.ATSeries.net/PDFs/JE5107-20.pdf	**AT Comm. Module (w/Ethernet) 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
JA5109-00	http://www.ATSeries.net/PDFs/JA5109-00.pdf	User Instructions - AT Comm Ethernet Gateway
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)
EJ5226-XX	http://www.ATSeries.net/PDFs/EJ5226-XX.pdf	Wiring Diagram - AT Comm Ethernet Gateway
EJ5284-XX	http://www.ATSeries.net/PDFs/EJ5284-XX.pdf	**Fiber Optics Ethernet** Interface for AT Comm
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 RS-485" **Fiber Optics** Interface for AT Comm.
EJ5230-2X	http://www.ATSeries.net/PDFs/EJ5230-2X.pdf	"DYMEC RS-232" **Fiber Optics** Interface for AT Comm.
JA5070-00	http://www.ATSeries.net/PDFs/JA5070-00.pdf	Analog Modem for AT Communications

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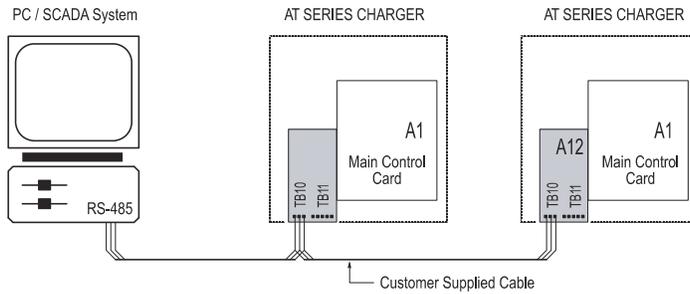
Figure 1. RS-485 Half-duplex Multi-Drop

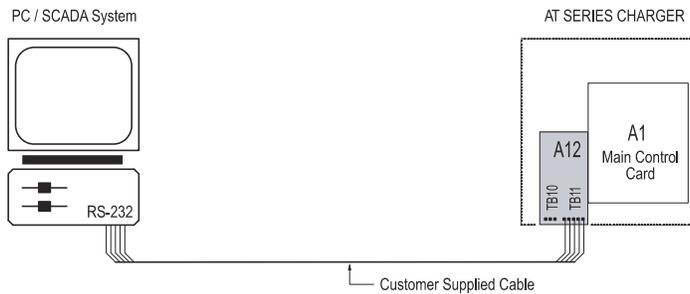## Figure 2. Standard RS-232 connection with or without hardware handshaking

Figure 3. Remote communications using a modem