C&D TECHNOLOGIES, INC.
Power Solutions

POWER SYSTEMS DIVISION

DNP3
Installation Guide
For
The ARE-M Series
Float Charger
DNP3 Communications Module

C&D Part #PM990.1074.00
Version 1
Revision Date: 02/22/2008
© Copyright C&D Technologies 2008

C&D Technologies, Inc.
Integrated Power Systems,
Power Systems Division
65 Industrial Park Road, Dunlap, TN 37327
Customer Service, Voice: (800) 440-3504
Customer Service, Fax: (423) 949-3647
Field Service: (800) 299-3907
Web site – http://www.cdstandbypower.com

REVISION HISTORY

Date	Version	Reason for change	Edited by
2/22/08	1	Initial Release, See ECN#16139	JKK

1 Introduction

The DNP3 communications kit (C&D #385.8335.00) will allow the ARE-M charger to communicate with a SCADA system that uses the DNP3 protocol. A couple of example SCADA system possibilities are illustrated in Figure 1.

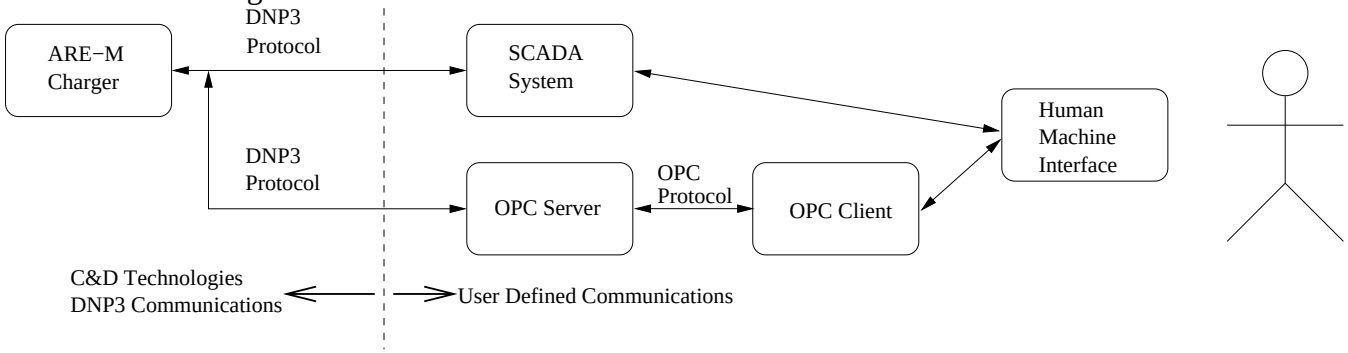

Figure 1 Diagram of the ARE-M charger with DNP3 communications integrated into a possible SCADA system configuration.

The Human Machine Interface (HMI) is what is used by a system operator to monitor and control a remote DNP3 device. The integration of the ARE-M DNP3 enabled charger into a SCADA system is beyond the scope of this installation guide. This guide is intended to show how the DNP3 communications hardware is installed and only overview some items that might be needed for integrating it into a SCADA system.

2 DNP3 Hardware Setup

The DNP3 communications module communicates with a DNP3 master through a 10Mbit Local Area Network (LAN) connection. The DNP3 communications module communicates with and is powered from the ARE-M display board through the supplied communication cable. The communication cable length comes in a standard length of 5 feet. The Ethernet cable lengths with option numbers are listed in Table 1. Should you need a different length communication or Ethernet cable, these are available from C&D. The connection between the DNP3 communications cable and the DNP3 communication module is shown in Figure 2. The connection between the communications cable and the ARE-M display board is shown in Figure 3. The communication cable connectors are keyed and not interchangeable to aid in correct installation.

Ethernet Communication Cable Length in feet	C&D Option Number
2	OPARE0441A
4	OPARE0037
25	OPARE0442A
50	OPARE0443A

Table 1 Listing of the different part numbers to order depending upon which Ethernet cable length is desired.

If the communication module will be installed on a running charger, be advised that the charger may restart when the DNP3 communication cable is plugged into the control board. A charger restart will cause the load to be dependent upon either another charger, or a battery backup for around 20 seconds until the charger recovers. Before installation begins, please choose and prepare a location where the DNP3 communication module will be placed after the installation is complete. This location should be safe and not exceed any ratings in section 7.

The following is a bulleted list of steps to be completed to install the DNP3 hardware kit.

- Plug the communications cable into the DNP3 communication module as illustrated in Figure 2.
- Mount the DNP3 communications module in the chosen location.
- If the module is not placed inside the charger, route the DNP3 communication cable through one of the cable entry points on the top of the charger.
- Connect the DNP3 communications module to the Ethernet cable (CAT-5, or CAT-6).
- Route the Ethernet cable to where it can connect to the LAN.
- Connect the Ethernet cable to the LAN.
- Connect the communications cable to the ARE-M control board as illustrated in Figure 3.
- If the ARE-M was shut off, it can now be powered back on as detailed in the charger user manual (PM990.1070.###). Where the ### represents the output voltage rating of the charger.
- A green network connection light on the DNP3 box's RJ45 connector light indicates a good Ethernet connection to the LAN.

Once the hardware is properly installed, a web browser on a computer attached to the LAN can be used to verify the charger's Ethernet interface is working properly. The network settings can be modified using the charger's web page. The charger's web page will be located at the IP address which can be found from the "DNP3 Setup IP" menu. The factory default address is 192.168.10.251. In this case one would enter http://192.168.10.251/ to browse the charger's web page. In order to modify the network settings, you will need to enter a username and password. The default user name is "admin", and the password is "pw". To prevent unauthorized changes, the username and password can be modified. Please keep the new username and password in a safe location for future reference.

The next section details how to configure the DNP3 communications through the ARE-M front panel menu interface.

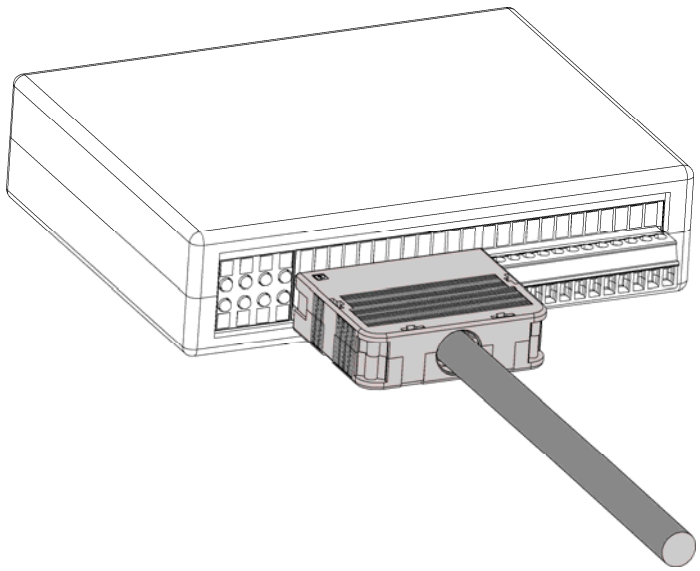

Figure 2 An illustration showing how to connect communication cable to the DNP3 interface module.

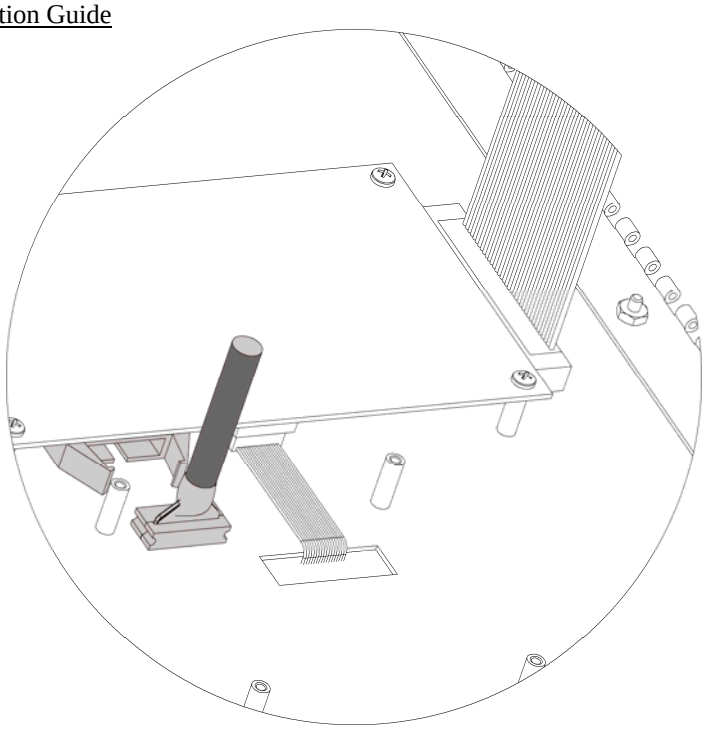

Figure 3 An illustration showing how to connect the DNP3 communication cable to the ARE-M control board.

3 DNP3 Configuration Menu System

The DNP3 communication interface requires a minimum ARE-M control board software revision of 3.03. The control board software version can be viewed on the Model and firmware version menu. This menu can be found by starting at the default menu that shows the Voltage and Current readings.

- Press the "UP" key 3 times to get to the "CHARGER STATUS" menu.
- Press the "SEL" key in the "CHARGER STATUS" to see the model and firmware version menu.

If you find that the control board software version is less than 3.03, please contact C&D about either upgrading the ARE-M control board software, or acquiring a new control board.

The DNP3 configuration menu system on the charger's front panel display will not appear until a DNP3 communication module is connected to it. These menus allow setting DNP3 specific settings including the TCP/UDP network connection. The menus will be located under the "CHARGER SETUP" series of menus, and are accessed. To get to the "CHARGER SETUP" screen do the following. From the default charger status screen which displays the voltage and current:

- Press "UP" on the keypad to see the "CHARGER SETUP" screen.
- Press "SEL" to get to the "System Setpoints" screen.
- Press the "UP" key to get to the "DNP3 Setup" screen.
- Press "SEL" to see the first DNP3 configuration screen called "DNP3 Outstation Address".

The menus that may be needed while configuring the ARE-M's DNP3 communications are illustrated in Figure 4. The front panel keys "UP", "DN", "ESC" and "SEL" are used to both navigate the DNP3 configuration menus, and to change individual configuration settings. The following bulleted list indicates how each the of the front panel keys is used while changing the DNP3 configuration.

- **Navigation**
  - Pressing the "SEL" key will cause the current menu selection to go to the right.
  - Pressing the "ESC" key will cause the current menu selection to go to the left.
  - Pressing the "UP" key will cause the current menu selection to go up.
  - Pressing the "DN" key will cause the current menu selection to go down.
- **Changing Parameter Values**
  - Pressing the "SEL" key the first time while viewing a value will allow the value to be changed. If password protection is enabled you will need to enter the correct password to change the value. The second press of the "SEL" key will cause the displayed value to be stored.
  - Pressing the "UP" key will cause the displayed value to increase.
  - Pressing the "DN" key will cause the displayed value to decrease.
  - Pressing the "ESC" key will cause the displayed value to be discarded.
- **Changing four part IP Addresses (###.###.###.###)**
  - Pressing the "SEL" key the first time while viewing an IP address will allow the least significant part of the IP address to be changed by the "UP" and "DN" keys (###.###.###.xxx). If password protection is enabled you will need to enter the correct password to change the IP address.
  - Pressing the "UP" key will cause the displayed value to increase.
  - Pressing the "DN" key will cause the displayed value to decrease.
  - Press the "SEL" key to allow changing the next most significant part of the IP address (###.###.xxx.###).
  - Press the "SEL" key to allow changing the next most significant part of the IP address (###.xxx.###.###).
  - Press the "SEL" key to allow changing the next most significant part of the IP address (xxx.###.###.###).
  - After editing the most significant part of the IP address, pressing "SEL" will save the new IP address**.**
  - Pressing the "ESC" key will cause the displayed value to be discarded.

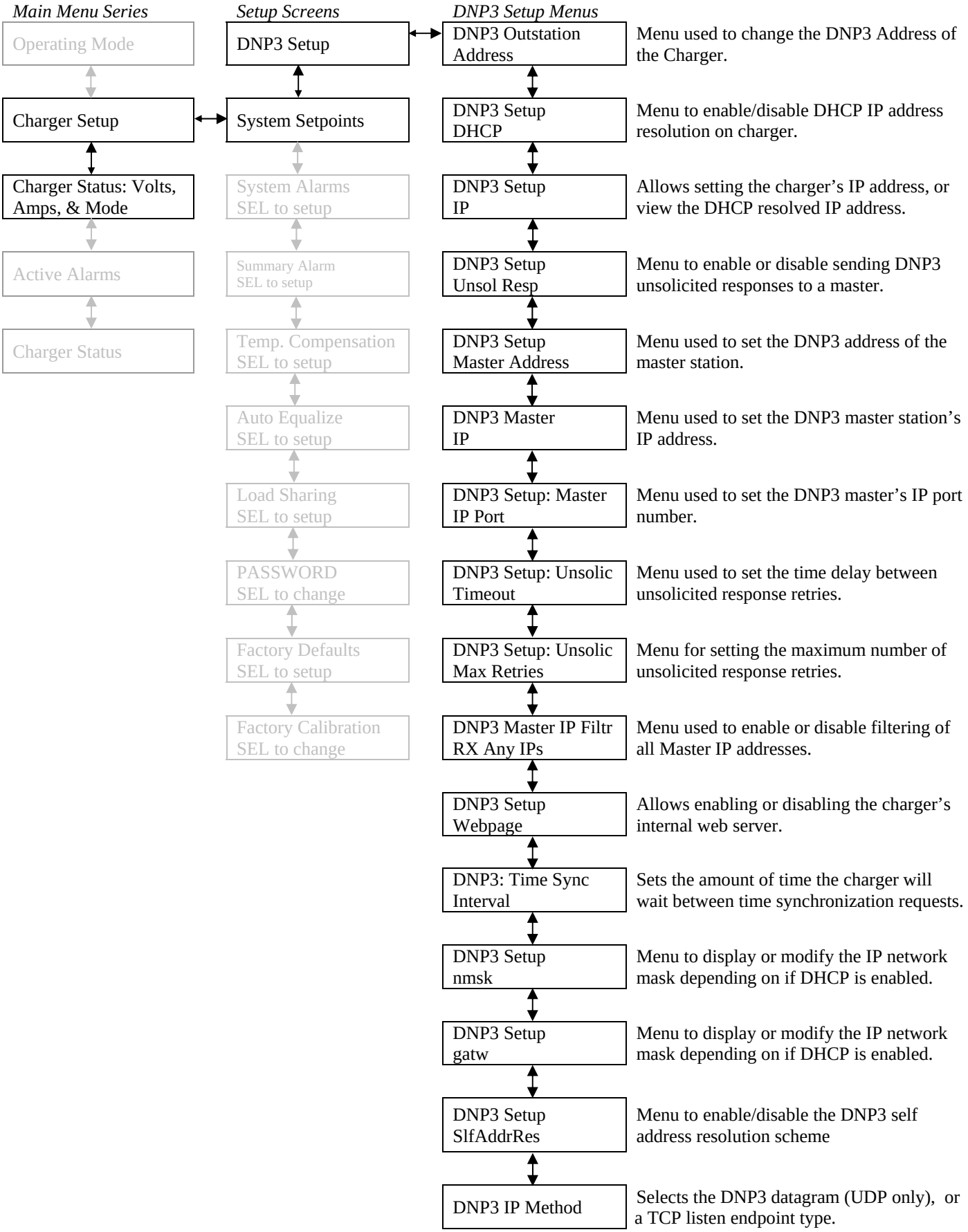

Figure 4 ARE-M Menus for DNP3 setup.

4 DNP3 Configuration Procedure

The required information needed to configure the DNP3 communications for the ARE-M charger depends upon the type of communications endpoint that is selected. The three types of communication methods are UDP datagram endpoint, TCP listen endpoint, and TCP dual endpoint. All three communication methods support receiving broadcasted messages from the master station over UDP. The general behavior of each endpoint method is as follows.

The UDP datagram endpoint listens for requests from the master station and can actively send information to the master station. The TCP Listen endpoint listens for TCP connection requests from the master station. It can only send information to the master station after the master station has opened a connection to it. The TCP Dual endpoint connection can actively open a TCP connection to the master as well as listen for incoming connections from the master station. The TCP Dual endpoint connection is not implemented in the ARE-M DNP3 communications software.

It is recommended before actually installing the DNP3 communications module that the following DNP3 installation worksheet be filled out. Detailed instructions for setting up each of the supported DNP3 communication endpoint types are given in the rest of this section.

4.1 DNP3 Installation Worksheet

Description	Value
Outstation Address (0-65519)	
Outstation IP address	
Outstation DHCP (enabled/disabled)	
Master Address (0-65519)	
Master IP Address	
Master IP Port (0-65535)	
Outstation Endpoint Type (UDP Datagram/TCP Listen)	
Outstation IP Network mask	
Outstation Gateway IP address	
Unsolicited Responses (enabled/disabled)	
Unsolicited Response Timeout	
Unsolicited Response Max Retries	
Outstation MAC Address	00-50-C2-7E- -

4.2 Datagram Endpoint (UDP only communications) Setup

4.2.1 Setup of the ARE-M DNP3 Outstation

1. In the "DNP3 Outstation Address" menu, choose the desired DNP3 address of the charger.
2. In the "DNP3 Setup Master Address" menu, set the DNP3 address of the master station.
3. Set the master IP address to the IP address of the master station in the "DNP3 Master IP" menu.
4. Use the "DNP3 Setup: Master IP Port" menu to set the master Port to the IP port on the master to communicate with (by default this is the DNP3 port 20000).
5. Set the endpoint type to "Datagram End Point" in the "DNP3 IP Method" menu. This is the default setting.
6. Set the IP parameters of the charger using either of the following two methods.
    a. The static IP method
        i. Disable DHCP using the "DNP3 Setup DHCP" menu.
        ii. Enter the static IP address on the "DNP3 Setup IP" menu. The default is 192.168.10.251.
        iii. Enter the network mask on the "DNP3 Setup nmsk" menu. The default is 255.255.255.0.
        iv. Enter the gateway on the "DNP3 Setup gatw" menu. The default is 192.168.10.130.
    b. To use the DHCP method to setup the IP information
        i. Enable DHCP using the "DNP3 Setup DHCP" menu.
        ii. The DHCP configured information will show up on the same menus that are used to configure the static IP information. The information cannot be edited while DHCP is enabled.
7. Enable, or disable unsolicited responses using the "DNP3 Setup UNSOL Resp" menu.
8. If unsolicited responses are disabled, skip steps 9 and 10.
9. The time between unsolicited responses can be changed by using the "DNP3 Setup: Unsolic Timeout" menu. This time represents the number of seconds the outstation will wait before attempting to send another unsolicited response.
10. The number of retries for unsolicited responses that contain event information can be changed on the "DNP3 Setup: Unsolic Max Retries" menu.

If unsolicited responses are enabled, the DNP3 outstation will start sending the unsolicited null response to the DNP3 master once the steps in this section are complete.

4.2.2 Setup of the DNP3 Master

The DNP3 master needs to be configured to both send and receive DNP3 information from the ARE-M DNP3 outstation. The following configuration information may or may not be required depending on what kind of software is used to implement a DNP3 master.

1. The current DNP3 address of the ARE-M outstation. This is displayed in the "DNP3 Outstation Address" menu.
2. The current IP address of the ARE-M. This is displayed in the "DNP3 Setup IP" menu.
3. The MAC address of the DNP3 Ethernet interface can be found on the label attached to the network side of the DNP3 interface module.
4. The DNP3 communication endpoint type can be referred to as "UDP Datagram" or "UDP only".
5. Names for the DNP3 object points that are available on the DNP3 interface are provided in the ARE-M Device Profile document C&D part number PM990-1072-00.

4.3 TCP Listen Endpoint Setup

4.3.1 Setup of the ARE-M DNP3 Outstation

1. In the "DNP3 Outstation Address" menu, choose the desired DNP3 address of the charger.
2. In the "DNP3 Setup Master Address" menu, set the DNP3 address of the master station.
3. Use the "DNP3 Setup: Master IP Port" menu to set the master Port to the IP port on the master to communicate with (by default this is the DNP3 port 20000).
4. Set the endpoint type to "TCP Listening End Pt" in the "DNP3 IP Method" menu.
5. Set the IP parameters of the charger using either of the following two methods.
    a. The static IP method
        i. Disable DHCP using the "DNP3 Setup DHCP" menu.
        ii. Enter the static IP address on the "DNP3 Setup IP" menu. The default is 192.168.10.251.
        iii. Enter the network mask on the "DNP3 Setup nmsk" menu. The default is 255.255.255.0.
        iv. Enter the gateway on the "DNP3 Setup gatw" menu. The default is 192.168.10.130.
    b. To use the DHCP method to setup the IP information
        i. Enable DHCP using the "DNP3 Setup DHCP" menu.
        ii. The DHCP configured information will show up on the same menus that are used to configure the static IP information. The information cannot be edited while DHCP is enabled.
6. Enable, or disable unsolicited responses using the "DNP3 Setup UNSOL Resp" menu.
7. If unsolicited responses are disabled, skip steps 9 and 10.
8. The time between unsolicited responses can be changed by using the "DNP3 Setup: Unsolic Timeout" menu. This time represents the number of seconds the outstation will wait before attempting to send another unsolicited response.
9. The number of retries for unsolicited responses that contain event information can be changed on the "DNP3 Setup: Unsolic Max Retries" menu.

If unsolicited responses are enabled, the DNP3 outstation will start sending the unsolicited null response to the DNP3 master once the steps in this section are complete.

4.3.2 Setup of the DNP3 Master

The DNP3 master needs to be configured to both send and receive DNP3 information from the ARE-M DNP3 outstation. The following configuration information may or may not be required depending on what kind of software is used to implement a DNP3 master.

1. The current DNP3 address of the ARE-M outstation. This is displayed in the "DNP3 Outstation Address" menu. If self address reservation is enabled on the outstation in the "DNP3 Setup SlfAddrRes" menu, this might not be needed.
2. The current IP address of the ARE-M. This is displayed in the "DNP3 Setup IP" menu.
3. The MAC address of the DNP3 Ethernet interface can be found on the label attached to the network side of the DNP3 interface module.
4. This DNP3 communication endpoint type is referred to as "TCP Listen".
5. Names for the DNP3 object points that are available on the DNP3 interface are provided in the ARE-M Device Profile document C&D part number PM990-1072-00.

5 Factory Defaults (for reference only)

The following factory default values are listed here for convienience only. The DNP3 Device Profile document PM990.1072.00 contains the complete and most updated list of default values.

Configuration Parameter	Factory Default	Range
DNP3 Outstation (ARE-M)		
Address	4	0-65519
TCP/IP Address	192.168.10.251	Any valid IP address
TCP/IP Port	20000	Fixed
Network Mask	255.255.255.0	Any valid IP network mask
Gateway	192.168.10.130	Network gateway for WAN / Internet access
Unsolicited Responses		
Enabled	Enabled	Enable/Disable
Maximum Number of Retries	10	0-254 & retry indefinitely
Timeout	5	1-254 seconds
DHCP	Disabled	Disabled/Enabled
DNP3 Master		
Address	3	0-65519
TCP/IP Address	192.168.10.178	Any valid IP address
TCP/IP Port	20000	Fixed

6 Acronyms

- **DHCP** – Dynamic Host Configuration Protocol: Used to configure network settings automatically.
- **DNP3** – Distributed Network Protocol: One protocol used to implement a SCADA system popular in Power Distribution systems.
- **DNP3 Outstation** – Refers to a remote device that can be controlled and monitored. In this document the remote device is an ARE-M charger with DNP3 communications.
- **DNP3 Master** – Refers to a device that can control and monitor multiple remote devices (outstations).
- **HMI** – Human Machine Interface: Used by end users to access and control a SCADA system.
- **IP** – A network layer protocol in the Internet protocol suite one layer above the physical interface (Ethernet)
- **LAN** – Local Area Network.
- **OLE** – Object Linking and Embedding is a technology that allows a document to embed the results of another program into the document.
- **OPC** – OLE for Process control: A specification managed by the “OPC Foundatation”, and is used to bridge Windows applications with process control and other software applications.
- **SCADA** – Supervisory Control and Data Acquisition: A system used to monitor and control multiple devices from a centralized location.
- **TCP** – Transmission Control Protocol: One of the core protocols of the Internet protocol suite.
- **WAN** – Wide area network.

7 Device Characteristics

- The Ethernet signal lines of the RJ45 connector are isolated from the DNP3 communications module up to 1500VDC.
- The ambient temperature of installation environment for the module should not exceed 50C.
- The module should be installed in a stable location near the charger it is connected to.
- An overview of the low level DNP3 communications is listed in the following bullets.
    - **Binary Inputs**: DNP3 groups 1 and 2
    - **Binary Outputs**: DNP3 groups 10 and 12
    - **Analog Inputs**: DNP3 groups 30 and 32
    - **Analog Outputs**: DNP3 groups 40 and 41
    - **Misc**: DNP3 groups 50,51,52, 60 and 80
    - **Misc DNP3 function codes**: 13, 23 and 24

8 References

1. C&D Technologies Standby Power Website, http://www.cdstandbypower.com/.
2. ARE-M DNP3 Device Profile document, PM990.1072.00.