EMH+

Energy Monitoring HUB+

Product Description

Technical Specifications

Installation Instructions

DI-000-A8814-00A-X1

LEVITON

Copyright Information

Limited Warranty

⚠ DANGER ⚠ ⚡
Hazard of Electric Shock, Explosion or Arc Flash
● Follow safe electrical work practices. See NFPA 70E in the USA, or applicable local codes.   ● This equipment must only be installed and serviced by qualified electrical personnel.   ● Read, understand and follow the instructions before installing this product.   ● Turn off all power supplying equipment before working on or inside the equipment. Use properly rated voltage sensing device to confirm power is off.   DO NOT DEPEND ON THIS PRODUCT FOR VOLTAGE INDICATION   ● Only install this product on insulated conductors.
Failure to follow these instructions will result in death or serious injury.

A qualified person is one who has skills and knowledge related to the construction and operation of this electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved. No responsibility is assumed by Leviton for any consequences arising out of the use of this material.

CAUTION
RISK OF EQUIPMENT DAMAGE
● EMH+ is rated for 50-60 HZ. Do not connect this product to circuits with high harmonic energy such as Variable Speed Drives (a.k.a. Variable Frequency Drives, Adjustable Frequency Drives) or similar sources, as they may permanently damage the product.   ● This product is designed to work with 1V and 0.333V Current transformers (CTs). DO NOT USE CURRENT OUTPUT (e.g. 5A) CTs on this product.
Failure to follow these instructions can result in overheating and permanent equipment damage.

NOTICE
● This product is not intended for life safety applications.   ● Do not install this product in hazardous or classified locations.   ● The installer is responsible for conformance to all applicable codes.

FCC Part 15 Information

Note: This equipment has been tested by the manufacturer and found to comply with the limits of a class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Modifications of this product without the express authorization of Leviton nullify this statement.

1.888.610.7664   www.calcert.com   sales@calcert.com

Contents

Overview

The A8814 (EMH+) is the first device of its kind to incorporate the ease of use and functionality of the Leviton Data Acquisition (DAS) platform with a line powered three phase meter. Once connected, the device begins logging data and monitoring loads with minimal configuration. The device can read inputs from a variety of CT's and has the option to be configured as a system, maximizing total system accuracy. By utilizing industry standard Modbus inputs, the A8814 has the capability to monitor over 60 different loads on a single Modbus drop. The flexible and expandable functionality of the device allows for a number of diverse applications including:

- Built in LCD Touchscreen display
- Utility Submetering
- Measurement & Verification (M&V)
- Reducing energy costs
- Track energy use and peak demand for Demand Response programs
- Benchmarking building energy usage
- Real time performance data
- Alarm notifications for data points above or below target levels (including SNMP traps)
- Collect load profile data for energy purchases.
- Monitoring performance of critical systems.
- Wide operating temperature range.
- Voltage, current, power per phase and total Bidirectional power meter values.
- Wide variety of data communication options including LAN and Serial connections.
- Supports industry standard communication protocols including Modbus, TCP/IP, and BacNet*
  * see specification chart.

Installation Checklist

An EMH+ system installation has the following components:

Required hardware

- EMH+ A8814 data acquisition server (required)
- Current transformers rated to load being monitored
- Voltage wire for connecting to phase connectors
- Circuit breaker or fusing with disconnect switch for voltage disconnect. (15-20A)
- Data connection (LAN).
- Ethernet Cat 5 cable (required for lan or direct laptop-to-EMH+ connection)

Optional hardware

- Additional Modbus RTU devices power meters (e.g., Leviton, Veris, Dent, etc)

For LAN installations only:

- Ethernet 10/100Mbit LAN connection point (hub or switch)
- DHCP. (static address also supported, check with system administrator)
- Recommended: computer with web browser and LAN access.

Markings and Symbols

WARNING: A potential risk exists if the operating instructions are not followed

General Warning Symbol: This symbol indicates the need to consult the operating instructions provided with the product

This symbol indicates the presence of electric shock hazards.

This symbol indicates: Do not apply to or remove from hazardous live conductors.

Direct Current symbol.

Protection containing a voltage disconnect switch with a fuse or disconnect circuit breaker. The protection device must be rated for the available short-circuit current at the connection point. No circuit breaker or disconnect switch is included with the meter.

Fuse. The installer is responsible for ensuring compliance with local requirements. No fuses are included with the meter.

.

1.888.610.7664   www.calcert.com   sales@calcert.com

A8814 Features and Specifications

Specifications

	Processor	ARM9 embedded CPU, ARM7 meter board
	Operating System	Linux 2.6
	Memory	32 MB Ram
	Flash ROM	16 MB NOR Flash
	Interval Recording	1 to 60 minutes, user selectable (default 15 minutes)
	LEDs	Ethernet, Modbus TX/RX, power, alarm
	Console	Interactive TFT TouchScreen
	Isolation	RJ45 Ethernet and RS485 port are isolated
	Serial Port	Supports up to 32 external devices (expandable)

Meter Inputs

	Input Voltage	208-480 VAC three phase, 50/60 Hz
		120,240,277VAC single phase, 50/60 Hz
	Power Consumption	8W Max
	Input Current	.333V and 1V (current transformer)
	Current Transformers	100, 300, 400, 800, 1600, 2400A
		(contact Leviton sales for other amperages)
	Serial Port	RS-485 Modbus

Accuracy

	Meter Accuracy:	Meets or Exceeds ANSI C12.1 (class 1% meter)
		+/- 0.5% from 2% to 100% of full scale.

Communications

	Protocols	Modbus/RTU, Modbus/TCP, TCP/IP, PPP, HTTP/HTML, FTP, NTP, XML, SNMP-Trap, Optional BACnet/IP
	LAN	RJ45 10/100 Ethernet, full/half duplex, auto polarity
	Baud Rate	9600, 19200, 38400, 57600, 115200

Environment

	North America	-30C to 50C, 95% RH, non-condensing

Safety

	UL	UL 61010-1 Listed
	CE	IEC 61010-1

EMC

	FCC	CFR 47 Part 15, Class A
	CE	EN 61000, EN 61326

Note: Model numbers include 001-A8814, 101-A8814, 201-A8814, however this manual will refer to the generic model A8814 to cover all products in this family.

1.888.610.7664   www.calcert.com   sales@calcert.com

Installation

The EMH+ is intended for indoor surface mount applications.

⚠ Warning – These installation/servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

A qualified person is one who has skills and knowledge related to the construction and operation of this electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved. No responsibility is assumed by Leviton for any consequences arising out of the use of this material.

Always adhere to the following checklist:

- Only qualified personnel or licensed electricians should install the EMH+ meter. The mains voltages of 120 Vac to 480 Vac can be lethal!
- Follow all applicable local and national electrical and safety codes.
- Verify that circuit voltages and currents are within the proper range for the meter model.
- The line voltage inputs to the meter must be protected by a circuit breakers (not included) Use 15 or 20A circuit breaker, with separate polls for each voltage phase to be measured. Disconnect not required for the neutral wire.
- Equipment must be disconnected from the HAZARDOUS LIVE voltages before access.
- The terminal block screws are not insulated. Do not contact metal tools to the screw terminals if the circuit is live!
- Do not place more than one line voltage wire in a screw terminal or more than one CT wire per screw terminal.
- Before applying power, check that all the wires are securely installed by tugging on each wire.
- Do not install the meter where it may be exposed to temperatures below –30°C or above 50°C, excessive moisture, dust, salt spray, or other contamination. The meter requires an environment no worse than pollution degree 2 (normally only non-conductive pollution; occasionally, a temporary conductivity caused by condensation must be expected).
- Do not drill mounting holes using the meter as a guide; the drill chuck can damage the screw terminals and metal shavings can fall into the connectors, causing an arc risk.
- If the meter is installed incorrectly, the safety protections may be impaired

Mounting the Device

1) Begin by identifying the location for mounting the EMH+. Ensure the distance from the panel or load does not exceed the length of the CT's.   The EMH+ should be mounted in a location close to the circuit breaker/disconnect switch.
2) The mounting location should not obscure the vent holes along the side of the product. Provide at least 4 inches of space around all edges of the enclosure to allow for venting and to connect external devices such as Ethernet LAN, RS485 and USB devices.
3) Mount the EMH+ using six #8 screws, minimum 1" long (not included)
4) At least three of the mounting screws must be securely attached to a structural wall component such as a stud. This will ensure adequate support for conduit attachment.

5) The EMH+ is designed to be connected using ¾"conduit. Remove the conduit knockout hole on the bottom of the enclosure and attach the conduit to the EMH+.
6) Attach the conduit to the enclosure, make sure the conduit is securely attached and make makes contact with the ground plate inside the EMH+.

Connecting the Device

1) Ensure power to load/panel has been turned off prior to connecting the EMH+
2) The EMH+ should be connected to the mains voltages using a Disconnect switch or Circuit Breaker, 15 or 20A max to provide disconnect and overcurrent.   The circuit breaker or disconnect switch should be in an easy to access location near the EMH+. Label the circuit breaker appropriately to indicate that it serves the EMH+.
3) Connect the ground using 12-14 AWG bare or green wire to the lug on the grounding plate inside the EMH+.
Ground lug tightening torque: 2.3Nm (20ft-lbs)
4) Connect the voltage leads to the phase conductors at a location that is not normally turned off. Connect voltage leads on the Line side of the conductor to ensure constant power to the EMH+.   Wire should be 12-14 AWG, Solid or stranded, rated to 600VAC, at 75c.
Screw Terminal tightening torque: 0.5Nm min, 0.6Nm max.
5) Snap the CT onto the conductor. Connect CTs to the corresponding phase as labeled on the board near the terminals of the EMH+ and be sure to mind proper load orientation labels on the CT.
Screw Terminal tightening torque: 0.5Nm min, 0.6Nm max.
6) Once leads have been connected, secure all monitored equipment back to its original state.
7) Restore power to the load/panel

Service Notes:

⚠ Should it be necessary to open the wiring access door on the EMH+ to change or add wiring, turn off the disconnect switch or circuit breaker before opening the service door.

Note: If cleaning is required, use a dry towel to remove dust from the EMH+. Do not use fluids to clean the EMH+.

General Wiring Diagram

A8814

FUSE / BREAKER
with disconnect switch

Lines run into
conduit at
botom of case
(not shown)

GND

CURRENT
TRANSFORMER

A

B

C

NEUTRAL

← SOURCE — — — — — — — — — — — — — LOAD →
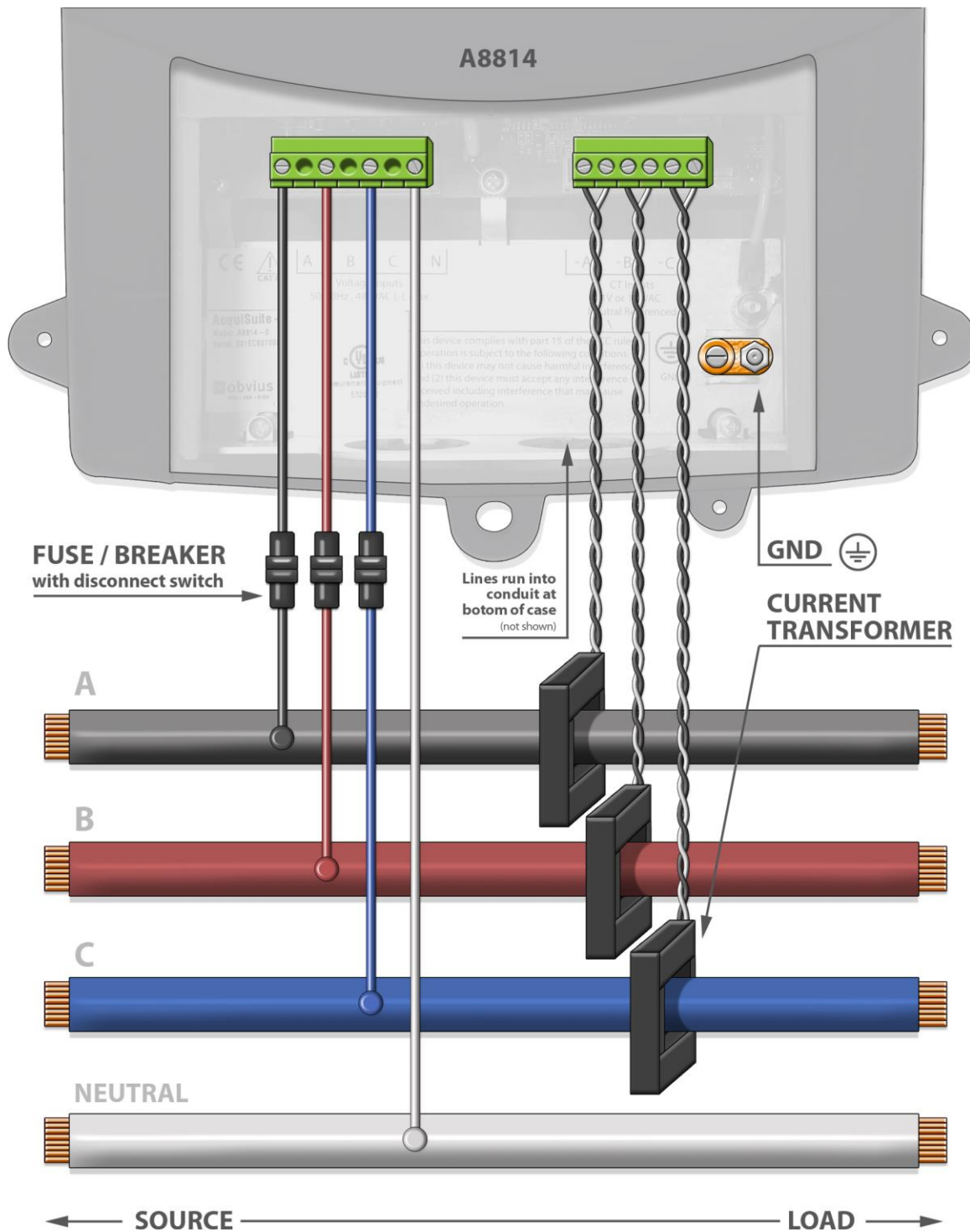
208/480VAC, 3 Phase, 3 Wire Delta (Without Neutral) Installation

Voltage

A   B   C   N

Current

CT-A   CT-B   CT-C
-   +   -   +   -   +

Black   White   Black   White   Black   White

A

B

C

← SOURCE ———————————————— LOAD →

Ground ———

1.888.610.7664   www.calcert.com   sales@calcert.com
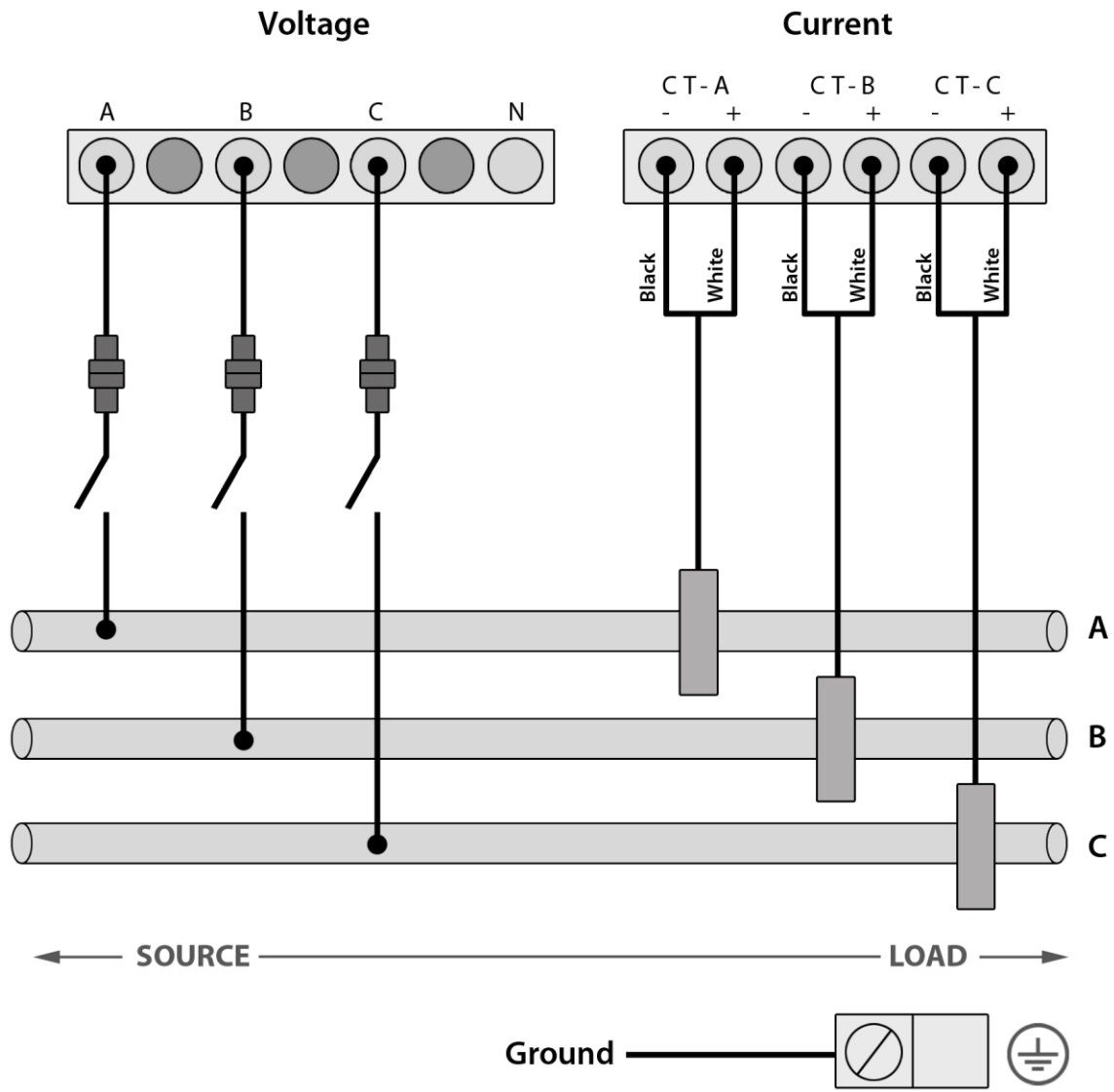
208/480VAC, 3 Phase, 4 Wire WYE (With Neutral) Installation

1.888.610.7664   www.calcert.com   sales@calcert.com
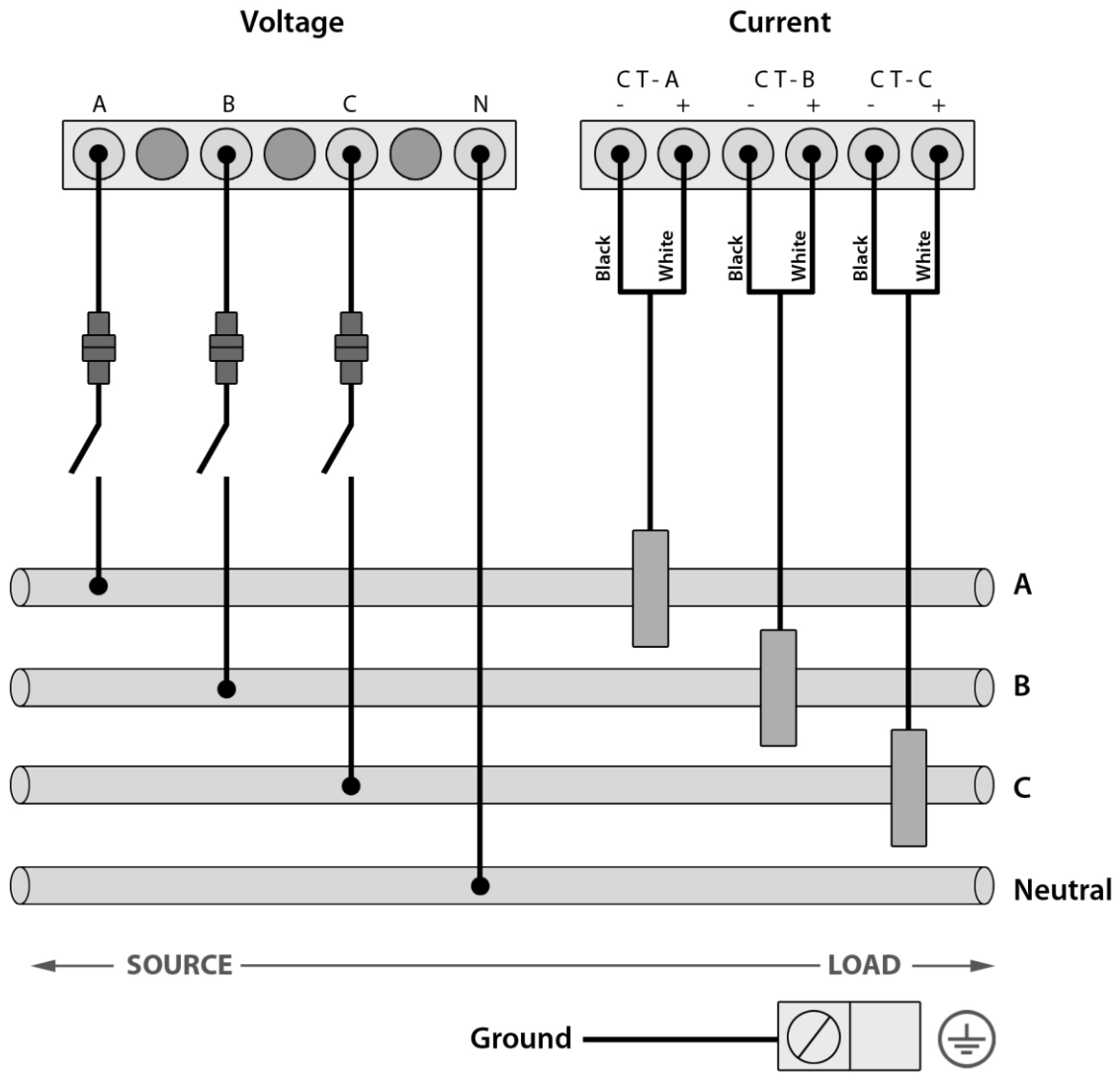
240VAC, Single Phase, 2 Wire (With Neutral) Installation

1.888.610.7664   www.calcert.com   sales@calcert.com
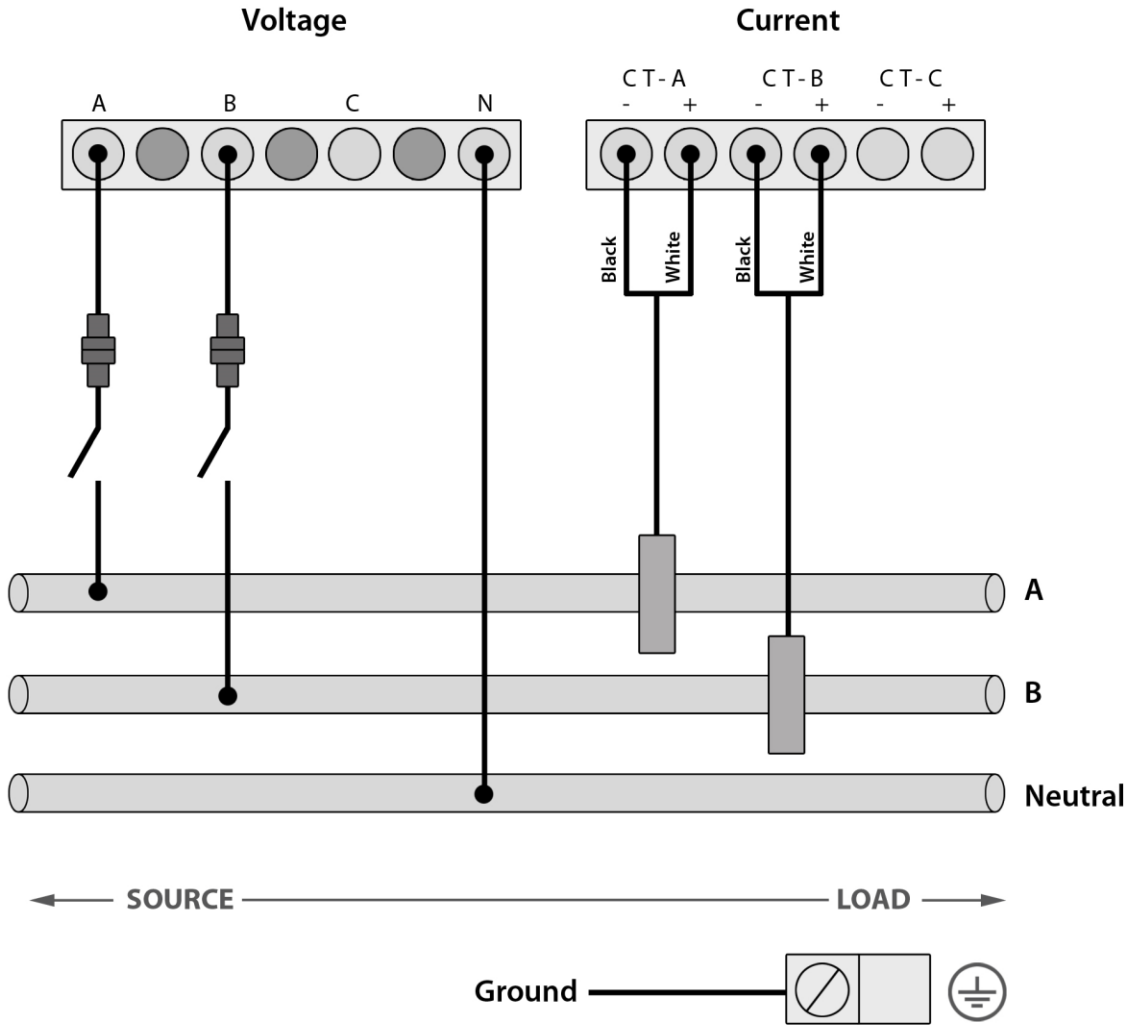
120VAC and 277VAC, Single Phase, 1 Wire (With Neutral) Installation
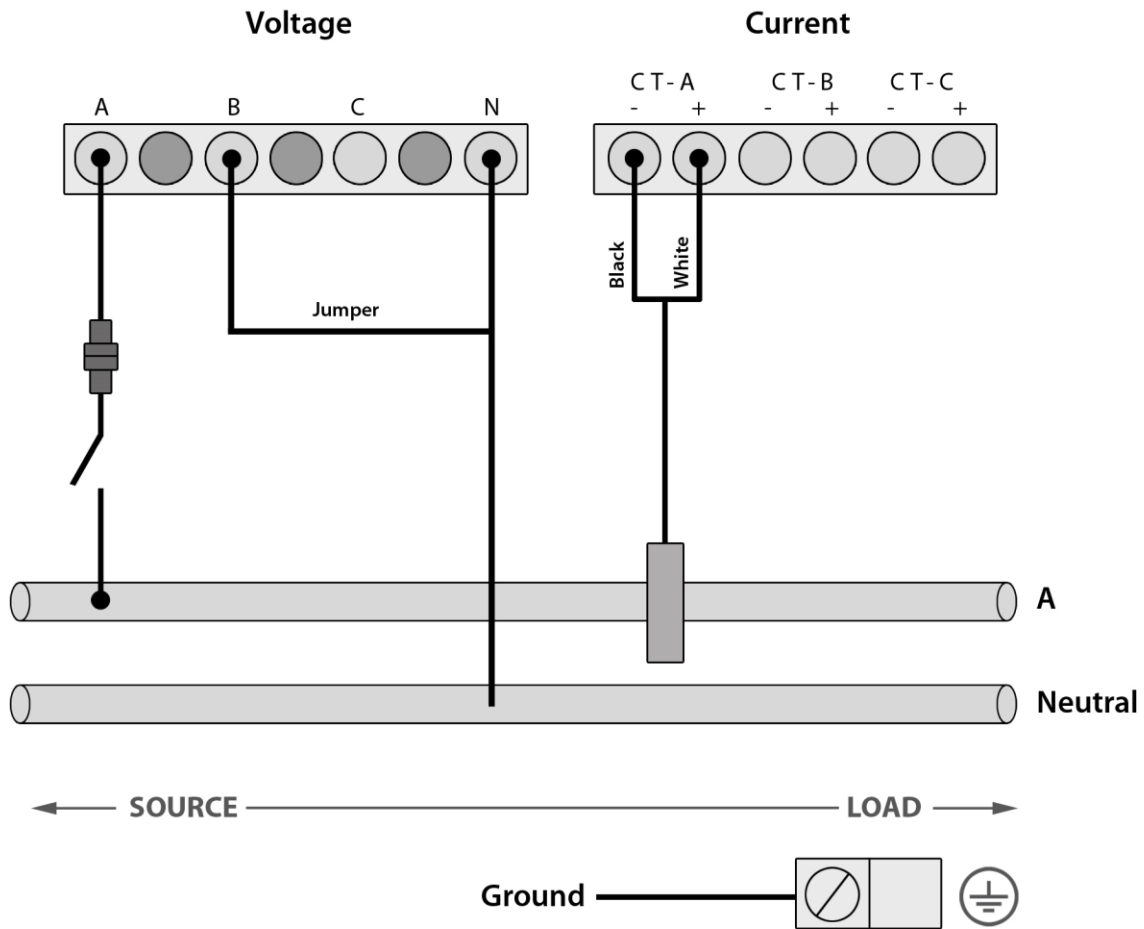
Note: The jumper wire between B and N in this configuration must be the same wire size as the Neutral wire.

Connecting Third Party Modbus Devices

Step 4 (optional) - Connect the Modbus network loop as shown in the wiring diagram. Follow the manufacturer's instructions for installing and powering the Modbus devices. Verify that the Modbus address settings are unique for each device (i.e., no two devices with the same address) and power up the device. Connect each device in the chain by "daisy-chaining" the devices together. Observe + and - polarity on the Modbus devices

Low Voltage analog, pulse, and RS485 wiring that enters electrical panels must have a minimum insulation rating that exceeds the voltage inside the panel. In addition, other regulations may apply; consult the building codes in your area prior to installation.

The RS485 port on the A8814 has a built in terminator. A 150 ohm termination resistor should be placed at the other end of the RS485 loop, between the + and – wires.

Some Modbus devices do not use the same label notation as the EMH+. Rather than the standard +, -, S, some companies Low, High, and Gnd. To attach this type of meter, use + to high, - to low, and shield to gnd.

The EMH+ A8814 built in electrical meter uses Modbus address 250, and will show up in the Modbus device count as a single Modbus device. Additional meters and sensors can be added to the Modbus loop.
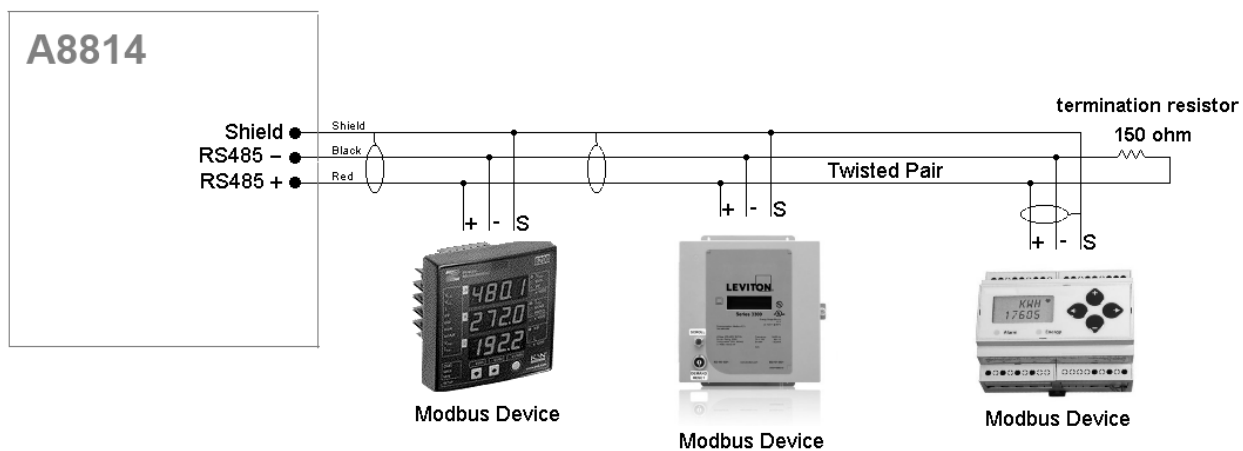
Laptop/Computer Setup

Step 1 - You must have a computer to access and configure the EMH+. This computer must have an ethernet connection (on the LAN or by direct connection) and must have a web browser installed such as Internet Explorer or Netscape.

Note: If your building already has an existing LAN that the EMH+ is attached to, you can use an existing computer on that LAN. Check with your network administrator for details. If this option is available, use a LAN connected computer and skip to the "EMH+ administration overview" section below.
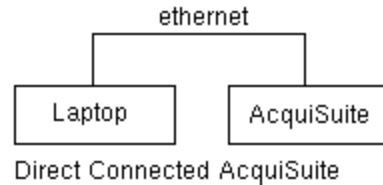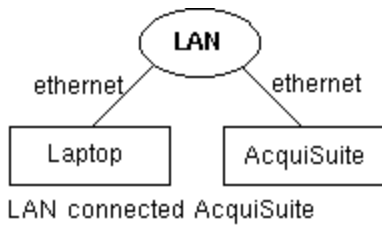
The remainder of this section will assume the installer has brought a laptop to the site, and will connect the laptop to the building LAN, or directly to the EMH+. Attach the laptop to the EMH+ or LAN as shown in figure 6, Ethernet hookup.

Configuring the Device – To be added (setting access code, setting IP address new Auto-IP feature, UPnP, etc)

Step 2 - Attach the Laptop to the EMH+ or to the LAN. The A8814 will automatically detect whether a direct or crossover cable is required, and will reverse polarity accordingly. This feature will allow you to use either a straight ethernet cable or a crossover ethernet cable interchangeably.

If the EMH+ is to be attached to an existing LAN, it will obtain an IP address using DHCP automatically. The IP address will be shown in the upper right corner of the EMH+ LCD display.

Step 3 - Configure the laptop IP address using the following steps. Note: Only Windows XP is detailed below, however you can use any OS/Browser you wish such as MacOS or Linux. Details on network setup for non-windows operating systems is beyond the scope of this document however.

A. From the Windows start menu, select the "Settings", "Network Connections" option. Double click the 'Local Area' network connection icon in the network folder, then click the "Properties" button.
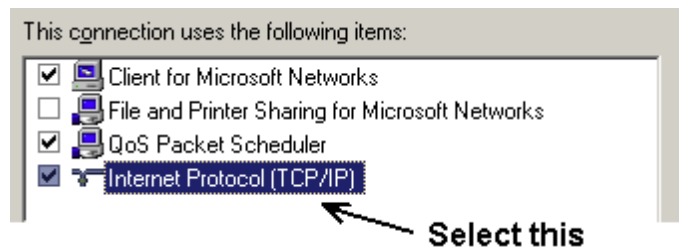
B. In the network setup dialog, there should be a list of items including adapters, clients and protocols. Locate the item labeled "Internet Protocol (TCP/IP)".
Note: If you have multiple ethernet cards, you may have multiple lines labeled "TCP/IP --> ethernet card". Locate the ethernet card that corresponds to the physical connection to the EMH+ and then select the TCP/IP option that is linked with that ethernet card.
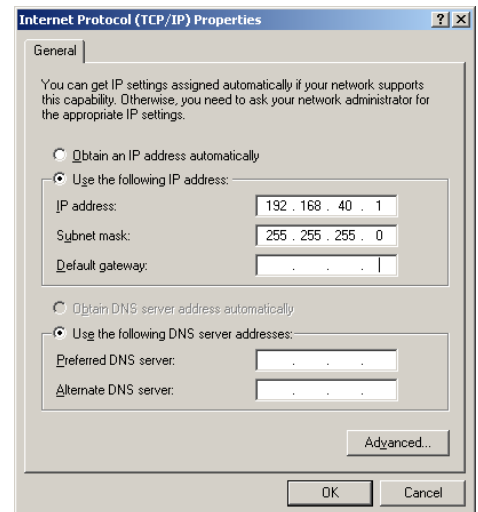
C. Double click the TCP/IP option you selected in step B above. The Ineternet Protocol properties dialog will be shown. This page allows you to select DHCP (obtain an IP address automatically) or configure an address manually.

D. Select the option for "Use the following IP address" as shown in the picture to the right. Set the IP and Netmask from the Laptop Address Worksheet above. It would be helpful to make note of your previous settings in this dialog so you may set them back after you are done with the EMH+ Configuration.

E. Close the TCP/IP settings dialog, and Network dialog.

1.888.610.7664   www.calcert.com   sales@calcert.com

EMH+ Administration Overview

The EMH+ should now be available on the local area network for you to access using a web browser such as Internet Explorer or Netscape.

Step 1 - Use your web browser to connect to the EMH+ by entering

http://192.168.40.50/setup/

Where 192.168.40.50 is the IP address displayed on the on the EMH+ LCD display.

Step 2 - When prompted, use the following default login information

Login: admin
Password: admin

Step 3 - Your web browser should now display the EMH+ configuration menu. To the left, a list of configuration options are available. On the right, a specific configuration page will be shown. The first page is a welcome message with some system status information. Proceed with the configuration of the EMH+ using your web browser.

Step 4 - Click on the + mark next to the Accounts menu. Select the Admin account, and click 'Change Password'. All units are shipped with the same factory default password, and it should be changed to prevent unwanted access.

Step 5 - Expand the Networking option, and select setup. Verify the addresses are consistent with those in the "Network Address Worksheet."

Step 6 - Expand the Modbus option, and select "Device List." You should see a list of each Modbus device attached to the EMH+. Before the EMH+ can begin logging data, each Modbus device must be assigned a unique name.

A. Click the device number to the left of the unconfigured Modbus device.
B. A page with the current device status and readings will be displayed. Click on the 'configure' button at the bottom of the page.
C. Enter a name for the device in the supplied field.
D. Change any low and high range alarm settings you may need. (optional)
E. Click the 'Save' button at the bottom of the page to save your changes.
F. Repeat these steps for each Modbus device.

Some devices may require additional information. For example, the Veris H8238 Multi circuit power meter allows the CT size to be specified. The Obvius A8332 IO Module has additional configuration options on each data point line to specify the details of the analog or pulse input. These include the 4-20mA device scale, multipliers and engineering units. Each 4-20mA or 0-10Vsensor should be supplied with technical information including the low and high range values that can be used to configure the EMH+. Also, the EMH+ has many common sensor types pre-programmed that can be selected from a drop down list. Review the Modbus Advanced Configuration Options section of this manual for further configuration details.

Step 7 - Select the Modbus/Setup menu option. Specify the Modbus Loop Name. This will become the name of the EMH+. This is the name that will appear on the BMO website service (if subscribed). Specify the data logging period. The default is 15 minutes.

Step 8 – Decide upon a method of data transfer. (see section later in this document) . If you select the HTTP/Post method to send data to the BMO website, you can configure this by selecting the "LogFileData, Setup/Upload" page.

A. Make note of the EMH+ serial number.
B. Select upload options as needed for time of day to upload the data and retry control.
C. Check the checkbox to allow remote configuration. This will allow you to reconfigure the EMH+ from the BMO web site without having to connect directly to the EMH+.
D. Specify the "Target address to upload data." This is the website address where the EMH+ will send the collected data. If you have an in-house data collection service, you should enter the address of your data server in this field. Leviton also provides a service called Building Manager Online that can collect and report data for you. If you are using the BMO service, the target address to upload data should be set to http://www.buildingmanageronline.com/upload.php
E. When configuring the EMH+ to send data to the BMO site or your own data collection server, the EMH+ will authenticate itself with the server by using the serial number and a password. This password must be supplied here, and can be obtained when you subscribe for the BMO service, or by your database administrator.
F. Click "Apply" to save your changes.

If you select a manual transfer method, remove (blank out) the target address in the Modbus/Upload Data page.

Security

The EMH+ has three levels of security. These are "operator", "user" and "admin".   When using a browser to access the EMH+, basic http authentication is used to prompt your browser for a username and password. The admin account uses "admin" as the default password. To change the password, select the Accounts menu from the left side tree display. Next, select the account name. Click the "Change Password" button to set a new password for the selected account.

admin: This account has full access to modify any of the system settings. The default password is "admin".

operator: This account may view settings, however may only change modbus alarm ranges and device names.

user: This account can view some system settings including the modbus device status pages and can change nothing.

When using FTP to access the EMH+, you may use the admin account username/password for read-only access. Log information is stored in /var/log/modbus.   For read-write-delete access, use the login name "root" and the admin password.

The three usernames specified are not able to be changed or renamed, nor can arbitrary usernames be added to the EMH+. Access is only controlled by setting the password for the three existing usernames noted above.

The "operator" and "user" accounts are disabled by default.   These accounts are activated when you first set a password for each.

Modbus

Modbus Device List

The EMH+ automatically searches for Modbus devices on the RS485 serial loop. The Modbus Device List page will show a listing of all the currently detected or configured devices the EMH+ has found.   The device list will show the Modbus address number, status (OK, Error, Alarm, Unconfigured), the device name (user specified) and the device identification string.

Click on the Modbus address number for any of the devices for specific device details

1.888.610.7664   www.calcert.com   sales@calcert.com
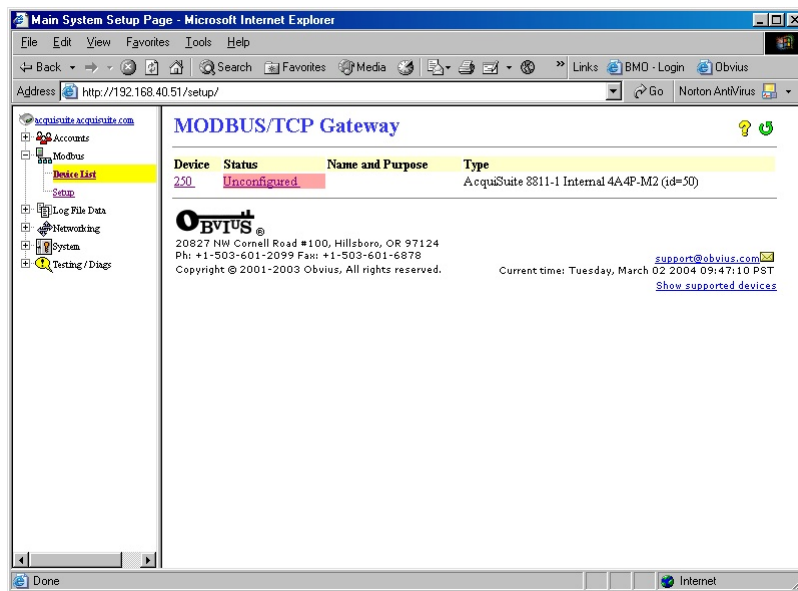
Note: not all Modbus devices have built in driver support in the EMH+. If a device appears in the list with "Unknown" in the status column, you may need to upgrade the firmware on the EMH+ to access the device. At the bottom of the device list page under the Type column, a link is shown that will show all the Modbus devices with built in driver support provided in the firmware. Use the System/Firmware update page to check for newer versions of the firmware. The Leviton.com website faq also has a list of supported Modbus devices. Modbus devices that are not supported by built in drivers may be configured using the Modbus Framework feature in the EMH+.

At the bottom of the device list, there is an option to allow you to rename all the devices listed. This is useful for initial deployments. There is also a troubleshooting link that will look for common configuration problems and alert you to the appropriate solution.

Device List Options

At the top of the Modbus device list page, there are several display options that control the sorting of the device list.

Tree display: Click this icon to organize the list by showing each ModHopper, and the devices attached to each one.

List display: (default) Show the list of Modbus devices sorted by the Modbus address number.

At the bottom of the Modbus device list, there are several options that may be selected to view or configure all the Modbus devices at the same time. These options are as follows:

Add: Manually add a Modbus device to the device list. This option can be used to configure a Modbus device that is not presently connected to the system, add a framework configured device, or add a Modbus/TCP connected device. See the section on manually adding a device below.

Troubleshoot: The EMH+ will review the devices connected and offer suggestions about any problems found.

Rename all devices: This option allows you to edit all the device names in one configuration page. This is useful when initially configuring a large number of new devices. A name must be assigned to a device before the EMH+ will log data for it.

List all supported devices: This option will show a list of all Modbus devices with built in drivers in the installed firmware.

1.888.610.7664   www.calcert.com   sales@calcert.com

Show [setup]: Display links for Device configuration and Advanced configuration for each device.

Show [devinfo]: Display the communications options including baud rate, serial number and firmware version (when available) for all devices in the Modbus device list.

Show [stats]: show packet counters for all devices in the device list. These include

> Sent: Total number of packets sent to this Modbus address.
> Received: Total number of valid packets received from this Modbus address.
> Error: Total number of packets received that fail CRC for this device. (does not include non-response queries)
> RTT: The average round trip time for the last 7-10 packets that received a valid response. This value is useful in configuring the Modbus timeout in the ModbusSetup/RS485 page. Note: if the timeout is set too short, you will not see an accurate value because packets dropped for timeout are not counted for RTT.

XML: Display the device list data in XML format.

Notes on RTT and Timeout configuration:

To best measure the true RTT, set the ModbusSetup/RS485 timeout to the maximum period and allow the EMH+ to run for 5 or 10 minutes. Next, review the RTT values seen in the device list page and make note of the longest RTT time shown for any device. Last, configure the ModbusSetup/RS485 timeout to the option that is the next largest than the longest time seen for any device. For example; if the worst RTT is 600ms, set the timeout to 1second.

Typical RTT values for direct connected devices should range between 40ms and 200ms. Systems that have wireless links such as ModHoppers should expect an additional delay of 500ms per hop. A complex system with multiple ModHoppers may have RTT values upwards of 3 seconds.

Device Details

The device detail page will show a list of all the meter data points, alarm settings and console options. The data point names for most devices are automatically entered. Some devices such as the A8923-4 io module have generic inputs, and will be labeled as "pulse input #1". At the top of the page, the status of the device is shown. This usually reports "ok" however it can include error information if the device is not responding properly. A list of device errors is available in the log file details section of this manual. At the bottom of the page, several buttons are present.

Done: returns you to the device list page.

Log File: This icon will display a table view of the most recent data in the current log file. Use the log file export page for complete log data access.

XML: This icon will show the current data from the Modbus device in an XML format. The URL from this icon can be copied and used to gather xml data for client side Javascript or Java applications.

Configure: This button will allow you to change the device parameters such as the name, alarm and console settings.

Device Configuration

When the "configure" button is clicked from the device details page, the screen will be refreshed, with the same information, however the device name, alarm settings and console checkbox will be available.

Device Name: This field allows you to specify a name for the device such as "main building power" or other useful name to indicate the location or function of the device. A name must be assigned to a device before the EMH+ will log data for it.

Low Alarm, High Alarm: Specify a threshold for the alarm. If the data point is recorded below the Low Alarm, or above the High Alarm levels at the time a log entry is taken, the point will be considered in an alarm state.

Console: Checking this checkbox will cause the EMH+ to display this data point on the LCD console. Multiple data points are rotated about every 10 seconds. The values on the LCD console are updated when the next log interval occurs.

Point Config: Some devices have configurable point features. The A8923-4 IO module has 4 pulse and 4 analog inputs that require additional configuration as detailed in the next section. The H663/704 BCM product only requires the circuit breaker name in this menu. Most data points are automatically configured and this option may not be displayed.

Advanced: At the lower right corner of the page, an advanced configuration button may be present depending on the Modbus device features.

Advanced Configuration Options

The advanced configuration page contains special options specific to the device you are configuring. For the A8923-4 io module, you may specify the pulse rate speed that the pulse inputs will work at, as well as review the 4-20mA/0-10v input status. On power meters, the CT size and orientation options may be present. The device serial number and other specific parameters will be displayed if available.

Specific options available in the Advanced Configuration page vary depending on the features available in the Modbus Device, as well as the features implemented in the built in EMH+ driver.

Meter Configuration Device 250– to be added (CT sizing, etc)

Troubleshooting Modbus Devices

If the device you have attached does not appear in the Modbus device list, check the following:

- Verify the + (red), - (black), and Shield connections are correct on all connections. Look for any connection in the middle of the loop that may have the wires reversed, or shorted together.   Check the Modbus faq on the Leviton.com website for further details on wiring a Modbus serial connection.

- Verify the address settings of every Modbus device. No two devices may have the same address. Note: the EMH+ A8814 uses the address 250 for the internal IO module. Do not assign this address to any other Modbus device.

- If only one device is not working, try disconnecting all the other devices on the Modbus loop to isolate the problem. If possible, bring the failed device adjacent to the EMH+ and attach it with a short stub of wire to eliminate possible wiring problems.   If the EMH+ can find a device on the short stub, the problem is probably a wiring related issue on the RS485 loop.

- Check to verify the Modbus device is supported by the EMH+. Usually, the EMH+ will locate the device and print "Unknown" in the device status column if the device is not recognized by the EMH+ firmware drivers. In the lower right corner of this screen, there is a link that will show a list of supported devices. Use this to verify the Modbus device in question is supported by the EMH+ firmware version. If not, check for firmware upgrades online with the Firmware Update configuration page.

- Remember, the EMH+ may take between 2 and 5 minutes to detect a new device that has been attached to the Modbus rs485 loop. Rebooting the EMH+, refreshing the device list page, or using the console 'Modbus status' menu will not speed up the recognition process.

🔍 Click the "Troubleshooting" link at the bottom of the Modbus device list page for further diagnostics.

Modbus Setup

The Modbus setup page provides several options related to the Modbus RS485 serial port.

EMH+ Name: This is the name of the EMH+. This name will be present on all log file descriptors when uploaded to a central database website such as BMO. It is helpful to name the EMH+ based on the physical location of the system, or building. Note: this feature was labeled "Loop Name" in older firmware versions.

Data logging period: This option sets the log interval for the EMH+. Options range from once per minute to once per hour. All of the selections are even divisions of one hour. The EMH+ calculates the next log time by finding the next multiple of the log period past the start of the hour. For example, if the log period is 15 minutes, log readings will be taken at 0, 15, 30 and 45 minutes past the hour. The log period is not calculated based on "15 minutes after the last reading"

When the EMH+ is first started, it will take an initial reading of all the Modbus devices immediately. Following that, the next log reading will be calculated as a multiple of the log period after the hour. The initial reading is taken to allow the EMH+ to gather information for meters that require demand calculations, as well as provide accurate information starting when the EMH+ is booted.

Modbus/TCP access: The EMH+ has a Modbus TCP gateway feature that allows other systems to send queries to all attached Modbus RS485 devices. This feature allows control of what systems have access to the Modbus TCP gateway feature. The settings include "no access", "local subnet only" and "allow any". This basic security feature only allows control based on the IP address of the system making the request. The Modbus TCP protocol does not have provisions for any authentication password or other methods of security. By default, the gateway feature is disabled, and set to "No Access."

The Modbus TCP gateway is a feature that allows the EMH+ to share the attached Modbus RS485 devices with other systems such as PCs with software and building control systems. The gateway receives incoming TCP requests, verifies the length of the packet does not exceed 255 bytes, and forwards the packet to the Modbus RS485 loop. The gateway does not verify the contents of the packet, nor the target address specified in the request. If the Modbus RS485 device sends a valid response back, the gateway will return this information to the the system requesting it via TCP. If no response is received, a timeout failure will be sent to the requester. Because the gateway does not process the contents of the request or reply, it is possible to query devices on the Modbus RS485 loop that are not specifically supported by the EMH+.

Modbus RS/485 baud rate: This feature allows the configuration of the RS485 serial port speed which the EMH+ uses to communicate with Modbus devices. Options include **9600**, **19200**, **38400, 57600,** and **115200**. The default is 9600, most Modbus devices communicate at this speed as well. Multiple baud rates may be selected in this menu. If multiple rates are selected, the EMH+ will automatically detect the baud rate of each Modbus device from the chosen options. Once the baud rate has been detected for a specific Modbus device address, and will continue to communicate with that specific device address at the detected speed. This feature will allow you to mix multiple devices on the same RS485 loop with different baud rates. Modbus devices default to a baud rate of 9600. Note: Modbus device manufacturers usually do not 'officially' support this configuration, however we have not seen any problems with this in any of the Modbus devices we provide drivers for. Most Modbus devices simply ignore packets received at the wrong baud rate. If you are experiencing Modbus communications problems, you should set the baud rate to a fixed 9600 before troubleshooting.

Modbus RS/485 Parity: This feature allows alternate parity options to be set. Default is no parity.

Modbus RS/485 Stopbit: This feature allows alternate stop bit options to be set. Default is one stop bit.

Modbus RS/485 timeout: This feature sets the period of time the EMH+ will wait for a response from any device on the Modbus RS485 serial loop. The default of 200ms is long enough for most Modbus devices. Longer timeouts may be required if you have a very slow device, or if you have a Modbus repeater device in the serial

loop. Devices such as the ModHopper, the Veris H8936 Local Display, or any RS485 wireless link repeaters add a substantial delay. Setting the delay longer than the default will increase the time required to auto-detect new Modbus devices when attached to the EMH+.   For ModHopper connections, use a minimum setting of 1.5 seconds. The allowed range is 100ms to 5 seconds.

Tip: Set the timeout to the longest available setting, and use the "stats" option on the bottom right of the device list page to monitor the actual RTT (response time) for each device. Next, decrease the RS485 Timeout that is close to (but longer than) the slowest device in the device list.

Modbus RS/485 Debug: This feature records Modbus RS485 transaction data in the system debug log file. You must click the "start log" button on the system/log files page to record this information. Debug options are as follows:

- None: No RS485 information is logged.
- Errors: Only Modbus errors are logged.
- Transaction: One line is logged describing every RS485 query, and the result of that query.
- Full Debug: Complete listing of all queries including hex dumps of all data sent/received.

Search for Modbus/RS485 Devices: This option allows the EMH+ to search for Modbus devices attached on the RS/485 port. This feature may be disabled to reduce queries on the RS/485 port. Default is enabled.

Search for Sensor Network Devices: This option will allow the EMH+ to search for sensor network enabled ModHoppers (R9120-3SN) , and log data from attached devices. Note: this is for sensor network devices such as PointSix and Badger receivers, and not Modbus or Pulse devices. Default is disabled.

Alarm Setup

The Modbus Alarms section provides the ability to send messages when alarm levels are exceeded. Messages can be sent by email, snmp or displayed on the LCD console.   Alarms are processed at the end of the data logging period. For more frequent alarms, shorten the data log interval. Log readings and alarm processing can be set to as often as once per minute.

Display all alarms on LCD console: When checked, all alarm messages are shown on the LCD display of the EMH+.

SNMP Trap Send Enabled: When checked, SNMP Trap messages are sent after every log period for each data point that is in an alarm state. The trap includes information about the EMH+ system data point, and alarm state. A full MIB is located on the EMH+, click the MIB link to the right of this option.

SNMP Trap Host 1 (2,3): When SNMP traps are enabled, a trap message is sent to each of the trap host addresses. Specify the trap host by IP address, not DNS name.

Direct email on alarm. When checked, the EMH+ will send an email message when any data point changes its alarm state.

SMTP Mail Server Address: The ip address of the email server on the LAN that will process and forward the email message to the recipient.

Sender Address: The address that will be used in the "From:" line of the email. This is helpful in identifying the source of the alarm email message. If your SMTP mail server has junk filtering, you may be required to use a sender address that matches a mailbox address on the SMTP mail server; check with your mail server administrator for specific details on this issue.

Recipient address 1 (2,3): The EMH+ can send a copy of the alarm notice to multiple email addresses. Specify one, two or three email addresses in the fields provided for the recipient addresses.

Modbus Framework

The Modbus Framework feature is a tool to allow the EMH+ to read data from any Modbus device by creating a template in the Modbus Framework editor. The template describes the Modbus register read commands, and the conversion required for each data point that is to be read.   The Framework feature is an advanced feature of the EMH+ that requires the user to be familiar with the Modbus protocol and with the Modbus register point list for the specific Modbus device that will be used.

Wireless

Sensor List

The sensor list feature works in conjunction with a number of non-Modbus sensors.   Sensor devices such as PointSix, BAPI, and Badger/Orion typically transmit data on a pre-set interval and are not polled by the EMH+. Data is received and uniquely identified by the sensor's serial number.   Each sensor may be given a name, and some have additional options to configure such as input value scaling.

ModHopper Map

The EMH+ has additional diagnostic features that assist with ModHopper deployments. The most useful is the ModHopper route map.   Select the ModHoppers menu from the Wireless section in the EMH+ menu tree as shown below.
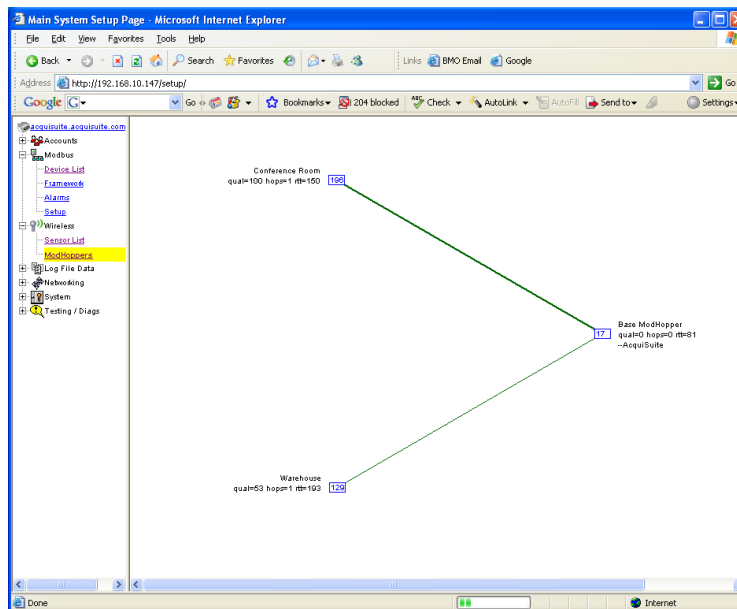
The graph will draw a blue box for each ModHopper that is attached to the system. The blue number inside the box icon is the Modbus address of the ModHopper.   To the side of each icon, three lines of information will be shown.

- The device list name will be shown to the side of each ModHopper icon

- The link quality, hops and round trip time (rtt) will be printed under the ModHopper name.

- A list of attached Modbus device addresses will be shown on the third line. This is a list of addresses that the ModHopper has automatically detected on the local RS485 port.

The graph will print strong links in thick green lines. Lines progress from green, to yellow, to red to indicate weak links.

Networking

Network Status

This page displays the current status of the EMH+ network connections. Several interfaces may be shown if both Ethernet and ppp dialin/dialout are active at the same time. Each interface will report the ip address, number of packets sent and received, and other details specific to the interface. For the ethernet interface, the MAC address (HWaddr) will be shown as well as a network collision count.

Ethernet network

```
eth0    Link encap:Ethernet  HWaddr 00:99:99:0E:C1:CA
        inet addr:192.168.10.50  Bcast:192.168.10.255  Mask:255.255.255.0
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:2624171 errors:6 dropped:0 overruns:0 frame:0
        TX packets:220342 errors:0 dropped:0 overruns:0 carrier:0
        collisions:1 txqueuelen:100
        RX bytes:174674347 (166.5 Mb)  TX bytes:50607122 (48.2 Mb)
        Interrupt:5 Base address:0x320
```

Note: the "lo" or Loopback interface is the internal network and is always present, "eth0" is the Ethernet segment, and "ppp0" is the dialout or dialin connection. In addition, the current gateway and DNS server information will be shown. These items will provide information about DHCP assigned configuration information.

Ethernet setup

The ethernet setup page has the following options:

- IP Address: The ip address of the ethernet interface: Default 192.168.40.50

- Netmask: The netmask of the ethernet network. Default 255.255.255.0

- Gateway Address: The gateway is the routing device that moves traffic from the LAN to the internet. The default is 192.168.40.1. If you do not have an internet connection for your lan, or you are using a crossover ethernet cable, leave this field blank.

- DNS 1, DNS2: These are the primary and secondary DNS servers. If you are using a dialout connection, these must be set to the DNS server provided by your dialup isp. If you only use the EMH+ on a crossover cable and/or dialin mode, you should leave these blank.

- DHCP (enable/disable) If you LAN has a DHCP server, you may enable this option and remove the previous options for IP, netmask, gateway, and DNS. Check with your LAN administrator first.

- HTTP Proxy. If your LAN is connected to the internet using a sophisticated firewall, you may need to use the HTTP proxy feature. Check with your LAN administrator first, however if you don't have a proxy set on your computer (MSIE/Tools/Connections-tab/LAN-Settings) then you most likely don't need to configure the EMH+ to use a proxy. If in doubt, leave this blank first, and try the connection test. If it fails, ask your LAN administrator about proxy servers, if any.

After changing any of the settings on this page, you will be required to reboot the EMH+ Use the system/status web configuration page, or the LCD console to reboot the EMH+.

Troubleshooting Ethernet Problems

After reconfiguring the ethernet settings you experience problems accessing the EMH+ with your web browser, check the following items.

- Verify that you rebooted the EMH+ after making the changes to the network settings.

- Use the EMH+ LCD console. Check the IP address and Netmask. Verify these are correct.

- Verify the ethernet link/act light next to the Ethernet port is on. It should blink with activity.

- Verify the network connection in your computer has the proper IP address, on the same subnet, to access the EMH+. NOTE: one common mistake is configuring the Laptop IP to the same address as the IP address of the EMH+. In order for the laptop and EMH+ to communicate, the IP addresses should not be identical. (see the basic network config for suggested IP addresses.)

- Use the LCD console to run the Network Status test. This will attempt a number of things including a ping query to the gateway address. If the EMH+ can ping an external machine such as a gateway, the ethernet port is most likely connected properly. If the EMH+ does not use a gateway, try adding a gateway address, and make it the address of your computer.

Manual Device Add Options

Modbus devices may be added manually by clicking on the "add" link on the bottom of the Modbus device list page. This option is intended for use when adding devices to the configuration profile prior to installing the physical hardware, or configuring Modbus/TCP devices that will not automatically populate in the Modbus device list.
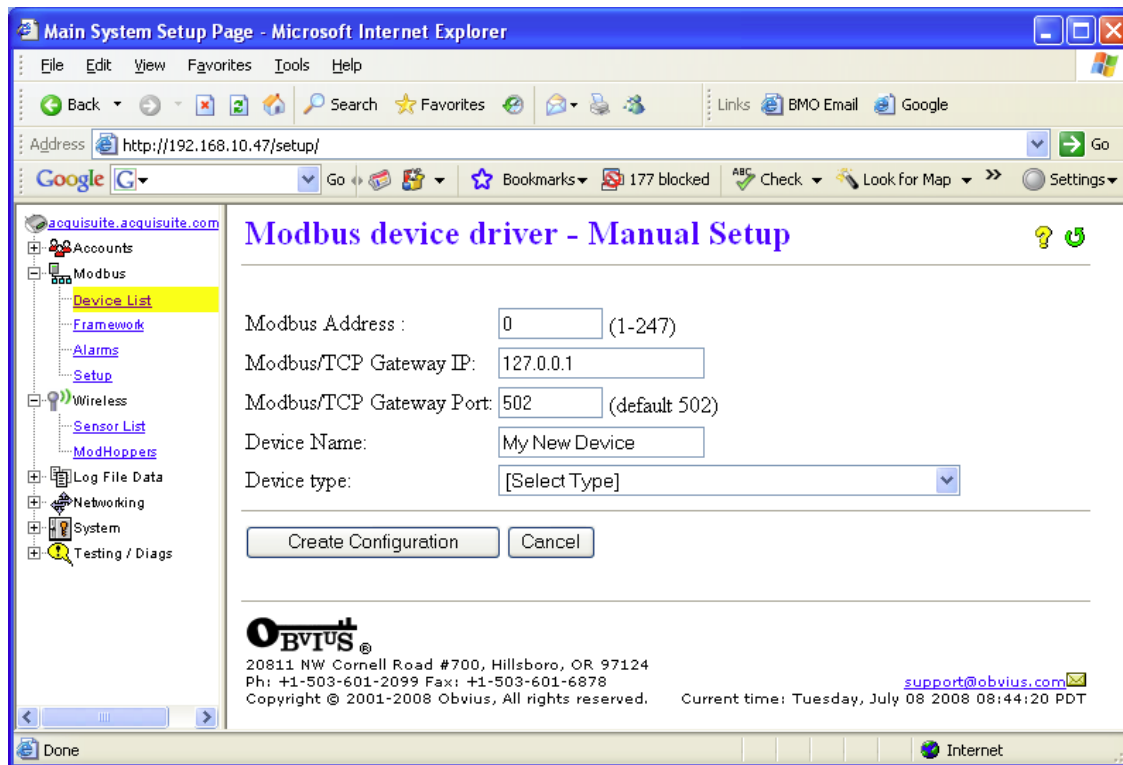
The manual setup page has several options that must be configured before the EMH+ will recognize the Modbus device. The options are as follows:

1.888.610.7664   www.calcert.com   sales@calcert.com

Modbus Address: The Modbus device address must be supplied. Note: when configuring a device on a remote Modbus/TCP gateway, the Modbus address of the remote device must not be the same as any address on the local RS485 loop.

Modbus/TCP Gateway IP: This option allows the EMH+ to log data from a remote Modbus device that is attached to the LAN via a Modbus TCP gateway device such as an EGX or Moxa gateway.   For local Modbus devices attached to the EMH+ RS485 port, use "127.0.0.1".

Modbus/TCP Gateway Port: If a remote Modbus/TCP gateway is used, the tcp port of the remote gateway must be specified. The default TCP port is 502 on most gateways. For local Modbus devices attached to the EMH+ RS485 port, use 502.

Device Name: You must provide a name for the Modbus device to identify it in the device list. This should be something that will identify the meter location and purpose.

Device Type: This menu will allow the selection of any built in driver or any Modbus Framework template that is available on the EMH+.   It is important to select the driver or template that matches the Modbus device.

Note: Up to 32 remote Modbus/TCP devices may be added to the system. Because of addressing the devices on the EMH+ device list, each Modbus/TCP device must have a unique ID in the same way that Modbus/RS485 devices do.

There is no hard limit on the number of Modbus/RS485, however typical systems should not exceed 64 total devices for performance reasons.   Depending on the Modbus/RS485 device, the RS485 line may limit the system to 32 physically attached meters, but can be expanded with the use of either ModHoppers or RS485 repeaters. The ModBus addressing system on some meters will only allow addresses between 1 and 64, the Modbus Protocol requires the address be between 1 and 256.

System Options

Status

The system status page shows the current memory and flash disk utilization values, system up-time, and load average. Also included on this page are two buttons for **Reboot** and **Shutdown**. It is important to use the shutdown option prior to removing power from the EMH+. The LCD console will report the reboot or shutdown status.

Processes

The system process table is shown in both tree and tabular formats. The process list is useful when contacting Leviton technical support.

Date and Time

The EMH+ keeps time using UTC or Universal time. All log files are recorded in UTC time as well. Timestamps shown on the EMH+ local configuration pages are converted to local time for the convenience of the installer. The date/time configuration page provides the following options

Date/time in UTC and Local time.

Date/time dropdown menus to select the current (Local) time manually.

Timezone: a drop down list of the supported timezones.

Time sync protocol: Select "Automatic" (default) to allow the EMH+ to try several time servers using NTP and rdate protocol.   If a working server is found, it will be used for future time sync activity.   The default automatic

mode can be overridden by selecting NTP or Rdate protocols.   If possible use NTP as it is a more robust protocol.

Time Server: Specify the dns name or ip address of your time server. The default "time.nist.gov" can be used with NTP protocol if the EMH+ has a connection to the Internet. The EMH+ will attempt to synchronize time one per day with the time server when an upload session is processed. This will ensure that the clock is checked and adjusted at a minimum of once per day. Typically, the synchronization will align the clock to within +-1 second of the internet time source or atomic clock. You may need to verify if your firewall will allow NTP or Rdate packets to pass through. Generally, it is better to use a local time server if possible.

Universal Time Is Your Friend

Log data is stored in UTC time. This allows data collection services such as BMO to collect data from multiple sites in different time zones. If you are operating your own database system to store log data from the EMH+, it is best to store the data in UTC time in the database as well, and only convert it to local time when generating the final report or graph for the user.

If you store data in Local time, you will have the following issues.

1) Local time is relative. Is Local the time where the EMH+ exists, or Local to where the data is stored. If local to the EMH+, you must shift each EMH+ data set depending on its location.

2) There are about 11 time zones in the US. Some observe DST, others do not.   These include Alaska, Aleutian, Arizona, Central, Eastern, Hawaii, Indiana, Michigan, Mountain, Pacific, and Samoa.

3) When converting to local time, there will be one hour of overlapping data in the fall when the time is adjusted for Daylight Savings time. ie, log entries run 12:45, 1:00, 1:15, 1:30, 1:45, 1:00, 1:15, 1:30, 1:45, 2:00am. This will prevent you from sorting your data by time in your database.

4) In the spring, you will have a gap in the data from 1:59 to 3:00am. This can cause problems if you are calculating demand values based on consumption.

5) Converting Local time to any other timezone usually involves converting it to UTC first.

Using UTC time solves these problems elegantly.   The best practice is to store data in the database in UTC format and then convert the information when generating a report for the user.

For example, if you wish to draw a graph of KW over Time, prompt the user for a date range, say Jan 1 midnight to Jan 2 midnight. Take the user specified end points and convert these times from Local time to UTC. Next, create an SQL query using the new UTC formatted data as your select statement. ie:

    SELECT * from TABLE where time > '2003-01-01 08:00:00' and time < '2003-01-02 08:00:00'

Note the time is 8 hours ahead of local time. This example is for Pacific which is 8 hours off from UTC. This will return a list of data points between the two specified time ranges. Next, plot the data on a graph, using the UTC times for start and end points. Lastly, when drawing the 'time' legend on the graph, convert the values back to Local time before displaying. Ie, 2003-01-01 00:00:00 to 2003-01-02 00:00:00. Any division lines on the time axis can be handled the same way. The advantage of using this technique is that it will properly draw a graph across DST change boundaries. The graph axis is based on UTC time with no DST, and will not show a gap or overlap a the time of the change. The axis labeling will be correct as well, matching the UTC times precisely.

Another way to handle the conversion is to query and convert all the returned timestamps to local time before drawing the graph. This is useful if you do not have detailed control over the graph legend drawing process. This technique will not properly graph across DST changes as the graph is based on local time including DST changes.

System logs

The EMH+ can keep several log files that report the general operation of the system, not related to the normal

data logs. These include the following:

Debug Messages: The EMH+ can run a "syslog" process to record more detailed information about its operations, however this log consumes vast quantities of memory quickly, and is disabled by default. Click the "start log" button to enable the feature. Click the "end log" button to disable. Note: when the EMH+ is rebooted, the debug log will be disabled on startup.

Kernel Boot log: Startup messages about the Linux operating system startup. This log shows what hardware items were detected and initialized.

Ftp Connection log: This log shows a list of files transferred by FTP on the EMH+.

Last Data Upload log: This log file contains a report from the last data upload attempt to remote database/webservers such as BMO. This log will show if any log files are being rejected by the dabase/webserver, or if the network is not allowing a connection.

Last Modem Connection log: This log file shows the details of the modem operation including modem connection quality parameters. This is updated ever time the modem makes a dilain or dialout connection.

Time Change Log: This log contains a list of time change events. When the EMH+ system clock is changed either manually or by automated time sync, and the change is more than a few seconds, the event is recorded here.

System boot log: This log shows when the EMH+ was started, and lists process events such as remote logins, or logger process restarts. This log is most useful for detecting when the EMH+ was restarted, and whether there was a proper shutdown event prior to rebooting (if not, possibly a power outage).

Start/End logging: This button allows the user to start detailed logging or disable it if it is running.

Purge Log Files: This button will clear all the system log files listed on this page, but not the meter data log files. (deletes kernel, boot, ftp, messages, upload log files) This does not clear the interval log data from attached meter devices.

Firmware Update

The EMH+ can upgrade its own firmware using the firmware update page.   The EMH+ must have an Internet connection to communicate with the Leviton.com website for firmware updates. If a LAN connection is present and configured, it will be used by default. If the EMH+ uses a dialout connection, you must first enable the dialout by clicking the "dialout now" button on the Networking/Modem-ppp/Status page.

After clicking the "Check for updates" button, the EMH+ will contact the Leviton.com webserver and attempt to download a list of firmware files. The list is compared to the firmware versions installed, and a listing of the files will be displayed. If any firmware updates are available, a button to the right will be shown labled "Upgrade". The firmware files are as follows:

        asarm.cramfs The main EMH+ firmware file including the modbus and data logging software
        usrarm.cramfs   High level system support files such as FTP, and timezone information
        ramdisk.gz   Low level system files and system libraries
        zImage   The Linux operating system.
        a8812io.hex   The analog/pulse io co-processor firmware.

When clicking on the Upgrade button, the EMH+ will again contact the Leviton.com website and download the requested firmware image file. The EMH+ will take a few seconds to verify the file checksum and prompt you with an "Install" button. Click the install button and the EMH+ will install the firmware update and reboot itself to make the changes take effect.

Do not power down the EMH+ during any step of the EMH+ firmware update process. Doing so may corrupt the system and render the EMH+ unusable.

1.888.610.7664   www.calcert.com   sales@calcert.com

Diagnostics

Host Lookup

The Host Lookup page provides the ability to do some basic network tests. These are as follows:

Ping: send an echo request to the specified host.

Traceroute: Send an echo request to the target address and attempt to locate every router in between the EMH+ and that address.

Nslookup: convert the dns name to an IP address, useful for testing the functionality of the DNS server configured in the Network/Setup webpage.

To run a network test, enter the ip address or dns name in the field provided, check the checkbox next to the test you wish to use, and click the OK button. Multiple tests can be specified.

Connection Test

The connection test page will attempt to establish an HTTP session with the specified upload server.   Click the "begin test" to start this process. Information will be printed in black. Success responses will be printed in Green, failure messages will be printed in Red.   A sample upload test follows:

```
Ping localhost [127.0.0.1]: Success
Ethernet IP address [192.168.10.50], mask [255.255.255.0]
Local subnet [192.168.10.0] to [192.168.10.255]
Ping ethernet ip address [192.168.10.50]: Success
Starting system debug logger
Dialout not enabled, using ethernet LAN connection.
Ping ethernet gateway [192.168.10.1]: Success
Ping DNS #1 [192.168.10.1]: Success
The DNS #2 server address is not configured.
Resolving time server [time.nist.gov] to an IP address: Success. Got [70.99.203.62]
Ping time server [time.nist.gov]: Success
Testing time server
SyncTime: Sync system time with time.nist.gov.
   16 Dec 19:49:36 ntpdate[3165]: adjust time server 70.99.203.62 offset 0.009985 sec
   new time: Tuesday, December 16 2003 19:49:36 PST, drift 1 seconds.
Processing upload url.
No proxy specified, using direct connect method.
Upload URL looks ok: http://www.buildingmanageronline.com/upload.php
Resolving web server [www.buildingmanageronline.com] to an IP address: Success. Got [70.99.203.62]
Ping web server [www.buildingmanageronline.com]: Success
Connecting to server at [70.99.203.62:80]: Success
Sending HTTP request: Success
Reading response:
Upload test completed.  Got:

  HTTP/1.1 200 OK
  Date: Wed, 17 Dec 2003 03:49:38 GMT
  Server: Apache/1.3.23 (Unix) PHP/4.1.2 AuthMySQL/2.20
  X-Powered-By: PHP/4.1.2
  Connection: close
  Content-Type: text/html
```

SUCCESS - Test Successful

Closing TCP connection
Shutting down system debug logger

Test complete

Note in the last section where SUCCESS is indicated. The failure is due to the password not being correct.

Log File Data

The EMH+ stores data from the modbus devices in text (csv) log files. One log file is created for each modbus device on the system. On a daily basis, the log files are "rotated", that is the current log file is renamed and compressed with gzip compression, and a new log file is started. This allows the EMH+ to make efficient use of the flash memory. When the storage capacity is beyond 95% full, the oldest log file will be removed from the system.

Log File Status

The EMH+ can display a list of log files in the "log file data/status" web configuration page. A bar graph will show the amount of storage capacity that is used by the existing log data. Below, a list of modbus device log file will be displayed along with the file size and timestamp when the file was last modified.

Each modbus device may have multiple log files. The log file name starts with "mb-xxx." where xxx is the modbus device id number. One file, with the .log extension is the file where the most recent data is being stored. Other log files have a .gz extension. These are older log data files that have been compressed to save space.

The file name will be a link that will open up a browser window to view the contents of the single log file. Clicking on the single log file will only show the contents of that log file, and not all historical data for the device. Use the log export feature if all log data is required.

Log File Format

Once you have downloaded the data from the EMH+, you will need to process it. The file is an ASCII text file with comma delimited data. One line is recorded for each log cycle. The file will look something like the following example from a 4A4P-M IO Module.
        '2002-01-31 18:30:00',0,0,0,-0.00,89.29,39.05,49.11,0,0,0,0
        '2002-01-31 18:35:00',0,0,0x02,-0.01,104.24,39.05,49.11,0,0,0,0
        '2002-01-31 18:40:00',0,0,0,,87.82,39.05,49.11,0,0,0,0
        '2002-01-31 18:45:00',139,,,,,,,,,,

In this example, the first line shows a regular log entry. The second line shows a high range alarm for data point 2. The third column shows point 1 as invalid, and the fourth line shows the Modbus device is not responding.

Notice the following columns are shown.

1. Date/Time in UTC (GMT) time. This field is quoted to handle the space in the middle.

The format is YYYY-MM-DD HH-MM-SS

2. Modbus error (if any). 0=no-error, see table below.
3. Low Range alarm bitmap (hex notation).
4. High Range alarm bitmap (hex notation)
5. Data point 1
6. Data point 2
7. - - -
8. Data point N

Comments:

Date/Time: The date/time column reports the time at which data was logged from the Modbus device. Note: this is not necessarily the time at the start of the log cycle. Users with large number of devices may notice some of the Modbus devices at higher address numbers report 1 or 2 seconds after the first Modbus devices. This is because the 9600baud speed of the Modbus loop is not fast enough to log all Modbus devices in less than 1 second. If a device does not respond during a log cycle, the EMH+ will attempt to query the device several more times. If a subsequent query is successful, the time of the successful query will be used in the log file but may be several seconds after the initial log cycle.

The log date/time is in Universal time. (UTC) This means that the data is logged with no shift for daylight savings time, and must be converted to local time for reporting purposes. When importing into a database, data should be kept in UTC time for ease of use. When reporting the final data, you should adjust the time to reflect the local timezone for which you are reporting. The data export option on the BMO website will prompt you for a timezone when you export the data, and will adjust the log date/time accordingly. Note: UTC is sometimes referred to as GMT. (Greenwich Mean Time)

Modbus Error: If the error value is not 0, the remainder of the columns for this line will be reported as NULL.

1	Operation not permitted
2	No such file or directory
3	No such process
4	Interrupted system call
5	Input/output error
6	No such device or address
9	Bad file descriptor
11	Resource temporarily unavailable
12	Cannot allocate memory
13	Permission denied
16	Device or resource busy
19	No such device
23	Too many open files in system
24	Too many open files
26	Text file busy
28	No space left on device
32	Broken pipe
52	Invalid Exchange
101	Network is unreachable
110	Connection timed out
111	Connection refused
113	No route to host
129	Illegal Function (function was not allowed by the slave device)
130	Illegal Data Address (the data address is not allowed by the slave device)
131	Illegal Data Value

1.888.610.7664   www.calcert.com   sales@calcert.com

132 Illegal Response Length

138 Gateway Path Unavailable (the Modbus/TCP gateway may be misconfigured)

139 Device Failed to Respond (the Modbus device may be off or disconnected)

140 Received invalid Modbus data checksum

141 Received response from unexpected device

142 Received unsolicited query, assume another Modbus master device is present.

143 Modbus device probe function received some good responses and some failures.

160 Start log (Entry in log file after EMH+ starts up)

161 Stop log (Entry in log file if EMH+ is shut down properly)

162 System time changed, caused logger to restart logging for intervals.

163 System auto-restart

164 Log entry corrupt.

165 Modbus device restart detected.

192 Modbus device does not match the device type in the configuration file.

193 Modbus device's serial number changed. (could be two devices with the same Modbus address)

Low/High Range Alarms: This number is a hex representation showing which data points are out of range. 0x01 shows data point 1 in alarm state. 0x04 shows data point 3 in alarm state.

Data Points: Data points are shown in the same order as the modbus device configuration display in the modbus/device list page. Data is displayed in floating point form. When a specific point is unavailable (4A4P-M broken wire alarm) or the point is not supported as part of the configuration (phase B current on a single phase H8163 meter hookup) the point will be logged as blank. This preserves the column structure of the file, and allows notation of invalid data. SQL databases often accept blank or NULL as a valid entry in a data table to represent invalid data.

For data exported from the BMO website, the columns that are invalid (NULL) are reported as blank fields. This makes it easier to import into MS Excel as blank cells. With the current firmware, the EMH+ will report blank fileds rather than "NULL" to make direct import of data from the EMH+ easier, as well as reduce the file size. Developers intending to use data files from the EMH+ should handle both the word "NULL" as well as a blank column as indications of an invalid data point.

Log Storage Capacity

The EMH+ uses approximately 8 Mbytes of flash disk for log file storage. As data from the modbus meters is collected, it is appended to log files on this flash chip. Once a day (at the first call-out period for uploading data) the log files are "rotated". This action renames each log file and compresses the old file using gzip. The net result is a smaller file for storage or modem/ethernet transfer.

Because the files are compressed, the actual size of the data on the flash chip will vary depending on the data itself. For example, if a device is reporting 25KWh, it will use fewer bytes than a log entry that has 9,999,999KWh.

We have measured a typical installation with 5 H8036 power meters and 5 A8923 IO modules, and determined the system will run for well over a hundred days with a 15 minute log cycle. Changing the number of meters, the type of log data, or the log cycle period will affect your results accordingly.   Please read Technote "TN-03" at Leviton.com for more information about log file storage capacity.

When the EMH+ storage area on the flash starts to run out of space, the following action is taken:

- When the 8 Mbyte log file storage area is 75% full, the EMH+ will immediately compress the log files and attempt to upload the data to the BMO website or user specified site. This action will not wait until the next scheduled upload time.
- When the storage area is 95% full, the EMH+ will immediately attempt to upload the data, and if

unsuccessful, will purge the oldest (rotated) log data file.

Log files are deleted automatically if the EMH+ has successfully uploaded the log file to a database server using the HTTP/Post protocol. If you do not configure the EMH+ to automatically push the log files to your server, you must manually delete them. To delete log files, refer to the FTP method of downloading log files. One step detailed in the FTP section is how to delete a log file from the EMH+.

Uploading data to the BMO website

After the EMH+ has been configured and has logged some data, you will want to collect the data for analysis. There are several ways of collecting the data from the EMH+ including the Building Manager Online service. Other methods are noted in the data collection FAQ. This section details configuring the EMH+ for use with the BMO service.

Step 1: First, use your browser to connect to the EMH+. Select the Modbus/Setup section from the menu on the left. In the field titled "Modbus Loop Name" enter a name for this EMH+ to uniquely identify it on the BMO website. Because the BMO site can show multiple EMH+ devices, it is important to have a descriptive name in this field.

Step 2: Select the "Log File Data", "Setup/Upload" menu option. The following features are available:

- **EMH+ Serial Number:** This is the serial number that uniquely identifies this EMH+. This number can not be changed. When uploading data to the BMO website, this serial number is used to identify the EMH+ to the BMO server.
- **Scheduled upload time:** This option allows you to control when the EMH+ will initiate the upload process. You can select any hour of the day, and the EMH+ will select some time at random within that hour to start the upload. The random feature allows multiple EMH+ devices to share a single dialup account or phone line by not starting the dialout at the same time for all devices. If the EMH+ is on a LAN connection (DSL, Cable Modem, T1, etc) an upload time of "hourly" may be selected.
- **Upload data on alarm status change** will cause the EMH+ to initiate the upload process if any point on any modbus device enters or leaves an alarm state. This allows the EMH+ to send data when an alarm is detected, and will upload that information to the BMO website in a timely manner. The BMO website will then send email notifications if necessary. If this option is disabled, the BMO website may not be able to send notifications until the end of the day when the EMH+ calls in at its specified upload time.
- **Upload data on low disk alarm:** This feature will cause the EMH+ to attempt a data upload immediately if the log file storage area is more than 75% full.
- **Allow remote modbus device configuration:** If enabled, users may remotely configure alarms and other modbus device features on the BMO website. When the EMH+ uploads data to the BMO website, it will also download any new configuration information as needed. Note: if configuration changes are made to the EMH+, those changes will be uploaded to the BMO site. If configuration changes are made at both the EMH+ and the BMO website, the most recent changes will be used.
- **Target Address to upload data:** This is the website URL to upload data to. This should always be set to "http://www.buildingmanageronline.com/upload.php" unless you are configuring the EMH+ to send data to your own internal database server. (see the Data Collection FAQ at Leviton.com)
- **Password to upload data:** This password is used by the BMO webserver to verify the EMH+ device authentication before accepting the uploaded data. You should select a password other than the default, and make note of it for future reference.
- **Number of times to retry:** In the event of a failure (often due to dialup problems, busy signals, etc) this option specifies the number of retries to attempt the upload again. If all retries fail, the EMH+ will wait until the next scheduled upload time before trying again.
- **Time to wait before retry:** In the event of a failure, the EMH+ can be configured to wait for a specified period of time before attempting another connection. This option specifies how long to wait before

retrying.

Step 3: Contact the Leviton Technical Support department. Please have the *EMH+ serial number* and *password to upload data* handy. Your tech support representative will confirm your BMO account and will add the EMH+ to one of your client databases.

Step 4: Click the "Upload Data Now" button. Your data should be sent to the BMO webserver.

Step 5: For more detailed information about the transfer process, use the Connection Test page in the Testing/Diags menu on the EMH+ for a full report of the data upload progress.

Retrieving Data From the EMH+

Overview of how the system was designed to work.

Now that you have installed your EMH+ and configured it to collect data from your meters and sensors, you will want to collect the data from your EMH+. This document will provide an overview for collecting data from the EMH+. Processing the data for billing reports, summaries, and other data processing are beyond the scope of this document.

Three basic ways to collect data from the EMH+:

- HTTP download from the EMH+ with a browser (pull)
- FTP download from the EMH+ (pull)
- Enertrax DL download from the EMH+. (pull)
- HTTP Post: The EMH+ uploads data to a database/webserver. (push)

HTTP Direct from the EMH+

The EMH+ has the ability to export log file data to a web browser directly from the setup web pages. To use this feature, access the EMH+ setup menu with your web browser. Select the "Log File Export" page from the Log File Data menu on the left side of the page.

For each device, a separate log file will be saved. Select the device from the dropdown list provided. Specify Comma or Tab delimited data, and indicate if column headers are required. Click the download button to download the data.

The log file format is the same as is provided by FTP and by the BMO web site. Note: All timestamps are in UTC.

When importing log files into Microsoft Excel, be sure to specify the log data is comma separated, and use a single quote mark as the text delimiter.

FTP Direct from the EMH+

The EMH+ will allow inbound connections for transfer of log data files using the FTP protocol.   Ftp to the EMH+ and log in using the system admin password. Files are located in /var/log/modbus. For further information on FTP log file transfer, please review the technote and FAQ section of the Leviton website.

Enertrax download direct from the EMH+

Leviton provides a free tool called Enertrax DL that can automate the process of downloading log data from the EMH+ to your Windows PC hard drive. Enertrax DL can merge new log data into existing log files on your computer as well as provide configuration information about the EMH+. Enertrax DL can also be configured to make LAN or Dilaup calls to one or more EMH+ or AcquiLite data acquisition servers.

HTTP/Post Upload To Building Manager Online

- ✍ EMH+ sends data to the BMO website
- ✍ The BMO Website stores the data in a SQL database.
- ✍ Quick reporting from our website
- ✍ Includes remote EMH+ configuration service.
- ✍ Includes alarm notification by email.
- ✍ Data available for download in CSV/Tab delimited format upon your request.
- ✍ For pricing and to sign up for service, contact sales@buildingmanageronline.com or call +1-503-601-2099

HTTP/Post Upload To Your Database Server

- ✍ EMH+ uploads data directly to your webserver or database server.
- ✍ You must supply a script to process the incoming data. Sample script for ASP and PHP are available upon request.
- ✍ Requires Webserver, CGI Scripting and, database (SQL) knowledge
- ✍ Alarm processing available by processing data on your server when data is uploaded
- ✍ Designed for integration with existing energy reporting systems.
- ✍ Contact Leviton technical support for further details and sample scripts.

Removing Data From the EMH+

When using an HTTP/Post method to allow the EMH+ to push data to a database server, the EMH+ will automatically remove log files from its' flash memory once the EMH+ has confirmed that the file was received by the database server.

If you are using the EMH+ with a standalone mode, you can use FTP or Enertrax DL to delete log files from the flash memory.

With EnertraxDL, simply check the setup checkbox to delete log data after download.

For FTP, the process is essentially the same process as the manual FTP data download. For more information on FTP access to the EMH+, please view the FAQ and Technotes section of the Leviton.com website.

Steps for Microsoft Windows command prompt ftp.

Use the following commands.

ftp 192.168.40.50   Use the IP address of your EMH+
username: root
password: admin   The same as the admin password
cd /var/log/modbus
dir   view a list of log files.
mdel *.gz   remove the log file to free up flash space
bye

The mdel command will tell the FTP software to delete all files ending in .gz in the current directory. Some FTP clients will allow you to specify a command "prompt" prior to using mdel that will prevent the FTP client software from asking if you are sure you wish to delete each file.

Linking to EMH+ Device Status Pages

It may be helpful to create a shortcut or a hyperlink on another web page that will direct the browser to bring up a specific device status page in your browser. To do this, right click on the page and select properties. The url for the page will be shown on that dialog. Simply copy/paste this url into your link.

The EMH+ can provide Modbus device data in XML format. This feature, coupled with browser based AJAX (Javascript) can provide a very powerful tool to allow the creation of custom web pages. Further examples of XML and its uses are available on the Leviton website in the Documentation/Technotes section.

Mechanical Drawing:

0.250
[6.35]

8.850
[224.79]

2.395
[60.84]

8.250
[209.55]

9.500
[241.30]

4.750
[120.65]

LEVITON.

7.617
[193.48]

2.395
[60.84]

0.250
[6.35]

8.850
[224.79]

1.033
[26.23]