GE Consumer & Industrial
Multilin

Instruction Manual

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GE Multilin's Quality Management System is registered to ISO9001:2000

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These instructions do not purport to cover all details or variations in equipment nor provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the General Electric Company.

To the extent required the products described herein meet applicable ANSI, IEEE, and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

GE Multilin EPM 1000 Sub-Meter instruction manual.

EPM 1000 Sub-Meter is a registered trademark of GE Multilin Inc.

Part numbers contained in this manual are subject to change without notice, and should therefore be verified by GE Multilin before ordering.

Part number: 1601-0155-A7 (November 2007)

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GE Consumer & Industrial
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EPM 1000 Single Point Submetering System

Chapter 1: Overview

1.1 Getting Started

1.1.1 Description

Thank you for purchasing the GE Multilin EPM 1000 sub-meter to monitor energy for your residential, commercial, or industrial applications. At GE Multilin, we pride ourselves by providing our customers with best-in-class products, which have been carefully selected by GE to best serve your solution needs.

The EPM 1000 is sold in KWh or Demand meter versions and is available for 120/208V and 277/480V applications. An integrated liquid crystal display (LCD) is standard on all versions, providing local access to real-time and historical data. The meter provides two standard communication modes: power line communications (PLC), which utilizes existing AC power lines as the communication medium, eliminating dedicated wiring, and Modbus (RS232, RS485, modem).

The EPM 1000 is packaged with either solid or split core CTs in various amperages to suit both new construction and retrofit applications.

NOTE

The EPM 1000 is primarily used for commercial and industrial applications and is available in voltages ranging from 120 to 600 V in both wye and delta forms. The following installation instructions are applicable to the EPM 1000 meter only.

1.1.2 Contact Information

For assistance and contact information in connection with meter internal program setup and configuration please contact GE Multilin.

1.2 Applications

1.2.1 Stand-Alone Meter

The GE Multilin EPM 1000 can be installed as a stand-alone device that is locally accessed via the LCD or remotely accessed via modem. A modem can be installed in each meter allowing the meter(s) to be read remotely.

1.2.2 Metering System

The GE Multilin EPM 1000 family of meters are ideally designed to comprise a metering system within a residential/commercial building or industrial site. This metering system can measure electrical usage for each tenant, cost center, or common area space and communicate this information over the building's power wires or dedicated communication wiring (RS485). A metering system is comprised two or more EPM 1000 meters and a communication transponder (see figure below). The transponder collects all of the metering data via the AC power lines and communicates data to an optional transponder.

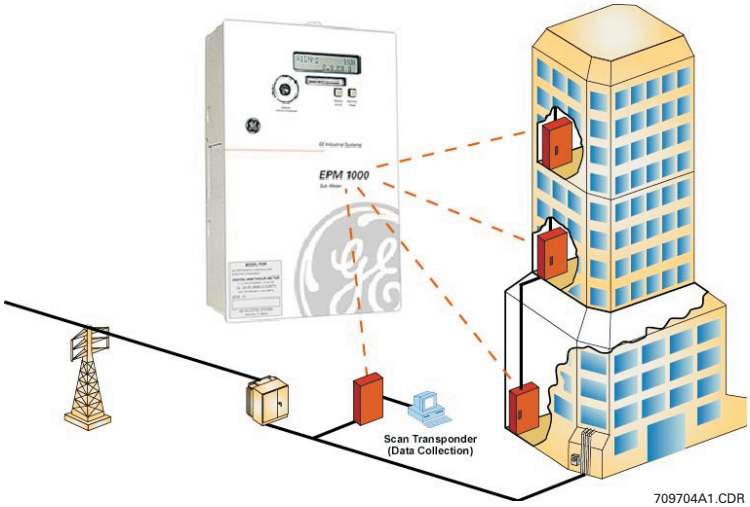

FIGURE 1–1: Overview of Transponder Functionality

1.2.3 Interior View

The interior of the EPM 1000 is shown below.

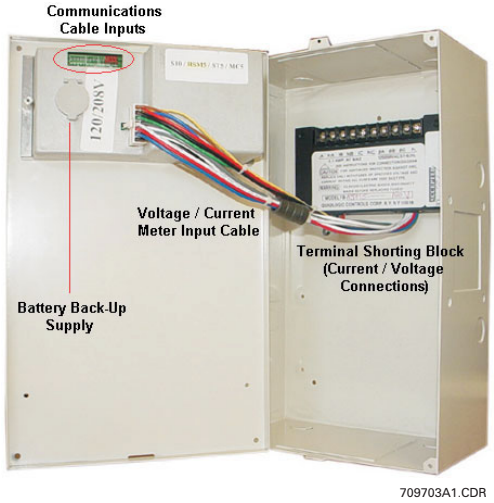

FIGURE 1–2: Interior View of the EPM 1000

NOTE

Where the ⚠ and ⏚ symbols are seen on the EPM 1000 meter, the manual must be consulted to determine the nature of any potential hazard and/or actions to be taken.

1.2.4 Cautions and Warnings

WARNING

- Do not install if the device is damaged. Inspect the housing for obvious defects such as cracks in the housing.
- If the device is installed or used in a manner not specified by accompanying documents, the protection of the device may be impaired.
- If the device functions abnormally, proceed with caution. The protection of the device may be impaired.
- Do not install the meter around combustible gas or gas vapor.
- Do not install the meter in an electrical service with current or voltage outside of the specified limit of the device.
- Do not operate the meter with the cover removed.
- To avoid electric shock, disconnect mains before replacing fuses!
- See instructions for connection diagram.
- Risk of electric shock. Beware of working around this meter when the voltage is live.
- For continued protection against fire, replace only with fuses of specified voltage and current rating.

1.2.5 Protective Conductor Terminal

Securely fasten one end of the earthing wire so that the screw cuts the paint on the back box. Securely fasten other end of the wire to a true earth ground connection. When earthing to the electrical conduit, use continuous pipes, bending when necessary instead of using couplers.

1.2.6 Preventive Maintenance

There are no necessary preventative maintenance or inspection.

A Toshiba CR2032 coin battery is used in each device and is intended to be good for decades before replacement. Return to manufacturer for replacement.

1.3 Specifications

1.3.1 Technical Specifications

OPERATING SPECIFICATIONS

Voltage: ..... 120, 240, 277, 347, 480, 600 V (90% to 110%)
Frequency: ..... 60 Hz
Power: ..... 2 W for 120V; 5 W for 220 to 600 V

ENVIRONMENT

Usage: ..... For indoor use only
Temperature: ..... –20°C to +60°C
Humidity: ..... 0 to 95% R.H. (non-condensing)
Pollution Degree: 1
Maximum altitude: ..... 2000 m

CONTROL POWER

Input: ..... 120 V phase A to neutral
277 V phase A to neutral
480 V phase to phase
(internally powered through metered voltage; no external source is required)
Frequency: ..... 50 to 60 Hz
Operating power: ..... 2 watts for 120 V
5 watts for 277 V and 480 V
Fuses: ..... 1 - Buss fuse 250 V / 500 V 0.25 A / 0.125 A slow-acting
3 - Buss fuse 250 V /600 V 4.0 A fast-acting

TYPE TESTS

Transient/surge suppression: ..... ANSI C37.90.1-1989
Installation category: III. ..... This product falls under Installation Category III because of its distribution level, fixed installation and has smaller transient overvoltages than an Installation Category IV.

METERING

Metered Voltage: ..... 120, 220, 240, 277, 347, 380, 480, 600 V Delta or Wye, 50/60 Hz
Current Input: ..... 0.1 A, 5.0 A
Secondary inputs: ..... 50 to 4000 A primary available
Minimum current sensitivity: ..... 0.06 A

INPUT AND OUTPUT CONNECTIONS

See installation diagram

INSULATION OF EXTERNAL CIRCUITS

See installation diagram

PHYSICAL

Dimensions: ..... 13.5"H × 8.5"W × 4.5"D

1.3.2 Approvals

APPROVALS

ANSI: ..... C12.1 and C12.16 accuracy

UL and CUL: .....recognized under E204142

1.4 Ordering

1.4.1 Catalog Numbers

The order codes for the EPM 1000 are indicated below.

Table 0EPM 1000 Order Codes

	PL1000	– *	– *	– *	
Base Unit	PL1000	|	|	|	EPM 1000 Sub-Meter
Supply Voltage		208	|	|	120/208 volts connection
		480	|	|	277/480 volts connection
Current Transformers			SP101	|	Split-core, 100 A CTs (set of 3)
			SP201	|	Split-core, 200 A CTs (set of 3)
			SP401	|	Split-core, 400 A CTs (set of 3)
			SP801	|	Split-core, 800 A CTs (set of 3)
			SP162	|	Split-core, 1600 A CTs (set of 3)
			SP322	|	Split-core, 3200 A CTs (set of 3)
			SL050	|	Solid-core, 50 A CTs (set of 3)
			SL101	|	Solid-core, 100 A CTs (set of 3)
			SL201	|	Solid-core, 200 A CTs (set of 3)
			SL401	|	Solid-core, 400 A CTs (set of 3)
Demand Version				K	kWh version
				D	Demand version

For example, for demand metering applications with 277/480 V AC system voltage, 1500 A mains, 60 Hz, on an existing facility (split-core CTs), the required order code is **PL1000480SP162D**.

1.4.2 Modifications

The following modifications are available:

– PL1000PULSIN10: pulse inputs

– PL1000MOD: Modbus communications

1.4.3 Accessories

The following accessories are available:

Transponder Models	Voltage	Options	Description
PL MODXPONDER120V	120/208*	Modem	data collector for PLC
PL 485XPONDER120V	120/208	RS485	data collector for PLC
PL RFXPONDER120V	120/208	Wireless	data collector for PLC
PL MODXPONDER277V	277/480	Modem	data collector for PLC
PL 485XPONDER277V	277/480	RS485	data collector for PLC
PL MODXPONDER347V	347/600	Modem	data collector for PLC
PL 485XPONDER347V	347/600	RS485	data collector for PLC

* same model works for 120/240 V
  modem has RS485 and RS232 standard

The transponder can handle up to 150 meter points (i.e. 150 EPM 1000 or 12 MC-5/12).

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EPM 1000 Single Point Submetering System

Chapter 2: Installation

2.1 Getting Ready

2.1.1 Determination of Metering System Requirements

Determine if the application is for a metering system or for a stand-alone meter. If the application is for a stand-alone meter, proceed directly to the next section. If the application is for a metering system, then please read *Installing the GE Transponder* on page 2–13.

2.1.2 Overview of Meter Wiring

Although this document treats the installation and certification stages separately, this does not imply that the recommended procedure is to install the entire system at once and then proceed to certification.

The recommended procedure is to install and certify the system in stages. By doing this, systematic error can be corrected before it propagates through the entire installation. To follow the recommended procedure, divide the job up into manageable stages and install and certify at each stage before proceeding to the installation of the next stage.

For the purposes of this discussion, the colors black, red and blue have been chosen to distinguish among the three phases of a three-phase network. White is the designated color of neutral and green is the color of earth ground. Please substitute the correct color according to local electrical code. For a two-phase installation, ignore the third phase (the blue phase in the following description).

WARNING

Failure to follow the proper procedures and reference the correct wiring diagram can result in damage to the equipment and/or physical harm.

2.2 Wiring Diagrams

2.2.1 Overview

Review the following wiring diagrams and select the one that matches your installation requirements and part number using the following table.

Table 2–1: Wiring Diagram / Model Reference

Figure	Applicable Models
FIGURE 2–1: *3-Phase, 4-Wire Wye Wiring* on page 2–3	PL1000208S****K PL1000208S****D PL1000480S****K PL1000480S****D
FIGURE 2–2: *1-Phase, 3-Wire Center-Tap-Neutral 120/240 V Wiring* on page 2–4	PL1000208S****K PL1000208S****D
FIGURE 2–3: *3-Phase, 4-Wire Center-Tap-Neutral 120/240 V Delta Wiring* on page 2–5	PL1000208S****K PL1000208S****D
FIGURE 2–4: *3-Phase, 3-Wire Ungrounded 480 V Delta Wiring* on page 2–6	PL1000480DELTA
FIGURE 2–5: *3-Phase, 3-Wire Corner-Grounded 480 V Delta Wiring* on page 2–7	PL1000480DELTA
FIGURE 2–6: *CT Terminations for 1600 A and 3200 A Models* on page 2–8	PL1000***SP162* PL1000***SP322*

2.2.2 3-Phase, 4-Wire Wye

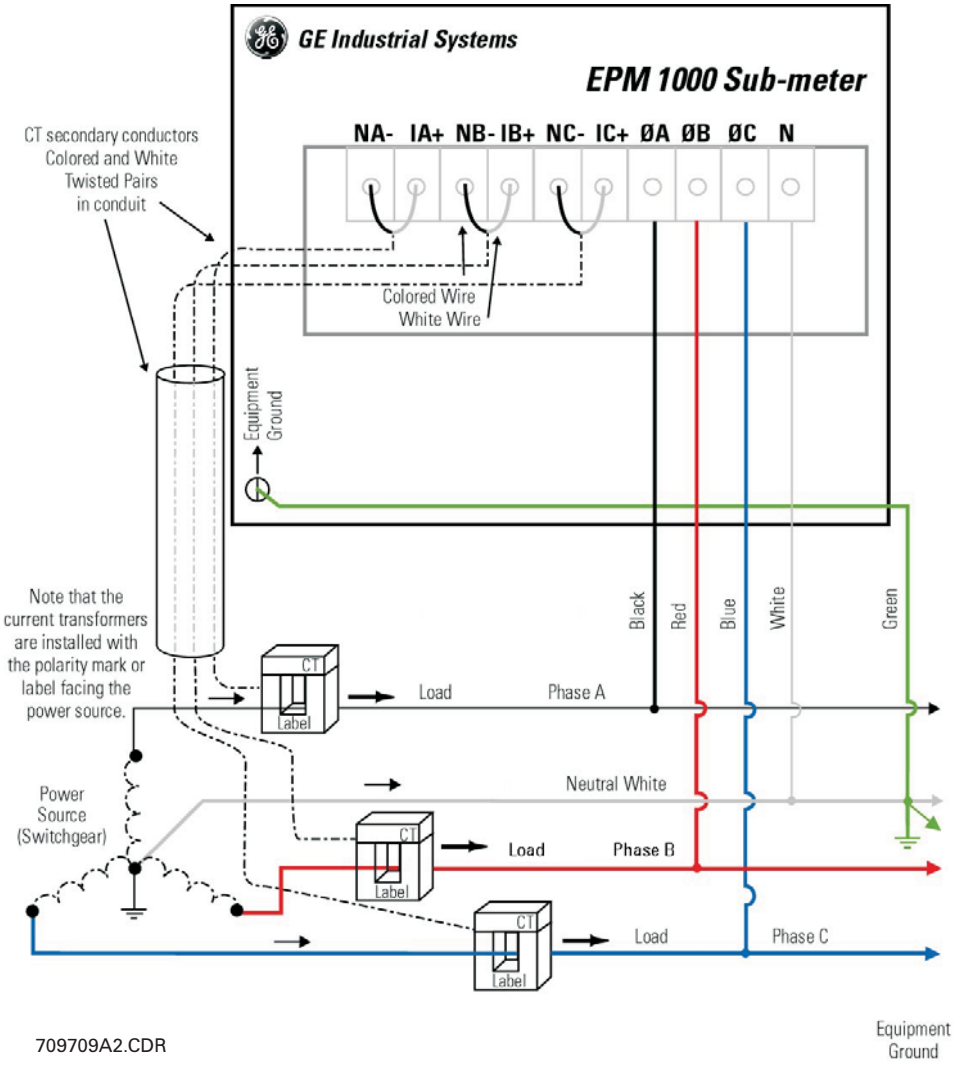

FIGURE 2–1: 3-Phase, 4-Wire Wye Wiring

2.2.3 1-Phase, 3-Wire Center-Tap-Neutral 120/240 V

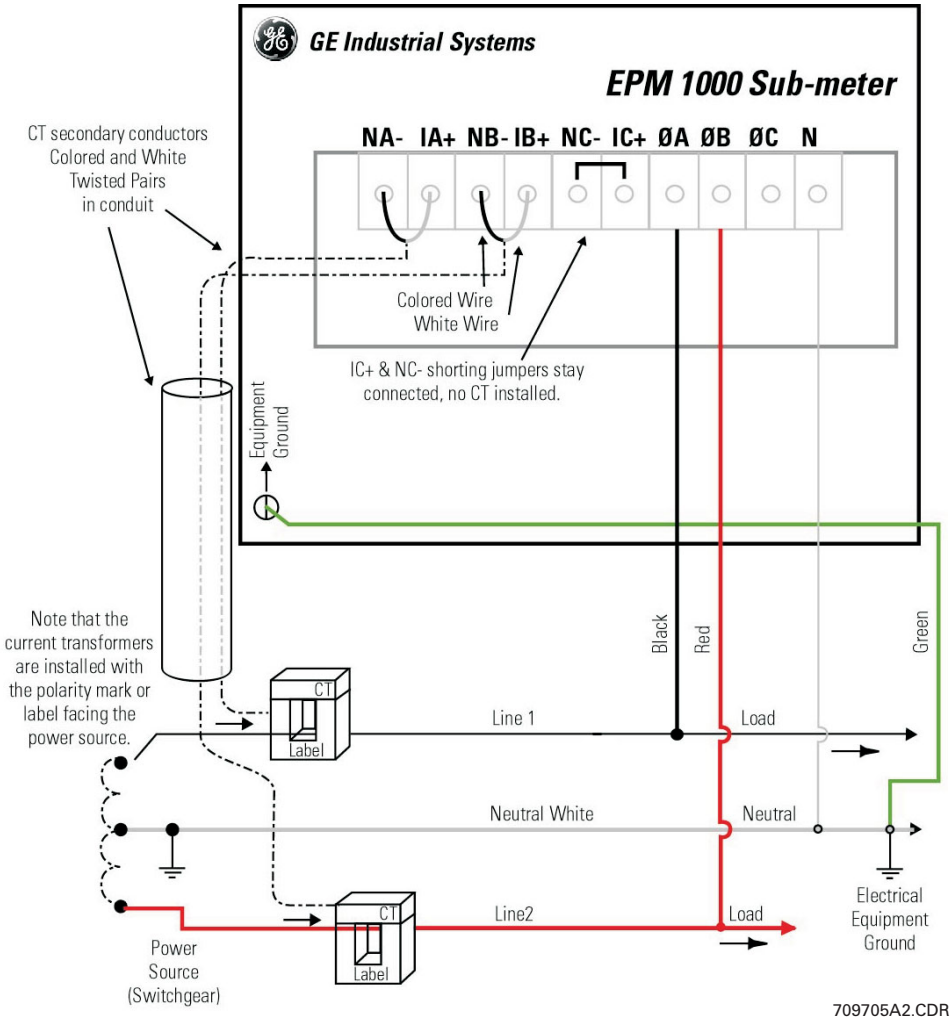

FIGURE 2–2: 1-Phase, 3-Wire Center-Tap-Neutral 120/240 V Wiring

2.2.4 3-Phase, 4-Wire Center-Tap-Neutral 120/240 V Delta

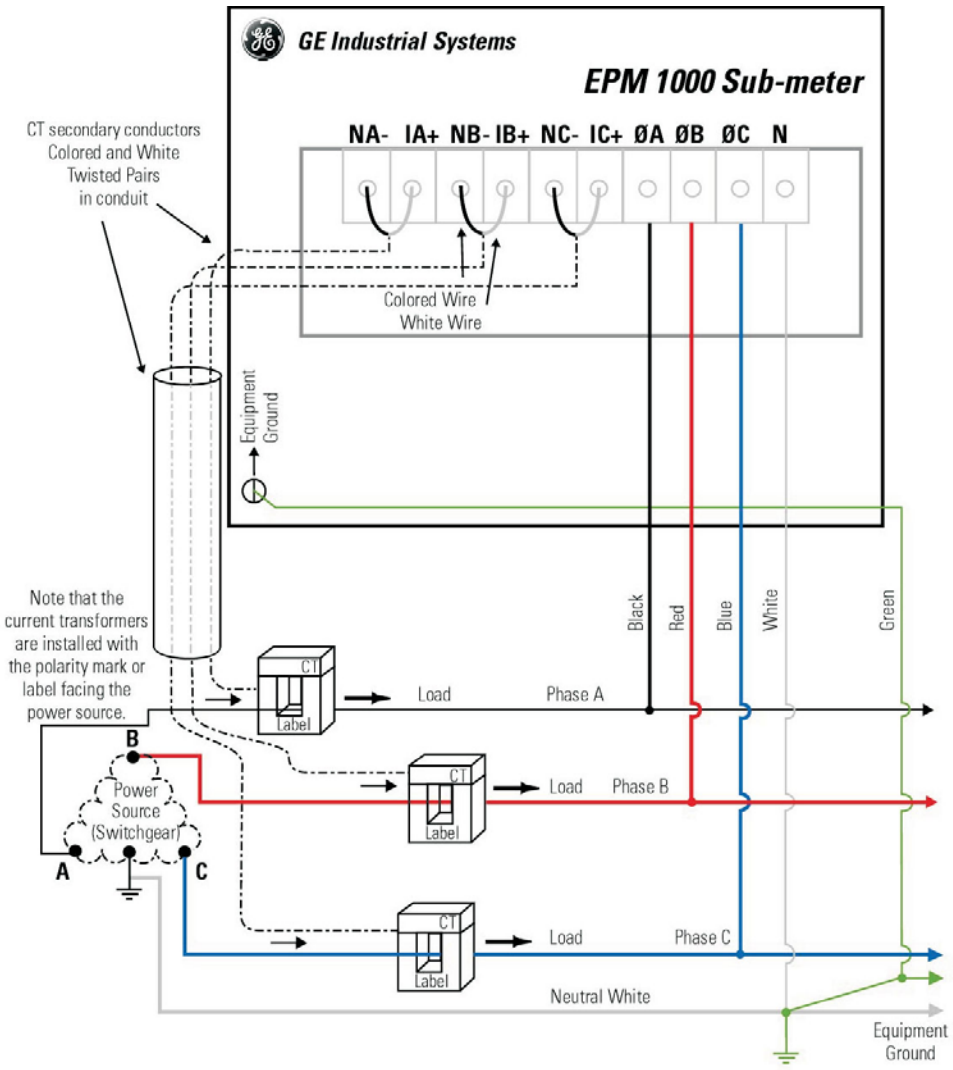

FIGURE 2–3: 3-Phase, 4-Wire Center-Tap-Neutral 120/240 V Delta Wiring

2.2.5 3-Phase, 3-Wire Ungrounded 480 V Delta

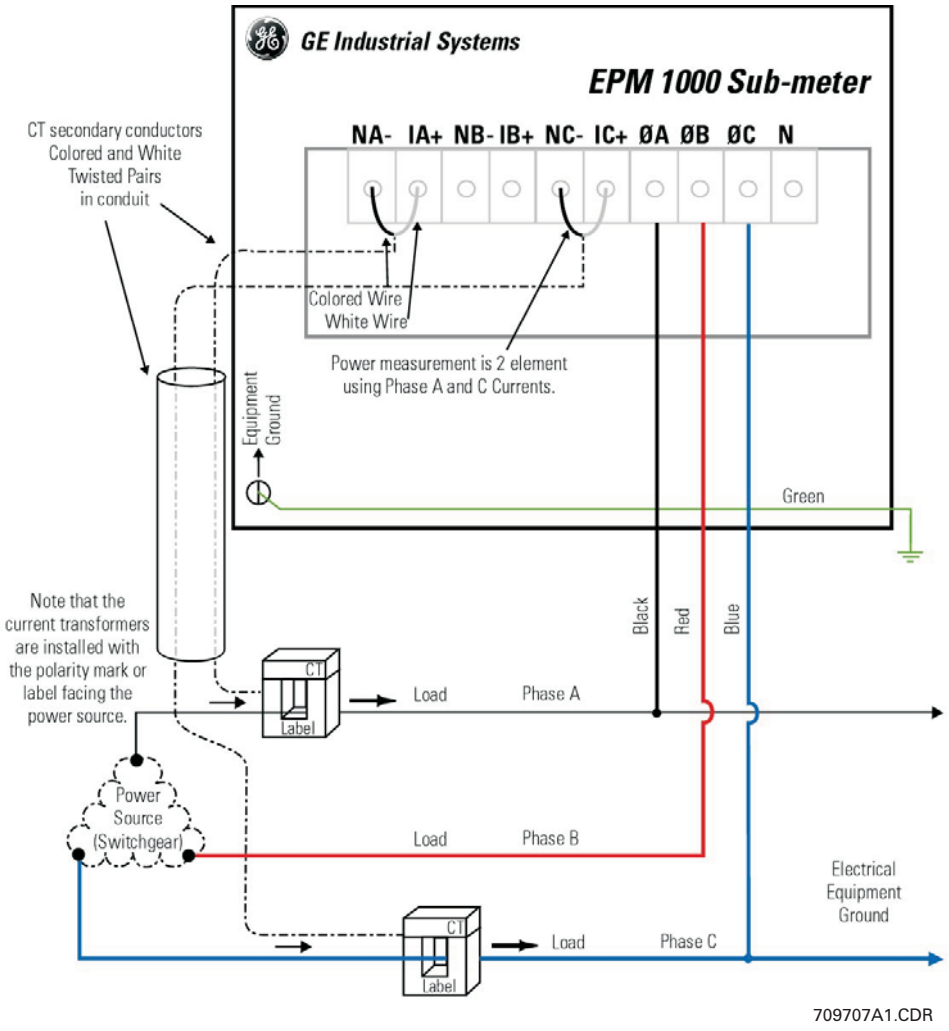

FIGURE 2–4: 3-Phase, 3-Wire Ungrounded 480 V Delta Wiring

2.2.6 3-Phase, 3-Wire Corner-Grounded 480 V Delta

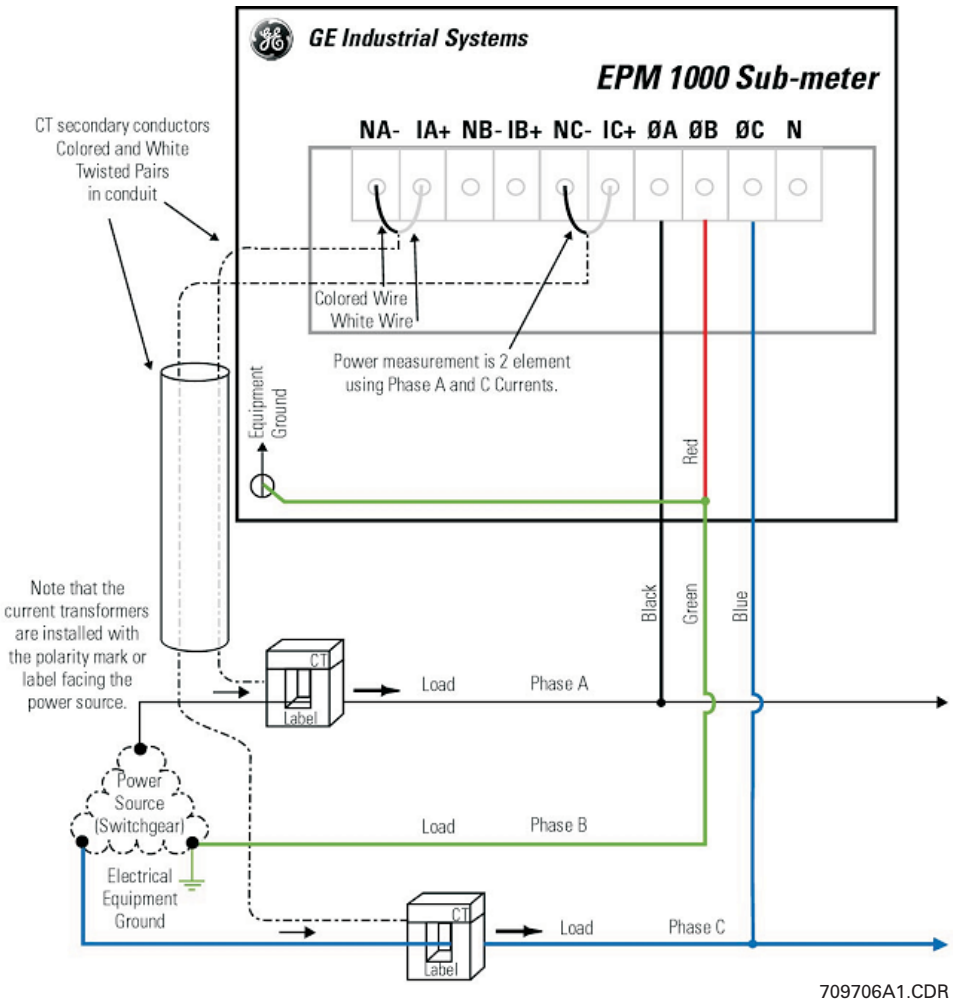

FIGURE 2–5: 3-Phase, 3-Wire Corner-Grounded 480 V Delta Wiring

2.2.7 Wiring for 1600 A and 3200 A Models

For the 1600 A and 3200 A models (order codes PL1000***SP162* and PL1000***SP322*), the CT terminations are made on the HCA-2 module to allow the EPM 1000 to accept 5 A secondary current inputs. CAREFULLY observe the following figure and terminate the CT leads on the included HCA-2 module, NOT the fuse block.

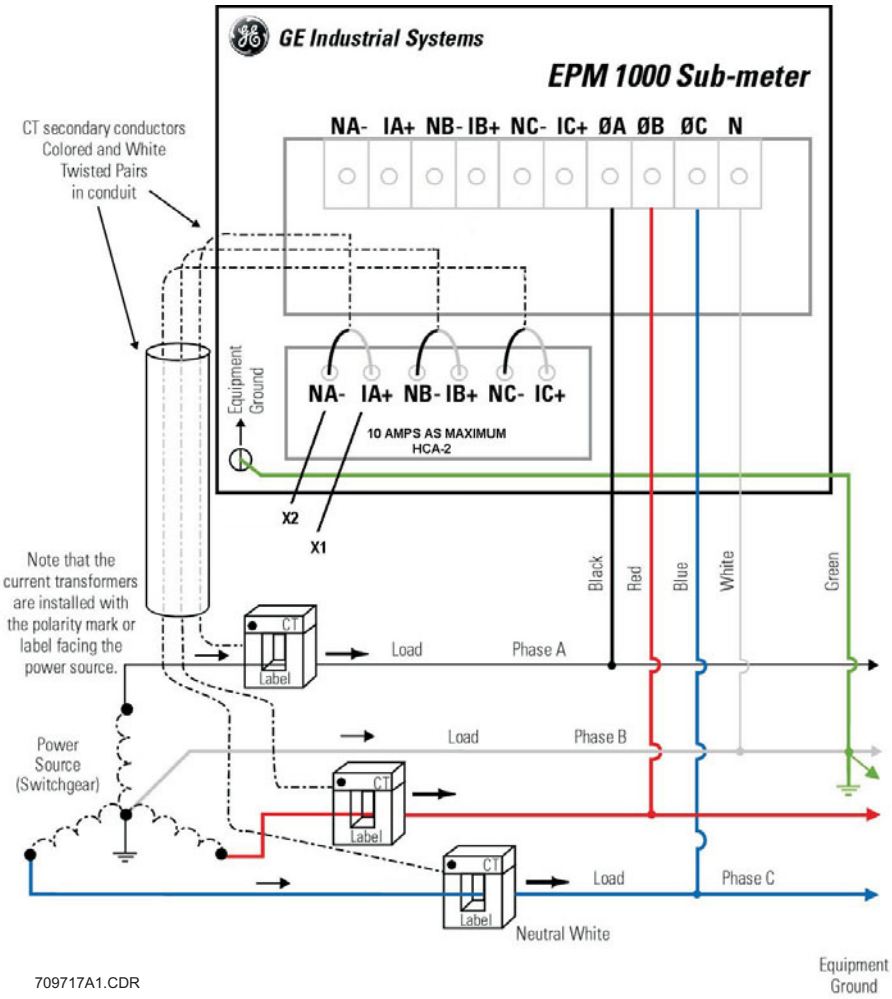

FIGURE 2–6: CT Terminations for 1600 A and 3200 A Models

2.3 Installation of Meter and Current Transformers

2.3.1 Procedure

The use of the following procedure is mandatory. Certification requires a visual inspection of the current transformers and the voltage taps on the incoming feeder phase wires.

- ▷ Mount the back box to the wall, or in the wall for flush mount installations.
  Connect the breaker panel box to the back box of the meter with a metal conduit through which the 3 or 4 feeder phase taps and the 6 CT wires will be run.
  Make sure to use at least a ¾-inch ID conduit to allow for all 9 or 10 wires to pass easily.
- ▷ Locate the incoming feeder phase (hot) wires at the top of the breaker panel.
  Tape the incoming feeder wires according to phase with black, red and blue electrical tape for identification purposes.
- ▷ Extend the CT wires with AWG #16 stranded with black, red and blue jackets so as to be the correct length to pass through the conduit and reach the fuse block in the meter back box.
  Extend the white wire of each CT with a white wire, but place a black, red or blue electrical tape on the end of the extended wire to identify the correct neutral.
  Refer to these CT white wires with tape as white/black, white/red and white/blue respectively.
- ▷ Remove the incoming feeder hot wires one at a time and place each CT over the proper feeder wire.
  Make sure that the colors of the CT leads correspond to the color of the tape on the phase feeder.
  Make certain that the white wire from the CT is closest to the line side of the feed, away from the top of the breaker panel.
  For split-core CTs, make sure that the X1 is toward the line side.
  Run the CT secondary wires through conduit to the back box of the meter.
- ▷ Tap the three feeder wires with AWG #12 stranded wire with black, red and blue jackets taking care to match the color of the insulation of the #12 wires to correspond to the color of the tape on the feeder wire.
- ▷ If the service is 4-wire, tap the neutral connection with a #12 AWG stranded wire with a white jacket.
- ▷ Run the six (6) current transformer wires black, white/black, red, white/red and blue, white/blue to IA+, NA–, IB+, NB–, IC+, NC– respectively on the fuse block (see *Internal Fuse Block* on page 2–11).

- ▷ Take the black, red, blue and white (if available) #12 AWG feeder phase tap wires and run them to ⇔A, ⇔B, ⇔C, and N (if available) respectively (see *Internal Fuse Block* on page 2–11).
- ▷ Plug the fuse block into the meter head and hang the meter head on the back box.
- ▷ Close up the breaker panel until the certification inspector arrives.

2.3.2 Internal Shorting Terminal

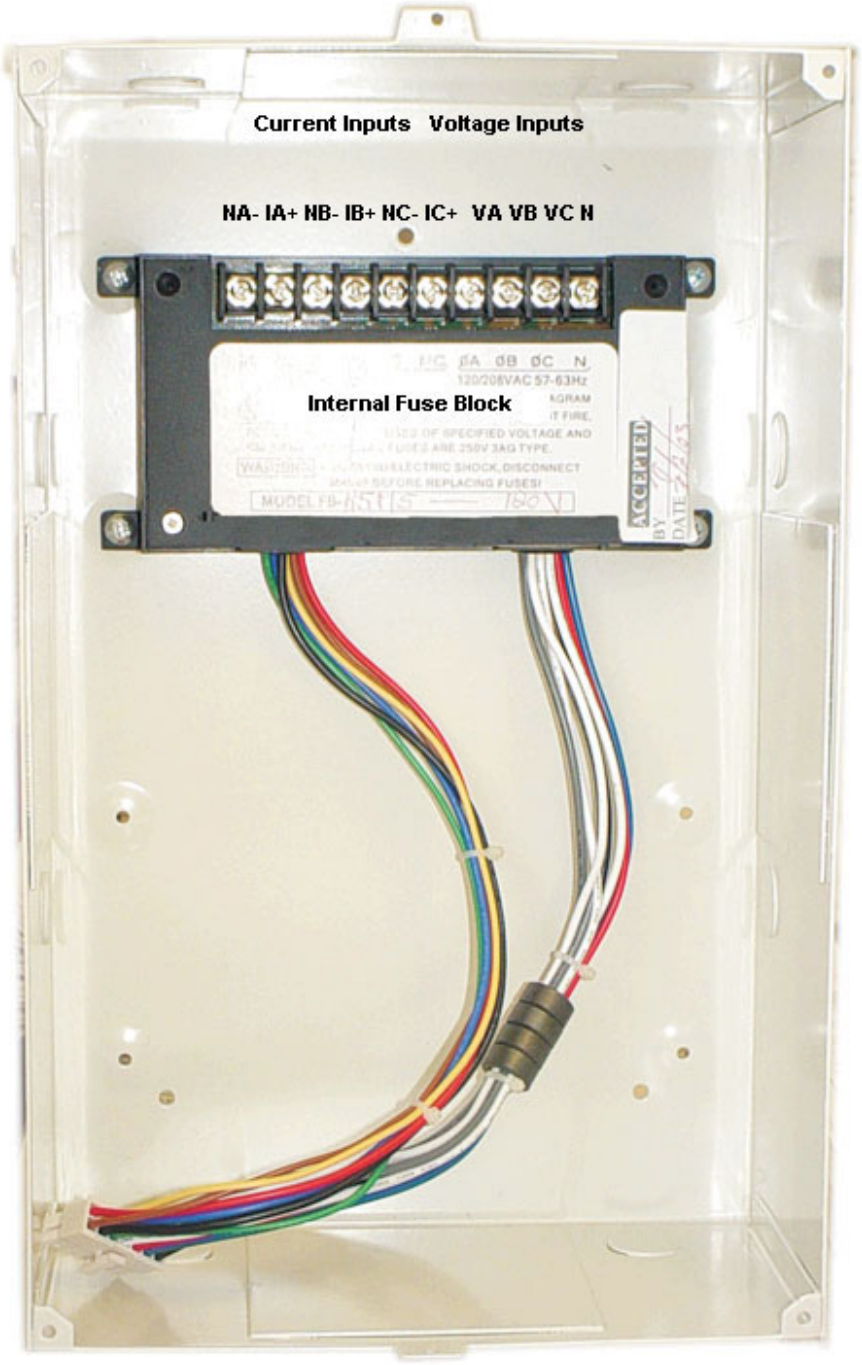

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FIGURE 2–7: Internal Fuse Block

2.4 Installing the Pulse Inputs

2.4.1 Pulse Input Option

The EPM 1000 with the Pulse Input option will provide a 5-wire harness from the back of the meter head. The color coding on the harness is as follows and the M# and Q# refers to meter registers that will appear if the meter has pulse inputs:

- COMMON (WHITE)
- M2 Q14 (GREEN)
- M2 Q13 (ORANGE)
- M1 Q14 (RED)
- M1 Q13 (BLACK)

2.5 Installing the GE Transponder

2.5.1 Procedure

If your application is for a metering system, use the following procedure to install the transponder.

▷ **Plan for the transponders.**

- Determine the number of services in order to determine the number of transponders. Do not rely solely on the memory of the local engineers or of the existing drawings. Drawings may not have been properly updated to reflect as-built conditions and memories are not always accurate. Use these as guidelines and then perform a survey. Open electrical cabinets as necessary and locate every master meter from the utility.
- Make careful note of the voltages of the various transponders.

▷ **Determine the number of tenant spaces.**

- In residential applications, this number should be fixed. Often apartments are laid out on a grid, such as by floor and by line. In this case, the number of meters is simply the number of floors times the number of lines. This information is needed before any meters are installed or entered into the transponders.
- Determine which service feeds each metering point. This information is vital to proper system operation. Without this information, a laborious process of trial and error is necessary to determine which transponder must be used for each meter. This will increase the cost of certification and commissioning of the system.

▷ **Determine the service size and type of meter for each metering point.**

- In residential applications, this is probably a constant amperage across the entire job (either 50A or 100A with Series 10 meters).

▷ **Determine the number of telephone lines required and ensure the lines are installed before the installation of any metering equipment.**

▷ **Determine the number of independent services.**

- Typically there is one service per distribution transformer that feeds the property, unless distribution transformers have parallel secondaries, which is rare.

Locating the best location for each transponder.

This is the closest point to the first point at which the feeders for the service branch out into sub-feeders. To find this point, follow the feeders from the secondary of the distribution transformer (or the service entrance if the transformer is off the property) and place the transponder at the last point before the feeder breaks into multiple feeders.

▷ Determine which of the transponders should have a telephone modem, and order a telephone line to terminate at that point. Do not proceed with the installation until the telephone line is installed.

▷ After the telephone line is installed, install the transponder with the modem next to the telephone line.
Install all three phases and the neutral to the transponder (see *Installation of Meter and Current Transformers* on page 2–9 for details).

▷ If there is more than one transponder, install the other transponders and the interconnecting RS485 line, if required, which links all of the transponders
(Go directly to *Installation of Meter and Current Transformers* on page 2–9 if there is only one transponder in the system or if each transponder in the system has a modem and telephone line connection).

- An RS485 line is a pair of wires, AWG #20 or larger in diameter, which begins at one transponder where a terminator is placed.
- The RS485 line runs from transponder to transponder ending at the final transponder, where another terminator is placed.

NOTE

It is *critically important* that there should *never* be three RS485 pairs entering or leaving a transponder box.

- For the two transponders which have terminators, only one RS485 pair leaves each box.
- For the other transponders, if there are more than two, exactly two RS485 lines should leave the box: each line goes to another transponder in the daisy-chain.
  Only one modem should be installed in a data link system. If there are two or more modems in a data link system, the transponders will not communicate with each other.
- There may be no more than 32 transponders on a daisy-chain. If there are more than 32, special care must be taken, which is beyond the scope of these instructions.

▷ If possible, run the RS485 lines in a conduit to protect them from damage.

NOTE

It is *critically important* to observe the polarity of the wires. The RS485 data link uses a black and yellow color code. Match black to black and yellow to yellow; otherwise the data link will not work.

▷ To test the data link, measure the DC voltage across the yellow to black wire.
This should measure between 0.1 and 0.3 V. If it is negative or outside of that range, re-check all of the transponder boxes according to the above specifications.

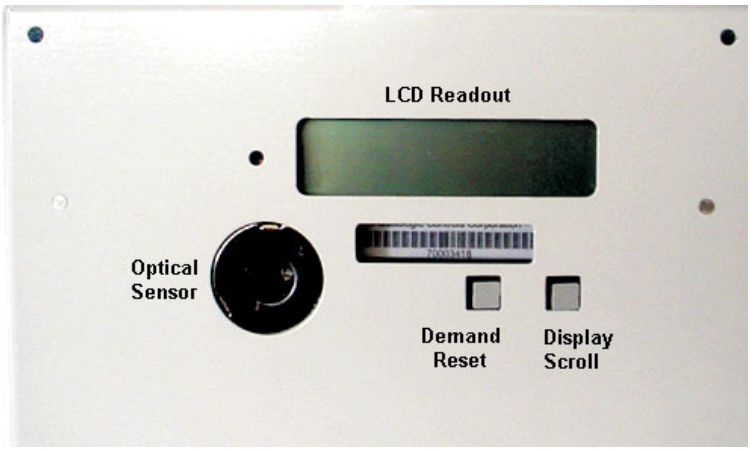
EPM 1000 Single Point Submetering System

Chapter 3: Using the Meter

3.1 Menu Navigation

3.1.1 User Interface

The following figure shows the EPM 1000 user interface located on the front panel of the meter. It is easy to navigate the various sub-menus to read metering data, reset values and view configuration data.



709719A1.CDR

FIGURE 3–1: EPM 1000 User Interface

Press and hold the "Display Scroll" button. After two seconds, the LCD will display the **REVERSE** message. Two seconds later, the LCD will display **FORWARD**. Two seconds later, a different sub-menu register heading as shown on the following page (the top row) in will be displayed in two-second intervals. Note that the EPM 1000 defaults to the kWh register.

Releasing the display scroll button at a given submenu heading will allow you to cycle through the registers listed under the selected submenu heading. Pressing and releasing the display button will advance to the next block of registers in the sub-menu.

To reverse scrolling direction at either the heading level or within a submenu, press and hold the display scroll button. When **REVERSE** is displayed after two seconds, release the display scroll button. You can now go backwards through the menu selections by pressing and releasing the display scroll button.

To go back to the forward scrolling option, follow the same procedure, except release the display scroll button when **FORWARD** is displayed.

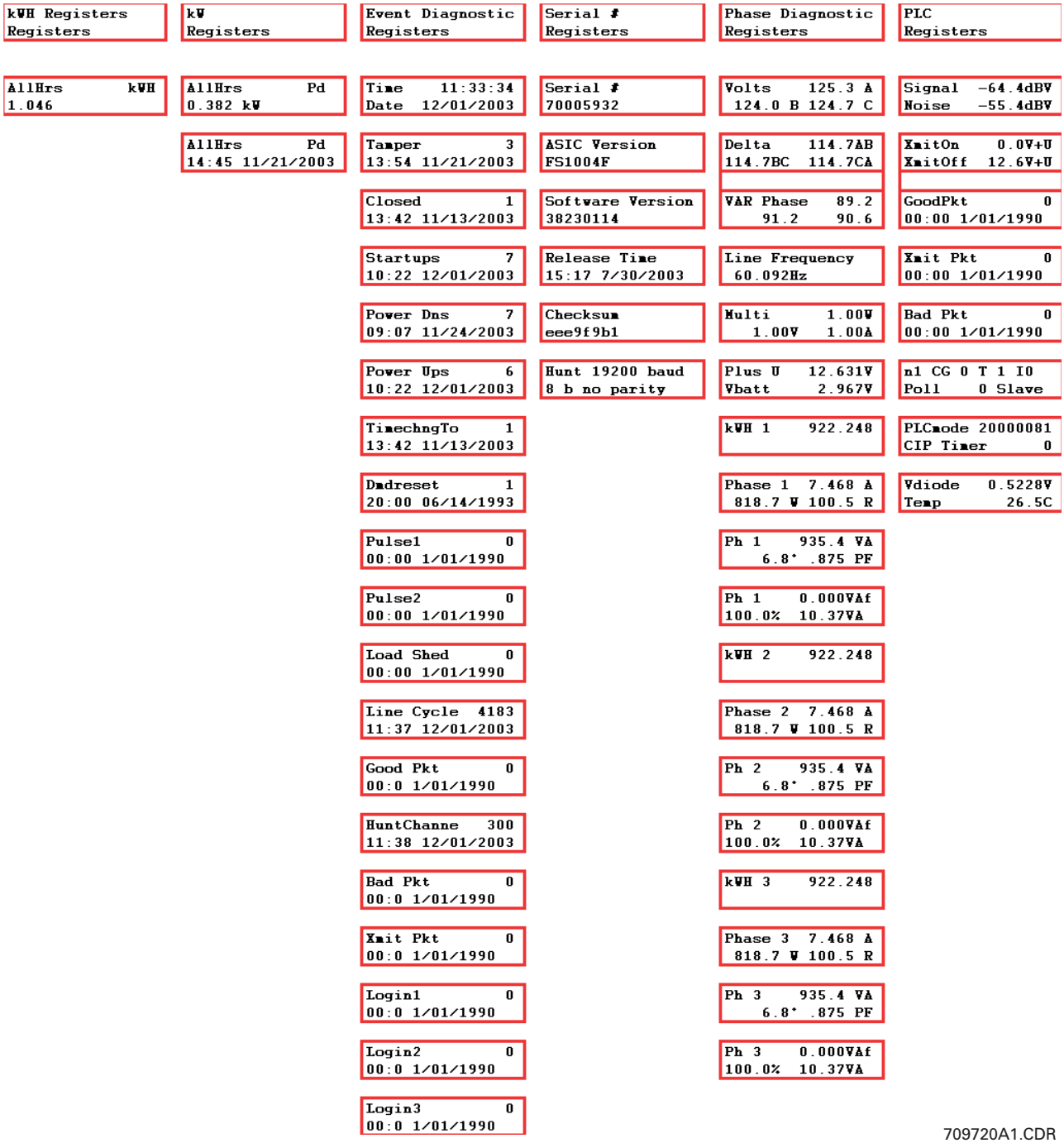


FIGURE 3–2: EPM 1000 Display Structure

3.2 CT Multiplier Table

3.2.1 CT Multipliers

NOTE

The following table MUST BE used to verify the correct current readings, based on the rating of the CT installed.

Table 3–1: CT Multiplier Table

CT Size	Multiplier
50 A	× 0.5
100 A	× 1
200 A	× 2
400 A	× 4
800 A	× 8
1600 A	× 32
3200 A	× 64

NOTE

The multiplier that corresponds with the CT rating MUST BE applied to the current reading shown on the display of the EPM 1000 by multiplying that reading by the multiplier shown above. The multiplier MUST also be applied in the same manner when calculating kW and kWh. Failure to use the appropriate multiplier will result in an incorrect diagnosis of the meter's functionality and incorrect revenue billing.

3.3 Verifying Meter Functionality

3.3.1 Overview

Once you have familiarized yourself with the EPM 1000 menu structure, *it is critical* to verify that the meter and CTs are properly installed.

To correctly diagnose the meter, there must be loads on all three phases of the meter.

3.3.2 Verifying Voltage

▷ Press and hold the Display Scroll button until the following menu heading is displayed:

```
Phase Diagnostic
Registers
```

▷ Release the Display Scroll button. Scroll down by pressing and releasing the Display Scroll Button until the following submenu is displayed:

```
Volts          125.3 A
124.0 B        124.7 C
```

▷ Verify that phases A, B and C are displaying voltages; i.e., for a 120 V AC, the reading should be 117 V +10%/–15%.

3.3.3 Verifying kWh Reading

▷ Press and hold the Display Scroll button until the following menu heading is displayed:

```
kWH Registers
Registers
```

▷ Release the Display Scroll button. Scroll down by pressing and releasing the Display Scroll button until the following sub-menu is displayed:

```
AllHrs              kWH
1.046
```

▷ Verify that the kWh value increases as you view the LCD.

3.3.4 Verifying Current and Energy

▷ Press and hold the Display Scroll button until the following menu heading is displayed:

```
Phase Diagnostic
Registers
```

▷ Release the Display Scroll button. Scroll down by pressing and releasing the Display Scroll button until the following submenu is displayed:

```
Phase 1      7.468 A
818.7 W      100.5 R
```

The A(mperage) reading in the display above will always be a positive number, even if the CT was incorrectly installed. Check the reading to see if it indicates the approximate current you expected. Remember that this applies to Phase 1 *only*. If all the numbers on the multiplier screen were 1.00 and the current transformers are 100:0.1, your multiplier is 1 and the readings are the actual values. If the CTs are 200:0.1, multiply the current reading by 2.

The W(att) reading will also count forward as your view the LCD. A negative power reading is indicative of an incorrectly installed CT, or one that is cross-phased with the wrong voltage (phase) leg. The R(eactive) reading can be negative, depending on the nature of the load. Negative values indicate a capacitive load while positive values indicate an inductive load.

▷ Scroll down by pressing and releasing the Display Scroll Button until the following submenu is displayed:

```
Ph 1          935.4 VA
6.8°           .875 PF
```

Under normal conditions the phase angle (x.x°) should be close to 0° and the power factor should be a number close to 1 (one). Resistive loads will have a power factor close to 1, while inductive loads will typically reflect a power factor between 0.80 to 0.95, or even lower.

If the phase angle on the lower left is a number close to 180°, it indicates the CT was installed backwards, or 180° out-of-phase. If the number is close to 120°, at least two CTs have been cross-phased, and a similar number will appear in the phase angle data in Phase 2.

▷ To view screens for Phases 2 and 3, repeat the same steps as above.

3.4 Resetting the Demand Values

3.4.1 Procedure

Use the following procedure to reset the Demand registers to zero:

▷ **Press and hold the Demand Reset button.**

- The LCD will initially display a copyright message.
- The LCD will then display the **Dmdreset** event screen:

```
Dmdreset              1
20:00       06/14/2003
```

▷ **Keep the Demand Reset button depressed until the screen updates and displays the current date and time. This signifies that the demand has been reset.**

EPM 1000 Single Point Submetering System

Chapter 4: Communications

4.1 Modbus Communications

4.1.1 RS485 Wiring for Modbus

The wiring for Modbus communications for two-wire and four-wire RS485 is indicated below.

For two-wire RS-485:

Color	Function	DB-9 Pinout
Yellow	RX (+)	2
Black	TX (–)	8

For four-wire RS-485:

Color	Function	DB-9 Pinout
Yellow (A)	RX (+)	2
Black (B)	RX (–)	3
Green (Y)	TX (+)	7
Red (Z)	TX (–)	8

FIGURE 4–1: RS-485 Serial Connections

NOTE

The EPM 1000 optical port is disabled for units with 2-wire RS485 connections.

4.1.2 RS232 Wiring for Modbus

The wiring for Modbus communications for RS232 is indicated below.

Color	Function	DB-9 Pinout
Black	TX	2
Red	RX	3
Green	GND	5

4.1.3 Modbus Commands

The EPM 1000 is capable of acting as a remote slave unit to a Modbus master device via modem, RS232, RS485, or PLC. Up to 32 EPM 1000 meters (or other RS485 devices) can be daisy-chained together on a single LAN.

The EPM 1000 communicates at a default baud rate of 19200, with no parity and 1 stop bit. The default Modbus address is 100. Changes to the default baud rate or address can be accomplished through the configuration file upload.

The following Modbus commands are supported by the EPM 1000:

- 03: Read R4 type register(s)
- 06: Write single register; address “0” is used as the broadcast address
- 16: Write multiple registers; address “0” is used as the broadcast address

4.1.4 Fixed Modbus Values

The EPM 1000 provides fixed register values indicating the meter's serial number, the meter's version number, and the Modbus addresses.

4.1.5 Modbus Data Register (R4 Type) Groups

The EPM 1000 has divided the supported register map (see following pages) into the following register groups for various fixed and dynamic data values:

- Setup Information
- Interval
- Average Interval Data
- Instantaneous Data
- Three-Phase Data
- Real Time Data
- Meter Configuration Data

The EPM 1000 provides access to stored-interval data channels via Modbus command. The data items as defined in the following register map are based on default data channels that include the following 3-phase-totaled values (interval average) per meter:

- Real Power in kW
- Reactive Power in kvar
- Apparent Power in kVA
- Power Factor

Data is logged per the configurable time interval value. The default log interval is 15 minutes.

The Modbus master can request stored interval data by writing the interval date and time to the appropriate registers and by setting the data status register to 1. Upon the data ready flag (address 67) being written to 1, the interval data registers (addresses 100 to 107) are simultaneously updated with the appropriate values for the requested interval. The data ready flag returns a 0 for "data is ready", or "2" for "invalid time interval requested."

The EPM 1000 also provides registers that constantly hold the oldest stored-interval (addresses 58 to 60) and most recent stored-interval time and date stamps (addresses 61 to 63).

4.1.6 Instantaneous Data Items

The EPM 1000 provides registers for per-phase instantaneous values (see below). Instantaneous register values are updated once per second.

- Frequency
- Total Harmonic Distortion (% for volts)
- Voltage
- Current
- Real Power in kW
- Reactive Power in kvar
- Apparent Power in kVA

The EPM 1000 provides one-second updated inputs, including the following 3-phase-totaled values per 3-phase-meter:

- Energy: kWh and kvarh
- Power: kW, kvar, and kVA
- Power Factor

4.1.7 32-bit Long and Float Data Formats

The EPM 1000 supports standard format for 32-bit Long (signed or unsigned). The first of the two 16-bit Modbus register set contains the HIGH order 16 bits of the 32-bit Long data. The second of the two 16-bit Modbus register set contains the LOW order 16 bits of the 32-bit Long data.

The EPM 1000 supports Intel 32 bit (IEEE) FLOAT format. That means, unlike the standard Long format, the first of the two 16-bit Modbus register set contains the LOW order 16 bits of the 32-bit Float data. The second of the two 16-bit Modbus register set contains the HIGH order 16 bits of the 32-bit Float data.

4.2 Modbus Activation

4.2.1 Overview

The EPM 1000 is shipped with Modbus not activated. To activate the Modbus protocol, it is necessary to use the Hilgraeve HyperTerminal Private Edition software. This software is available from the following website:

http://www.hilgraeve.com/htpe

Once Modbus is activated, the meter will ignore the following ASCII commands unless the login string is sent using the "Key Macros" function within HyperTerminal. Set up "Key Macros" to send the login string (see *Logging into the Meter* on page 4–5) followed by [ENTER].

NOTE

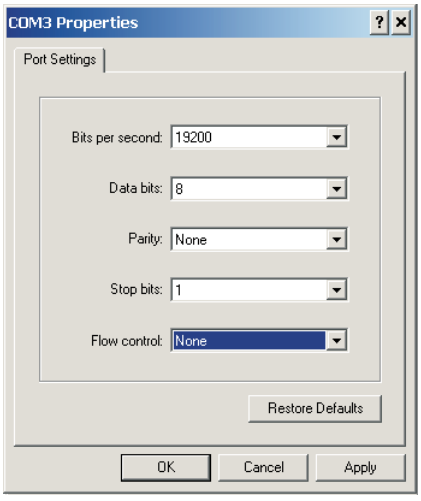
The login string must be sent without breaking up packets.
A direct connection from a serial port to the EPM 1000 RS485 port (via RS232/485 converter) is highly recommended. GE's Ethernet Gateway will break up this login string into packets and prevent login.

The EPM 1000 only allows login at 9600, 19200 or 38400 baud when NOT in Modbus mode. This is displayed as **HUNT** in the meter display under **Serial # Registers**. Once in Modbus, the EPM 1000 only responds at the programmed baud rate.

4.2.2 Configuring a New HyperTerminal Session

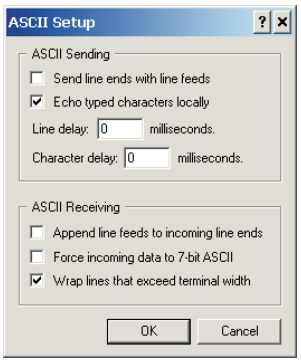
Use the following procedure to configure a new HyperTerminal session.

- ▷ **Enter the New Connection Name.**
- ▷ **Select the COM port to connect to the meter.**
- ▷ **Select the COM port properties.**
  The following window will appear – use the setting shown below.



- ▷ Select the **File > Properties > Settings > ASCII Setup** menu item.

▷ Check the **Echo typed characters locally** option, as shown below.



4.2.3 Confirming Connection to the EPM 1000

▷ To confirm a proper RS485 connection to the EPM 1000, enter the following command:

`attn -D` (followed by the [ENTER] key)

If meter is properly connected, it will respond with a serial number and poll address. Once in Modbus mode, this command will no longer work.

For example, entering the command

```
attn -D
```

followed by the [ENTER] key returns:

```
60005866 256
```

for a meter with serial number 60005866 and poll address 256.

4.2.4 Logging into the Meter

Use the following procedure to login to the EPM 1000.

▷ Setup a 'key macro' in HyperTerminal by selecting the **View > Key Macros** menu item.

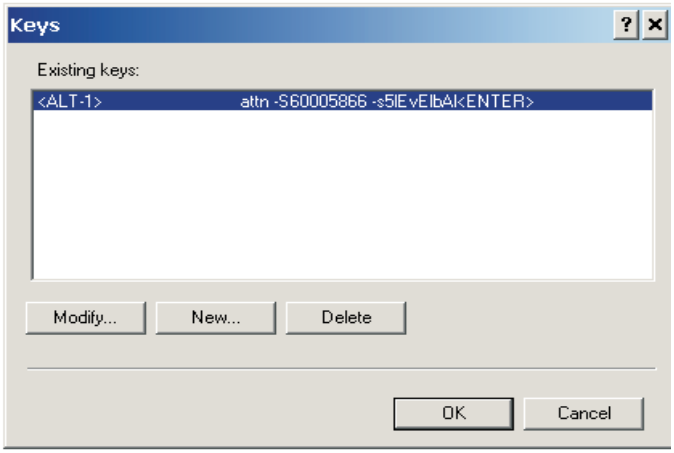
▷ Click **New** and select an appropriate macro key sequence (ALT-1 is used the example below.

▷ Enter the following command in the **Action** area:

`attn -S[`*`serialNumber`*`] -5lEvElbAl<ENTER>`

The password is `-s5` followed by the `LABLEVEL` text spelled backwards, with the vowels in upper case. This login string must be followed by the **ENTER** command within the key macro.

▷ For example, for a unit with serial number 60005866, enter the following text:



4.2.5 Activating Modbus Communications

Use the following procedure to activate Modbus communications.

▷ **Enter the following command to activate Modbus:**

`stty -M1` (followed by [ENTER] twice)

▷ **Select the baud rate by entering the following command. The baud rate options for Modbus communication are 9600, 19200, and 38400.**

`stty 19200` (followed by [ENTER] twice)

▷ **Save Modbus activation by entering:**

```
stty -W1234
```

▷ **Display Modbus activation by entering:**

```
stty
```

This command displays meter port setting, baud rate, etc. If Modbus is active, it returns "Modbus"; if Modbus is not active, it returns "no Modbus".

For example, consider the following set of commands sets the activates Modbus, sets the baud rate to 19200, and saves the Modbus activation. The text returned by the meter is also indicated.

```
CIP#stty
hunt 19200 baud 8 bits no parity no echo no modem no
modbus
CIP#stty -M1
CIP#stty 19200
CIP#stty -W1234
CIP#stty
hold 19200 baud 8 bits no parity no echo no modem modbus
```

4.2.6 Changing Modbus Settings

Use the following procedure to change the Modbus address setting:

▷ **Enter the following command to set the Modbus address:**

```
attn -p#
```

where **#** is replaced by the actual address desired (for example, `attn -p100`).

▷ **Save the Modbus address as follows**

```
attn -W1234
```

▷ **Enter the following command to display and verify the Modbus address:**

```
attn -d
```

This command displays the meter serial number and the poll/Modbus number.

4.2.7 Logging Out

Use one of the following commands to logout of the meter:

`attn` or `exit`

Once Modbus is set, it is best to type [HALT] followed by [ENTER] or cycle power to the meter. Otherwise, Modbus will become active one minute after logout.

To log into meter once Modbus is active, use hot keys to program the login sequence. The login sequence must include either the serial number or the Modbus address.

Example hot key sequences are shown below:

```
attn -S60005866 -3Super3
attn 256 -3Super3
```

4.2.8 Disabling Modbus Communications

Use the following procedure to disable Modbus communications:

▷ **Turn off Modbus with the following command:**

```
stty -M0
```

▷ **Save Modbus settings:**

```
stty -W1234
```

4.3 Modbus Memory Map

4.3.1 Memory Map

The Modbus memory map is shown below.

Table 4–1: Modbus Memory Map (Sheet 1 of 4)

Hex Addr	Addr	Description	R/W	Units	Notes
	Fixed Value Registers (Read Only)				
0000+	0000	Meter Serial Number	R		32-bit long integer
0002+	0002	Meter Serial Number Extension	R		Returns same value as address 0000 32-bit long integer
0004+	0004	Meter Version Number	R		32-bit long integer
0006+	0006	Meter Version Number Extension	R		Returns same value as address 0000 32-bit long integer
0008	0008	Meter Modbus Address	R	---	8-bit Modbus Address in LSB
	Setup Information				
0009	0009	Baud Rate	R		
000C	0012	Meter Status	R	---	Always 1 for Modbus.
000D	0013	Meter Ready	R	---	Always 1 for Modbus.
000E	0014	Number of Meters Configured	R	---	Always 1 for EPM 1000
000F	0015	Number of Real-Time Points Configured	R		
0010	0016	Number of Interval Points Configured	R		Returns 0 if intervals are disabled
0011	0017	Number of Max/Min Points Configured	R		Always returns 0
0012	0018	Maximum Number of Intervals That Can Be Recorded	R		Dependent upon the number of parameters optioned and the number of meters returned in address 0015
0013	0019	Number of slots configured for Transponder	R		
0014	0020	Current slot being read in Transponder	R/W		
	Interval Setup				
0031	0049	Store Interval Length	R/W	minutes	Interval length in minutes must be evenly divisible into 60 (1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60)
	Read Clock				
0032	0050	Internal Time - Hours/Minutes	R/W	hours/ minutes	16-bit, Hours: 0-23 (bitmask = FF00) Minutes: 0-59 (bitmask = 00FF
0033	0051	Internal Time - Seconds	R/W	seconds	
0034	0052	Internal Date - Month/Day	R/W	month/day	
0035	0053	Interval Date - Year	R/W	year	

Table 4–1: Modbus Memory Map (Sheet 2 of 4)

Hex Addr	Addr	Description	R/W	Units	Notes
0036	0054	Internal Time - Hours/Minutes	R/W	hours/ minutes	16-bit, Hours: 0-23 (bitmask = FF00) Minutes: 0-59 (bitmask = 00FF
0037	0055	Internal Time - Seconds	R/W	month/day	
0038	0056	Internal Date - Month/Day	R/W	Year	16-bit Unsigned Integer
0039	0057	Interval Date - Year	R/W		16-bit Unsigned Integer
003A	0058	Date/Time of Oldest Interval - Hours/Minutes	R/W	Hours/ Minutes	16-bit, Hours: 0-23 (bitmask = FF00) Minutes: 0-59 (bitmask = 00FF) DDE Data is COM Compatible, Date/Time Numeric
003B	0059	Date/Time of Oldest Interval - Month/Day	R/W	Month/Day	16-bit Month: 1=Jan., 12=Dec. (bitmask = FF00) Day: 1-31 (bitmask = 00FF) DDE Data is COM Compatible, Date/Time Numeric
003C	0060	Date/Time of Oldest Interval - Year	R/W	Year	16-bit Unsigned Integer
003D	0061	Date/Time of Newest Interval - Hours/Minutes	R/W	Hours/ Minutes	16-bit, Hours: 0-23 (bitmask = FF00) Minutes: 0-59 (bitmask = 00FF)
003E	0062	Date/Time of Newest Interval - Month/Day	R/W	Month/Day	16-bit Month: 1=Jan., 12=Dec. (bitmask = FF00) Day: 1-31 (bitmask = 00FF) DDE Data is COM Compatible, Date/Time Numeric
003F	0063	Date/Time of Newest Interval - Year	R/W	Year	16 Bit Unsigned Integer
0040	0064	Date/Time of Currently Selected Interval - Hours/Minutes	R/W	Hours/ Minutes	16-bit, Hours: 0-23 (bitmask = FF00) Minutes: 0-59 (bitmask = 00FF
0041	0065	Date/Time of Currently Selected Interval - Month/Day	R/W	Month/Day	16-bit Month: 1=Jan., 12=Dec. (bitmask = FF00) Day: 1-31 (bitmask = 00FF) DDE Data is COM Compatible, Date/Time Numeric
0042	0066	Date/Time of Currently Selected Interval - Year	R/W	Year	16 Bit Unsigned Integer
0043	0067	Data Ready Flag	R/W		16 Bits: Mask out/ignore Bit 15. 0=Data is ready for read 1=Populate registers with timestamp data 2=Invalid Timestamp Requested Stored Dynamic Data Ready for Read
	3-Phase Totaled Values				
0063	0099	Interval Data Qualifying Register	R		16-bit Unsigned Integer, 8 = Invalid Interval
0064	0100	3-Phase Totaled kW	R	kW	Stored Interval 1
0066	0102	3-Phase Totaled kvar	R	kvar	Stored Interval 2
0068	0104	3-Phase Totaled kVA	R	kVA	Stored Interval 3
006A	0106	3-Phase Totaled Power Factor	R	%	Stored Interval 4
	Metered Values				
0162	0354	Frequency (Phase A)	R	Hz	Instantaneous Frequency
016A	0362	Voltage (A-N)	R	V	Instantaneous Voltage
016C	0364	Voltage (B-N)	R	V	Instantaneous Voltage
016E	0366	Voltage (C-N)	R	V	Instantaneous Voltage

Table 4–1: Modbus Memory Map (Sheet 3 of 4)

Hex Addr	Addr	Description	R/W	Units	Notes
0170*	0368	Voltage (CT01)	R	V	Instantaneous Voltage
0172*	0370	Amps (CT01)	R	A	Instantaneous Current
0174*	0372	kW (CT01)	R	kW	Instantaneous Power
0176*	0374	kvar (CT01)	R	kvar	Instantaneous Reactive Power
0178*	0376	kVA (CT01)	R	kVA	Instantaneous Apparent Power
017A*	0378	Voltage (CT02)	R	V	Instantaneous Voltage
017C*	0380	Amps (CT02)	R	A	Instantaneous Current
017E*	0382	kW (CT02)	R	kW	Instantaneous Power
0180*	0384	kvar (CT02)	R	kvar	Instantaneous Reactive Power
0182*	0386	kVA (CT02)	R	kVA	Instantaneous Apparent Power
0184*	0388	Voltage (CT03)	R	V	Instantaneous Voltage
0186*	0390	Amps (CT03)	R	A	Instantaneous Current
0188*	0392	kW (CT03)	R	kW	Instantaneous Power
018A*	0394	kvar (CT03)	R	kvar	Instantaneous Reactive Power
018C*	0396	kVA (CT03)	R	kVA	Instantaneous Apparent Power
	Three-Phase Metered Values				
0288*	0648	3-Phase kWh	R	kWh	Real Time Input 1
028A*	0650	3-Phase kvarh	R	kvarh	Real Time Input 2
028C*	0652	3-Phase kW	R	kW	Real Time Input 3
028E*	0654	3-Phase kvar	R	kvar	Real Time Input 4
0290*	0656	3-Phase kVA	R	kVA	Real Time Input 5
0292*	0658	3-Phase Power Factor	R	%	Real Time Input 6
	Total Harmonic Distortion (THD)				
03E8*	1000	THD Phase A	R	%	Total Harmonic Distortion
03EA*	1002	Phase Angle A	R	degrees	Phase Angle
03EC*	1004	Phase-to-Phase Voltage A	R	V	Instantaneous Voltage
03EE*	1006	THD Phase B	R	%	Total Harmonic Distortion
03F0*	1008	Phase Angle B	R	degrees	Phase Angle
03F2*	1010	Phase-to-Phase Voltage B	R	V	Instantaneous Voltage
03F4*	1012	THD Phase C	R	%	Total Harmonic Distortion
03F6*	1014	Phase Angle C	R	degrees	Phase Angle
03F8*	1016	Phase-to-Phase Voltage C	R	V	Instantaneous Voltage
	Counters				
07D0	2000	Number of phases offset			16-bit Unsigned Integer 1, 2, 3, or 24 phases available

Table 4–1: Modbus Memory Map (Sheet 4 of 4)

Hex Addr	Addr	Description	R/W	Units	Notes
07D1	2001	Demand Window Offset			16-bit Unsigned Integer 5, 15, or 30 minutes available
07D2	2002	I Multiplier Type Offset			16-bit Unsigned Integer Internal calibration value
07D3	2003	Number of Pulse Counters Offset			16-bit Unsigned Integer Number of external pulse inputs installed
07D4	2004	Overlap Offset			16-bit Unsigned Integer Number of adjacent demand windows that are averaged to determine peak demand
07D5	2005	Number TOU's Offset			16-bit Unsigned Integer Number of different TOU periods defined in the time-of-use table
07D6	2006	MDT_M_TABLE_REG_START			16-bit Unsigned Integer
07D7	2007	NUM_MDT_M_TABLE_COLUMNS			16-bit Unsigned Integer
07D8	2008	NUM_MDT_M_TABLE_REGS			16-bit Unsigned Integer
07D9	2009	MDT_M_TABLE_REG_END			16-bit Unsigned Integer

* 32-bit floating point register.

+ 32-bit long integer - Range: 00000000h to FFFFFFFFh

1. 32-bit floating point numbers are as per the IEEE 754-1985 standard.
2. Registers 0X0063 to 0X025E are all read-only and cannot be modified. They break down as follows:
    - Registers 0X0064 to 0X0122 are not real-time, but are populated with stored interval data based on user inputs to registers 0X0040 to 0X0043.
    - Registers 0X0162 to 0X025E are all real-time data registers.

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EPM 1000 Single Point Submetering System

Chapter 5: Miscellaneous

5.1 Revision History

5.1.1 Release Dates

Table 5–1: Release Dates

MANUAL	GE PART NO.	EPM 1000 REVISION	RELEASE DATE
GEK-106554	1601-0155-A1	1.0x	21 May 2004
GEK-106554A	1601-0155-A2	1.0x	20 October 2004
GEK-106554B	1601-0155-A3	1.0x	1 December 2004
GEK-106554C	1601-0155-A4	1.0x	14 February 2005
GEK-106554D	1601-0155-A5	1.0x	08 April 2005
GEK-106554E	1601-0155-A6	1.0x	30 June 2006
GEK-106554F	1601-0155-A7	1.0x	15 November 2007

5.1.2 Changes to the Manual

Table 5–2: Major Updates for 1601-0155-A7 (Sheet 1 of 2)

PAGE (A6)	PAGE (A7)	CHANGE	DESCRIPTION
Title	Title	Update	Manual part number to 1601-0155-A7

Table 5–2: Major Updates for 1601-0155-A7 (Sheet 2 of 2)

PAGE (A6)	PAGE (A7)	CHANGE	DESCRIPTION
3-5	3-6	Update	Text change re on-screen copyright statement
4-7	4-8	Update	Changes to Modbus Memory Map

Table 5–3: Major Updates for 1601-0155-A6

PAGE (A5)	PAGE (A6)	CHANGE	DESCRIPTION
Title	Title	Update	Manual part number to 1601-0155-A6
4-1	4-1	Update	Updated RS485 WIRING FOR MODBUS section
4-2	4-2	Add	Added RS232 WIRING FOR MODBUS section

Table 5–4: Major Updates for 1601-0155-A5

PAGE (A4)	PAGE (A5)	CHANGE	DESCRIPTION
Title	Title	Update	Manual part number to 1601-0155-A5
4-3	4-3	Update	Updated MODBUS ACTIVATION section

Table 5–5: Major Updates for 1601-0155-A4

PAGE (A3)	PAGE (A4)	CHANGE	DESCRIPTION
Title	Title	Update	Manual part number to 1601-0155-A4
---	4-1	Add	Added RS485 WIRING FOR MODBUS section

Table 5–6: Major Updates for 1601-0155-A3

PAGE (A2)	PAGE (A3)	CHANGE	DESCRIPTION
Title	Title	Update	Manual part number to 1601-0155-A3
4-3	4-3	Update	Updated MODBUS ACTIVATION section

Table 5–7: Major Updates for 1601-0155-A2

PAGE (A1)	PAGE (A2)	CHANGE	DESCRIPTION
Title	Title	Update	Manual part number to 1601-0155-A2
1-3	1-3	Update	Updated OPERATING SPECIFICATIONS
---	2-7	Add	Added CT TERMINATIONS FOR 1600 A AND 3200 A MODELS diagram
2-8	2-8	Update	Updated INTERNAL SHORTING TERMINAL diagram and renamed to INTERNAL FUSE BLOCK
---	4-1	Add	Added MODBUS COMMUNICATIONS chapter

5.2 Warranty

5.2.1 GE Multilin Warranty

General Electric Multilin (GE Multilin) warrants each device it manufactures to be free from defects in material and workmanship under normal use and service for a period of 24 months from date of shipment from factory.

In the event of a failure covered by warranty, GE Multilin will undertake to repair or replace the device providing the warrantor determined that it is defective and it is returned with all transportation charges prepaid to an authorized service centre or the factory. Repairs or replacement under warranty will be made without charge.

Warranty shall not apply to any device which has been subject to misuse, negligence, accident, incorrect installation or use not in accordance with instructions nor any unit that has been altered outside a GE Multilin authorized factory outlet.

GE Multilin is not liable for special, indirect or consequential damages or for loss of profit or for expenses sustained as a result of a device malfunction, incorrect application or adjustment.

For complete text of Warranty (including limitations and disclaimers), refer to GE Multilin Standard Conditions of Sale.

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