PowerMaster® 3 Series

Firmware Version 2.1.2.1

Product Manual

Revision 1.8

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Contacting Powermetrix

General

For general information regarding Powermetrix products and services, contact one of the following representatives listed on the website at https://www.powermetrix.com/contact-us/contact-partners/.

Technical Support

For technical support, please contact the factory at (865) 966-5857 and press #3 for Technical Support. You may alternatively email Powermetrix at support@powermetrix.com. The support staff will answer questions about the operation and care of your equipment, assist you in troubleshooting a problem, and help you overcome common application difficulties whenever possible. If it becomes necessary for your equipment to be returned to us for any reason, you will be issued an RMA number during the technical support contact.

Feedback

Powermetrix depends on information from our customers to continue the attributes of quality, dependability, and simplicity associated with our products. We invite you to contact our Technical Support office.

Calibration and Certification

Your Powermetrix equipment is calibrated and certified effective the date of shipment. Powermetrix requires the unit to be calibrated by Powermetrix or a Powermetrix authorized service facility on an annual basis to insure accuracy and currency of installed electronic components. In addition, current and voltage probes are also required calibration on an annual basis or when dropped, damaged, or suspect of improper operation. The unit is identified as calibrated by a sticker stating the date of calibration and next due date of calibration. A certificate of calibration is provided to you to verify compliance to inspectors. A permanent record of your calibration is maintained by Powermetrix. For information on calibration services, contact Powermetrix Technical Support.

Additional services to be included at no additional charge during annual calibration:

1. Inspection of probes, cables, and internal circuit boards
2. Proper maintenance and/or prevention to any suspect components
3. ECN's (Engineering Change Notices)
4. Update firmware
5. Reproducibility report for clamp-on probes
6. Service Report for all work completed

Warranty

PowerMaster® 3 Series Warranty

TEC/Powermetrix Division warrants the POWERMASTER® product to be free of defects in material and workmanship for a period of two (2) years following the purchase date. The warranty covers the POWERMASTER® provided it is properly used, stored and maintained in accordance with provisions in the User Manual. Items not covered under the warranty policy include (but not limited to) cracked or broken LCD, water damage, and neglect to the battery (see Section 2.5).

Annual calibration at the Knoxville TN factory is required to maintain the validity and terms of this warranty. Please call TEC-Powermetrix Division at (865)966-5857 to obtain an RMA number and form prior to any return of equipment for service or recalibration. Your POWERMASTER® unit will alarm you when it is time for a recalibration. Please send your unit in at this time. If an annual calibration is not maintained for over one (1) year from either the purchase date or the last calibration date (within a maximum of two (2) years from purchase date), the warranty is null and void. To re-enter the warranty period, the customer must send the POWERMASTER® in for calibration cost. At this time the warranty period is valid for one (1) year from calibration date, as long as the two (2) year time period has not exceeded the purchase date. If a repair is required while the POWERMASTER® is within two (2) years from purchase date, but outside one (1) year of last calibration, the customer has the option of paying for the repair cost or paying for the annual calibration cost to be re-instated into the warranty period (within a maximum of two (2) years from purchase date). If the POWERMASTER® is outside the purchase date of two (2) years, the cost of the calibration and/or repair service will be at the customer's expense.

Safety

⚠ WARNING

Operation of the PowerMaster® and the supplied accessories and adapters can present the user to potentially hazardous conditions. Please follow all required safety procedures set forth by the user's safety organization within the company. If no safety organization exists, please follow all applicable OSHA rules and standards for PPE (Person Protective Equipment) when working in high voltage and low voltage environments. This equipment should be used by trained and qualified personnel ONLY.

The protection rating is reinforced insulation per IEC 61010-1 3rd Edition (2010-06), Category IV 600V.

Per IEC 61010-1 3rd Edition –

Measurement Category IV (CAT IV) is for equipment installed at or near the origin of the electrical supply to a building, between the building entrance and the main distribution board. Such equipment may include electric power meters, current transformers, and potential transformers.

Probes - only use probes meeting the manufacturer's specifications. Using probes that do not meet the manufacturer's specifications may be a safety hazard or could invalidate the product warranty.

Making Connections

1. Press the PowerMaster® ON key, and wait until the Main Menu is displayed.
2. Connect the voltage leads, current leads, and CT probes to the metering service.
3. Proceed with testing.

Safety Tips for Testing:

1. The jack screws used to secure the banana cables to the DIRECT CURRENT connector MUST be screwed down at all times during testing. This process prevents the possibility of arc flash from an open secondary in situations where the current leads become free of the front panel while still inserted into the test switch
2. Verify the probe is rated for the voltage and current being tested (see Section 2.7 for probe specifications). Only use probes meeting the manufacturer's specifications. Using probes that do not meet the manufacturer's specifications may lead to a safety hazard.
3. Never connect a probe around a conductor or connect to a live terminal before terminating it to its cable and to the PowerMaster®.
4. For LiteWire probes, verify the fiber optic cable is clean to prevent surface arcing. For cleaning and maintenance information, refer to the Amp LiteWire or Volt LiteWire manual supplied with the probe.
5. When using LiteWire probes, verify the hot stick being used has been certified previously to prevent high voltage arcing.

6. When inserting duck bill probes into a test switch, short the CT secondary (+) first by pulling the test switch in an open position. This will prevent possible arcing.
7. For clamp-on probes, clean contact surfaces and then snap and release the jaws to verify a metal-to-metal contact of the jaws (dirt and grease may contaminate the surfaces).
8. For flexible probes, take care to pad mount CT installations. Always wear appropriate PPE when inside the CT installation.
9. For pad mount CT installations, be wary of various items around the installation (chairs, tables, etc.) which can potentially become a safety hazard.

Battery Safety Tips

⚠ WARNING

Using the Battery

1. Any misuse of the Lithium Ion battery that leads to overheating, rupture, or ignition may cause serious injury. Follow the safety rules below:
    a. Keep the battery from fire or heat
    b. Do not reverse the polarity of the battery
    c. Do not allow the battery terminals to connect to each other
    d. Do not store the battery with other metal objects
    e. Do not subject the battery to high impacts, strike the battery, step on the battery, or puncture the battery
    f. Do not solder directly onto the battery
    g. Do not subject the battery to water or salt water. Do not immerse the battery or allow it to get wet.
    h. Do not take apart, tamper with, or rework the battery. This could damage the safety and/or protection devices which could cause the battery to produce heat, rupture, or ignite.
    i. Do not allow the battery on or near fire, stoves, or high temperature areas. Do not place the battery in direct sunlight or store the battery inside cars that may exceed 140°F (60°C). Doing so may cause the battery to produce heat, rupture, or ignite. Additionally, it may result in the loss of battery performance and shortened life expectancy.

⚠ CAUTION

2. Immediately stop battery usage if, while using or storing, the battery emits an unusual smell, feels hot, discolors, changes shape, or appears abnormal in any other way. Contact Powermetrix if any of these problems are observed.
3. Do not place the battery inside microwave ovens, high-pressure containers, or on induction cookware.
4. Should the battery leak and fluid gets into a person's eye, do not rub the eye. Rinse well with water and immediately seek medical care. If left untreated the battery fluid could cause damage to the eye.

⚠ WARNING

Charging the Battery

1. Be sure to follow all the rules while charging the battery. Any breach may cause the battery to overheat, rupture, or ignite and cause serious injury.
    a. When charging the battery, only use the specified battery charger from Powermetrix.
    b. Do not attempt to charge the battery using a power supply plug or a vehicle cigarette lighter.
    c. Do not place the battery in or near fire, or in direct sunlight. When the battery becomes hot, the installed safety equipment is triggered which prevents the battery from continuing to charge. Additionally, heating the battery can damage or destroy the safety equipment and cause further heating, breaking, or ignition of the battery.
2. Do not continue to charge the battery if it does not recharge within the specified charging time. Doing so may cause the battery to become hot, rupture, or ignite.

⚠ CAUTION

3. The temperature range over which the battery can be charged is 0°C to 40°C. Charging the battery at temperatures outside of this range may cause the battery to become hot to break. Charging the battery outside of this temperature range may also harm the performance of the battery or reduce the battery's life expectancy.

⚠ WARNING

Discharging the Battery

1. Do not discharge the battery using any device except for the specified device. When the battery is used in devices aside from the specified device it may damage the performance of the battery or reduce its life expectancy, and if the device causes an abnormal current to flow, it may cause the battery to become hot, rupture, or ignite and cause injury.

⚠ CAUTION

2. The temperature range over which the battery can be discharged is -20°C to 50°C. Us of the battery outside of this temperature range may damage the performance fot he battery or may reduce its life expectancy.

⚠ WARNING

Disposal of the Battery

1. Please dispose of the battery by taking it to a local recycling center that can handle lithium ion batteries. Many hardware and home improvement stores offer this service at no charge.

Maintenance of Unit

Cleaning
Clean the case with a damp cloth with mild detergent. Do not use abrasives or solvents.

Calibration
Powermetrix or a Powermetrix authorized service facility recommends calibration on an annual basis to insure accuracy and currency of installed electronic components.

Firmware Release Notes

Product:	PowerMaster® 3 Series and Accessories
Release Date:	4/26/19
Firmware Version:	2.1.2.1
Windows CE (BSP):	2.3.0.0.120620
Database:	2.4
Meter Site Manager:	2.5.4.8 or later
3302 FPGA:	0.2.5
3302 PIC Firmware:	1.0.0.3
3xx FPGA	0.0.0.5
3xx PIC Firmware	0.5.1.2
3xx Boot Loader	3.1.1.0.180720

What's New:

1. Added a new feature to Customer Load Meter Test to show average power values (W, VA, VAR) calculated pulse to pulse. This information is for reference only and is not saved in the database or shown in reports currently.
2. Added a new feature to Customer Load Meter Test to toggle Power Factor calculations using Vector math or an Arithmetic method. This feature is available after the meter test is complete and operated by using a soft key. This feature can be turned off or on in the Preferences menu, with a default mode of "off" being enabled. This information is for reference only and is not saved in the database or shown in reports.
3. Added a new feature to the Vector Diagram and Power Table that adds an option of phase angle display to either 0/360 or -180/180. This feature can be turned off or on in the Preference menu (Lead/Lag Angle), with "Positive" (0/360) as a default value.
4. For the Model 303 or 335, fixed a bug to increase the maximum current allowed when performing a Ratio Only test to 20A secondary max. If the 3 Series detects currents that are beyond the maximum limit, the test will not proceed. Burden Only and Burden + Ratio are still limited to 10A secondary max at 0.5 Ω.
5. For the Model 303, 305, or 335, fixed a bug in Integrated Site Test that forced a Burden + Ratio test even if Burden Only was selected.
6. For the Model 305 and 335, fixed a bug in Phantom Load Meter Test where the current source continues to drive until F6 is pressed to complete the test. Instead, the current source will shut off at the end of the last meter test.
7. Fixed a bug in the 3-Wire Delta wiring diagram that now shows the Neutral and B phase voltage leads connected to the same reference phase.

1 Introduction

The PowerMaster® 3 Series is a handheld field instrument with a true 3-phase analyzing standard. There are two versions of the 3 series, the 3301, and the 3302. The 3301 has the ability to do customer load meter testing, register and demand testing, and provides access to vector diagrams, waveforms, and harmonics. The 3302 has the same ability, but also adds CT and PT burden measurement, CT and PT ratio testing, and direct current inputs.

Accuracy

With an accuracy of ± 0.05% on direct current channels and ± 0.10% accuracy on the probe channels, the PowerMaster® is 4 times more accurate than most meters.

User Interface

The user interface is a Windows CE based program that enables the user to perform complex tasks with an easy-to-use dashboard. This allows the user to either select the appropriate test within the list, or select "Integrated Site Testing" which incorporates all tests together in a step-by-step process. Hot keys on the front panel are used as shortcuts to quickly view the vector diagram, power meter, waveforms, and harmonics at any time during testing. With features designed to help the meter technician with their job, this user interface is a tool for beginners to metering that normally was designated to seasoned technicians and engineers only.

Integrated Site Testing

Using Integrated Site Test, the user can easily test the entire site using a step-by-step process that eliminates mistakes and proves the installation is operating accurately. Integrated Site Test allows the user to perform tests in sequence that are built into the PowerMaster®. The user will have the option to customize each test for a particular site, which can be associated to any site in the database. These test setups can be created and customized as many as required.

Instrument Transformer Testing

Some of the most powerful features of the PowerMaster® are in the Instrument Transformer Testing section. The PowerMaster® 3302 has the ability to sequentially test all three CTs and PTs in the metering circuit. Using the Hot Keys, the user can quickly view the power pairs (secondary and primary) for diagnostics. Each test displays the graphs of the ratio and the parallelogram for all phases on one page. A brand new feature limited to the 3302 as well is the ability to measure the total burden on the circuit. With a simple quick test, the total burden of the CT circuit can be measured and analyzed to determine the potential for an overburdened CT.

Customer Load Meter Testing

In accordance with ANSI C-12.1-2001 using Method 3 (5.1.5.3), a customer load test can be performed. The PowerMaster® can determine within seconds how accurate the meter is under real-world conditions. Determining this accuracy is incredibly valuable since the customer is being billed under these conditions.

Phantom Load Meter Testing

When using the Model 303 or 335's true 3-Phase current source, the PowerMaster® can simulate a phantom load meter test with an accuracy (± 0.05%). The user interface allows the ability to select a pre-loaded setup or create a custom setup. Testing can be done under many varying conditions including active and reactive energy, and delivered or received energy flow. Without removing connections, a phantom load test can be performed while the meter is in the socket. The currents are injected with the standard lead sets (alligator current lead set available), so there is no need to change leads in the middle of a test. Also, the Model 303 and 335 introduces the ability to generate six different types of current waveforms to be utilized under phantom load field testing conditions For meters without a test switch, various meter base adapters are available. .

Hot Keys

The user can easily access important functions at any time in the PowerMaster® with a push of a button. The 1) vector diagram, 2) power meter, 3) waveforms, and 4) harmonics all have dedicated buttons on the PowerMaster® front panel. These keys can be alternatively accessed using a PC/laptop or USB keyboard via function keys (F7-F10 respectively).

Database

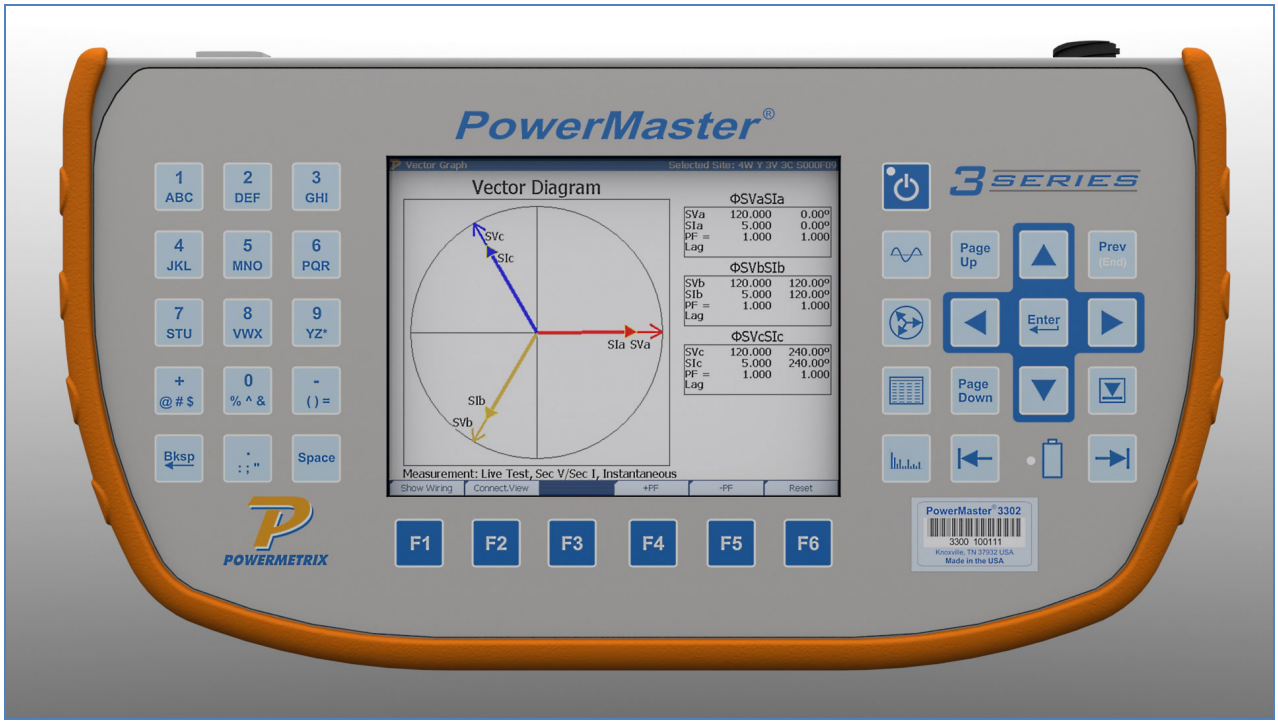
The PowerMaster® has a built-in SQL database that can hold all information pertaining to the site including (but not limited to) the meter, CT, PT, AMR, account number, address, substation, GPS locator, billing multiplier, and when the site needs to be tested again. The user can easily select a pre-loaded component (meter, CT, PT, etc.) from our large database or create a new component to be associated to each metering site. Using the Meter Site Manager PC software, this information along with data results can easily be synchronized to the master database or formatted into a .csv or .txt file for exporting into the utility's master database. The real power of having a built-in database inside the PowerMaster® is the ability to create a daily "route" of tests for the user that can be setup in the shop (or synched from Meter Site Manager) before going into the field.

Hardware

The PowerMaster® can be stored in a compact Pelican case, which is waterproof, weather tight, and extremely rugged. The large buttons are on a tactile key panel creating a splash-proof membrane. A keyboard and mouse can be alternatively used instead of the key panel, which allows the user the freedom of operating the PowerMaster® identical to a PC. Implementing a 5.7 inch, full color transflective VGA display allows the user to view the data and operate much easier in full sunlight. It also prevents eye strain found in other products with small, black and white displays.

2 Product Description

This section gives the user a brief tour of the PowerMaster®. It describes the various keys and their functions, the input and output ports, and the standard accessories supplied with the PowerMaster®. Optional accessories are discussed later in Section 2.7.



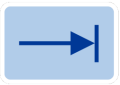
2.1 Keypad

The PowerMaster® keypad uses 37 function keys. Descriptions of all keys are discussed below:

To turn the system on, press and hold down the Power key located at the top right of the PowerMaster® screen until the green LED embedded in the key turns green. Once powered, pressing the Power button again turns the system OFF. The PowerMaster® incorporates a power conservation function. If no activity (keystroke) occurs within 1 minute following the Power keystroke, the PowerMaster® will go into "sleep" mode in which the display is turned off. Any tests in process will not be affected. To restore the display press any key.

The HOT KEYS are used to quickly access the power data at any time while using the PowerMaster®. All hot keys are located to the right of the display. The key functions are: 1) waveform display, 2) vector analysis, 3) power meter, and 4) harmonics, respectively. For more information on the hot keys, see Section 8.

The Function keys (F1 - F6) are located directly below the PowerMaster® display. Six rectangular boxes on the display directly above the function keys define their use as it corresponds to each screen. The purpose of each key may change from screen to screen. If any of the screen boxes are blank, the box's corresponding key has no function in that screen.



The TAB key moves the cursor from one field to the next field.

The BACK TAB key moves the cursor from one field to the previous field.

The DROP-DOWN key enters the drop-down box menu once the cursor is focused on that field. All available selections are displayed at the time of keystroke. This key also checks and un-checks checkboxes. Press the key a second time to select an item and close the dropdown list.

The PREVIOUS key is used to allow the user to go back to the previous screen. Continually pressing this key will always take the user back to the Main Menu.

The DIRECTIONAL keys are used to move the cursor up or down in a menu selection. Also, the keys are used to make selections in a drop-down box. These keys can be used alternatively to view selections in a drop-down box without having to press the DROP-DOWN key.

The BACKSPACE key will delete one character at a time in a reverse direction OR delete the text in the field entry all together if highlighted

PAGE UP and PAGE DOWN keys are used to move the screen either up or down one page. This function is available if information exceeds the first page of the screen.

The ENTER key is used to accept data or a menu selection.

The SPACE key is used to place a space in between text fields and can also be used to check/uncheck checkboxes.

The ten alphanumeric keys (0 through 9 / A through &) are used to input alphanumeric values into the PowerMaster®. A single press followed by a one-second delay returns the numeric value (first character of the key. Two rapid presses followed by a one second delay returns the second character (first of the three alpha characters) of the key. Three or four rapid presses followed by a one-second delay returns the third or fourth (second or third alpha) characters of the key, respectively. For example, if you want to type the letter “N” which is the third character on its corresponding key, press the key three times rapidly, and then stop for one second. The letter “N” will appear on the screen.

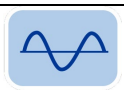
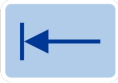
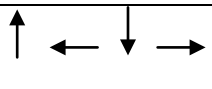
The symbols keys operate the same as the alphanumeric keys. These keys will normally be used when entering notes and comments in the PowerMaster®. Note the “period” key (second from left) is used to help enter the Kt value of the meter (ex. 1.8 Kt).

The battery indicator is located on the unit’s front panel and features four notifications.

1. Charging: Light blinks green
2. Fully Charged: Solid Green
3. Almost Depleted: Yellow
4. Battery Dead: Red. At this point the unit shuts down and will not turn on until A/C power is reconnected.

2.2 Keypad and USB Keyboard Use Table

The PowerMaster® allows the user to input a USB keyboard & mouse to alternatively operate the unit. The USB keyboard & mouse is used by connecting to one of the USB ports labeled "USB." The following table is an explanation for each corresponding key on the PowerMaster® keypad.

Label	PowerMaster® Key	USB Keyboard & Mouse Key
Power		N/A
Waveform hot key		F7
Vector hot key		F8
Power Meter hot key		F9
Harmonics hot key		F10
Function keys		F1 – F6
Tab key		Tab
Back Tab key		Shift, Tab
Drop-Down key		Num Lock, 5
Previous key		End
Directional keys		
Backspace key		Backspace
Page Up, Page Down		Page Up, Page Down

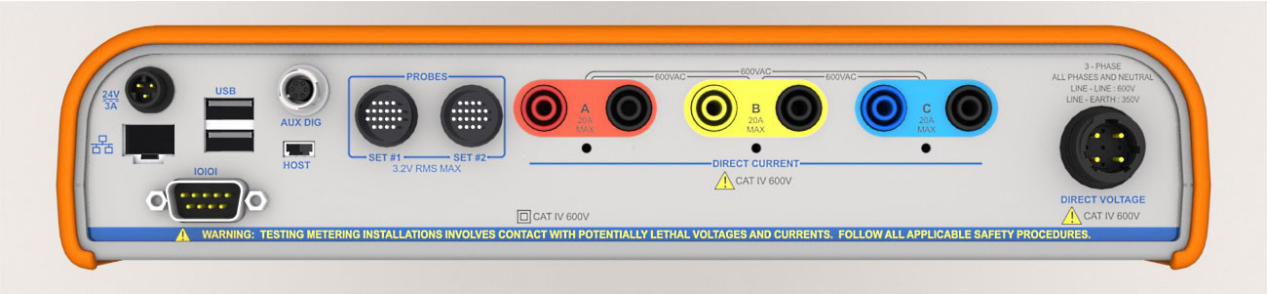
Enter key		Enter
Space key		Space bar
Alphanumeric keys (Numbers)		1 - 0
Alphanumeric keys (Letters)		A - Z
Symbol keys		-, (,), =, ., :, ;, “, +, @, #, $

2.3 Screen

The full graphics Liquid Crystal Display (LCD) screen is how the PowerMaster® communicates with the user. In computer technology, the screen is the "graphical user interface (GUI)." The screen displays messages, menus, selection lists, and graphic illustrations.

The display is 5.7" in diameter. It is a full-color VGA (video graphics array) with a resolution of 640 x 480 pixels. A thin piece of clear polycarbonate material is used to protect the screen and is mounted on top of the display.

2.4 Connector Panel



DIRECT CURRENT

The direct current connector provides direct access to the current inputs of the measuring standard. The standard current lead set has 3 pairs of banana cables with three test switch probes ("duckbill") for phases A, B, C. These probes are meant to insert into the test switch of a CT rated installation. The three AC current inputs are rated at 20 amps each.

⚠ WARNING

The jack screws used to secure the banana cables to the front panel assembly MUST be screwed down at all times during testing. This process prevents the possibility of arc flash from an open secondary in situations where the current leads become free of the front panel while still inserted into the test switch.

DIRECT VOLTAGE

This connector provides direct access to the voltage inputs of the measuring standard. The standard voltage lead set has a 6.5 ft. lead terminated with four banana jacks and alligator clips for phases A, B, C, N. The phase voltage inputs are intended to connect to the potentials of the metering installation. The four voltage measurement inputs are rated at 600Vac Line to Line, and 350Vac Line to Neutral.

PROBES SET #1 & SET #2

These connectors are used for all other probes (not including the test switch probes). The input connects to a 3-phase clamp-on probe cable that is terminated with three connectors. One each for phases A, B and C. They are color-coded red, yellow and blue respectively. When probes are connected on the end of the 3-phase clamp-on probe cable, the PowerMaster® recognizes the type of probe and calibration detail. To use clamp-on current probes for secondary current measurements connect them to Set 1. Secondary current probes are normally the MN375 probes. If the secondary probes are connected to Set 1, probes used for CT and PT

measurements will be connected to Set 2. If you wish to use three probes for simultaneously measuring the primary currents for CT testing connect all three to the same Set.

When testing sites with CTs the user would normally use the CURRENT direct inputs to measure the secondary currents and probes connected to Set 1 to measure the primary currents. In cases where a test switch is not available a set of MN375 probes would be connected to Set 1 for measuring secondary current and another set of probes (FLEX current probes or Amp LiteWire) would be connected to Set 2 to measure primary current. By using two separate probe sets, the user can view both the secondary and primary currents without moving or changing connections.

For self-contained meters connect the current probes (MN353, SR752, or FLEX) to Set 1.

Specifications for available probes can be found in Section 2.7.

AUX DIG

This external port is for meter testing pickups. All pickups are terminated with the 6-pin locking connector. It can also be used as a calibration pulse input and output.

USB

These two USB ports are used for external USB devices. Examples of these devices are a keyboard, mouse, or memory storage device

HOST

This port is for a MINI USB cable (standard accessory) for connectivity to a host computer. This port is used to communicate with the PowerMaster® PC software Meter Site Manager 2.

10101

This port is for legacy devices that may use the RS-232 connectivity. Currently not used.

ETHERNET

This port is for a high speed connection used in factory calibration settings.

24V/3A

This port is for connection for the 24V, 2.7A power supply for the purposes of charging the internal battery. With the power supply, the input can accept external connections from 100-240VAC.

2.5 Battery

The PowerMaster® features a PTO1661 10.8V, 3.07Ah Lithium-Ion (Li-Ion) rechargeable battery pack internal to the unit. The charging circuit inside the PowerMaster® is considered to be a "fast charging" circuit. This circuit operates when 24V/3A is connected.

Battery Safety
Please refer to the Battery Safety Tips section at the beginning of the manual for battery safety information.

Charging the Battery
To charge the battery, connect the power supply adapter to the 24V/3A connector on the PowerMaster® and plug into a normal AC power outlet.

Battery Voltages
The maximum voltage of the battery at full charge (100%) is 12.3V. When the battery voltage reaches 10.5V, the PowerMaster® battery indicator will turn yellow. When the battery voltage reaches 9.5V, the PowerMaster® will automatically power off to prevent permanent damage to the battery. To view the battery voltage, at the Main Menu, enter Utilities. Next, enter Status, then F2 (Internals).

Charge Life
With a full charge (100%), the battery will last between 7-8 hours. During data acquisition with the LCD backlight at full power, the battery will last between 3-4 hours.

Charging Time
A full charge to the battery from a minimally charged state (10%) will take 2-3 hours.

Battery Life
The PowerMaster® battery should last 1 year with heavy use (400+ charge cycles). The battery can be replaced in the field without requiring the unit returning to the factory.

Replacing the Battery

Unscrew the battery door on the rear of the unit. Take the battery out of the compartment to expose the battery connector. Press against the hinged connector and pull gently to remove. Plug in the new battery, making sure the hinged connector locks in place. Place the battery in the compartment and replace the battery door. Screw the door lid shut. Take the old battery to a local recycling center for disposal. Many hardware and home convenience stores offer this service at no charge.

Only use the 3 Series replacement battery from Powermetrix. Use of any other battery may damage the unit and is not covered by warranty.

2.6 Standard Accessories

The PowerMaster® base unit comes with the following standard accessories:

Part Number	Product	Notes
10-340-3103	3 Series Direct Voltage Cable	Terminated with banana jacks to allow user customization. Rated at 350/600Vac max.
10-340-3103	3 Series Probe Cable	Used for connection to all current and voltage probes.
10-340-3101	3 Series Current Cable w/Duckbill Probes	These probes are used for insertion of a test switch. They are rated at 350/600Vac, 0.1-20A max.
10-100-3334	Magnetic IR Pulse Detector for 3 Series	For interfacing to a metallized pulse output of solid state meters with an infrared light
10-100-3345	IR Pulse Detector with Flexible Arm for 3 Series	For interfacing to the pulse output of solid state meters with an infrared light. Used for meters with a non-metallized pulse output.
75-800-3000	Mini USB Communication Cable	USB cable for communication to a computer
10-340-3104	Power Supply (North America)	For charging the PowerMaster® battery using a wall outlet.
10-310-0000	CD	Compact disc including software to be used on a PC or laptop (Meter Site Manager 2) and the product user manual

2.7 Optional Accessories

The accessories listed below are not included in the standard accessories package with the PowerMaster® base unit. These accessories are purchased as separate items. As more features become available, more accessories will be available for purchase.

⚠ WARNING

Only use probes meeting the manufacturer's specifications. Using probes that do not meet the manufacturer's specifications may lead to a safety hazard.

CURRENT PROBES

10-140-0353 MN353 Clamp-On Probe

These probes are normally used if no test switch is present or for testing a class 200 self-contained meters.

Range	0.1 – 150A
Max Voltage	600V
Opening	0.83" (21mm)
Accuracy	TBD

10-140-0375 MN375 Clamp-On Probe

These probes are normally used if no test switch is present.

Range	0.1 – 10A
Max Voltage	600V
Opening:	0.83” (21mm)
Accuracy:	TBD

10-140-0752 SR752 Clamp-On Probe

These set of clamp-on probes are normally used for class 200, 400, and 600 self-contained meter testing or CT ratio testing.

Range	0.001 – 1200A
Max Voltage	600V
Opening:	2.25” (57mm)
Accuracy:	TBD

10-140-1036 36” Flexible Current Probe 3000A

These probes are normally used for used for class 200, 400, and 600 self-contained meter testing or CT ratio testing. Other current ranges available upon request.

Range	5 – 3000A
Max Voltage	600V
Opening:	N/A
Accuracy:	TBD

10-140-1048 48” Flexible Current Probe 3000A

These probes are normally used for used for class 200, 400, and 600 self-contained meter testing or CT ratio testing. Other current ranges available upon request.

Range	5 – 3000A
Max Voltage	600V
Opening:	N/A
Accuracy:	TBD

10-140-30K48 48” Flexible Current Probe 30,000A

These probes are normally used for used for class 200, 400, and 600 self-contained meter testing or CT ratio testing. Other current ranges available upon request.

Range	5 – 30,000A
Max Voltage	600V
Opening:	N/A
Accuracy:	TBD

10-140-8016 Amp LiteWire Probe

These probes are normally used for used for CT ratio testing. They can be used for high voltage (> 600V) or low voltage (< 600V) installations.

Range	1 – 2000A
Max Voltage	150,000V
Opening:	N/A
Accuracy:	TBD

10-140-8014 Volt LiteWire Probe

These probes are used for used for PT ratio testing. They can measure phase to ground, or phase to phase measurements.

Range	1 – 40,000V
Max Voltage	40,000V
Opening:	N/A
Accuracy:	±2% of reading

CURRENT & VOLTAGE DIRECT LEADS

10-340-3103 3-Phase Voltage Cable
Terminated with banana jacks to allow user customization. They are rated at 350/600Vac max.

10-340-3101 3-Phase Test Switch Current Direct Probes
These probes are used for insertion of a test switch. They are rated at 350/600Vac, 0.1-20A max.

10-340-3102 3-Phase Current Lead Set (terminated with banana jacks)
This lead set is used for direct connections to the current circuit of the meter. Banana jack termination allows user customization of leads.

CABLES & ADAPTERS

10-340-3100 3-Phase Probe Adapter Cable
Used for connection to all current and voltage probes

10-340-0026 15 Foot Probe Extension Cable
This cable is terminated with 8-pin connectors. Multiple cables can be connected serially for longer lengths with a maximum length of 45 feet. Any type of probe can be used with this extension cable.

10-340-0025 BNC to PowerMaster Probe Adapter Cable
For connection to High Voltage Amp or Volt LiteWire probe

75-700-2001 40' Fiber Optic Replacement Cable
For High Voltage Amp and Volt LiteWire Probes

SPARE PARTS

29-100-3100A Li-Ion Battery Pack
Replaceable PTO1661 10.8V, 3.07AHr Lithium-Ion (Li-Ion) rechargeable battery pack

Z3302-CASE Hard Carrying Case for PowerMaster Unit and Accessories
Rugged, watertight case. Includes fitted foam insert.

EP10-320-3309 RS232 Cable Assy – comm.

75-800-3000 Mini USB Cable

75-300-9001 Replacement clip for Flexible Current Probes

50-950-0001 White Alligator Clip

50-950-0002 Black Alligator Clip

50-950-0003 Red Alligator Clip

50-950-0004 Yellow Alligator Clip

50-950-0005 Blue Alligator Clip

50-950-0006 Green Alligator Clip

METER TESTING PICKUPS

10-100-3334 Magnetic IR Pulse Detector
For interfacing to a metallized pulse output of solid state meters with an infrared light

10-100-3333 Magnetic Visible Pulse Detector
For interfacing to a metallized pulse output of solid state meters with a visible light

10-100-3345 IR Pulse Detector with Flexible Arm Mount
For interfacing to the pulse output of solid state meters with an infrared light. Used for meters with a non-metallized pulse output.

10-100-3341 Visible Pulse Detector with Flexible Arm Mount
For interfacing to the pulse output of solid state meters with a visible light. Used for meters with a non-metallized pulse output.

10-120-0020 Isolated KYZ Contact Pulse Detector
Rated for use on dry contacts or powered contacts up to 480 Vac. Connected to terminal blocks via rugged mini clips.

10-100-3313 Manual Pushbutton Switch
This pushbutton provides a manual pulse input to verify meter accuracy for any meter.

METER BASE ADAPTERS

75-310-0013 Form 9 Meter Base Test Adapter (13 Terminal)
Also used with Form 8 and Form 6 installations

75-310-0008 Form 5 Meter Base Test Adapter (8 Terminal)

75-310-0006 Form 4 Meter Base Test Adapter (6 Terminal)

Also used with Form 3 installations.

CALIBRATION CHECK ACCESSORIES

10-340-3105 External Digital Cable
Multi-function cable adapter for the AUX DIGITAL input on the PowerMaster®. Used for a standard pulse output/input.

10-340-0052 Calibration Check Adapter Cables (Voltage)
These cables have 4mm female receptacles terminated with small ring terminal connections that adapt to the voltage connections on a single phase AC reference standard.

10-340-4101K Stackable Jumper Cable
Two of these cables are used to jumper the potential neutrals together during a calibration check on a 3-phase reference standard. A quantity of two is required.

CALIBRATION PACKAGES

ED-2YR-RECAL-3302: 2 Year Annual Calibration Package

ED-5YR-RECAL-3302: 5 Year Annual Calibration Package

ED-5YR-RECAL-AMPLTWR: 5 Year Annual Calibration Package for Amp Litewire Probe

ED-5YR-RECAL-FLEX: 5 Year Annual Calibration Package for Flex Probe

SINGLE CALIBRATIONS

ES-RECAL-3302: Single 3302 System Recalibration

EXTENDED WARRANTIES

ED-2YR-Ext War-3302: Two Year Extended Warranty Package for Model 3302

ED-3YR-Ext War-3302: Three Year Extended Warranty Package for Model 3302

ED-4YR-Ext War-303: Four Year Extended Warranty Package for Model 303

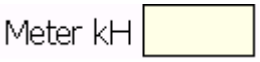
ED-4YR-Ext War-305: Four Year Extended Warranty Package for Model 305

ED-4YR-Ext War-335: Four Year Extended Warranty Package for Model 335

3 Graphical User Interface

3.1 Controls

The PowerMaster® human interface uses familiar Windows style controls. The behavior of many of the controls have been enhanced to eliminate the need for a pointing device such as a mouse.

Text Boxes 

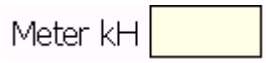
Text boxes are entered by  or  . When the cursor enters the control, any data in the text box is highlighted. Typing at this point will replace the information currently in the text box. If the text box is colored yellow, it is a required field. If the text box is colored gray, the field cannot be edited. This is typically data from the master database which is presented for reference only.

Drop-down boxes 

Once the user tabs ( or ) into a dropdown list box, they can change the selection in one of two ways:

1. Press  or  to move to the previous or next selection in the list, press  to accept and continue.
2. Press  to cause the selection list to drop down, then press  or  to make a selection, press  again or  to accept the selection. Note: focus remains on the drop down box. The user must press  to go to the next field.

In drop-down boxes, the user can also enter text as long as an item is not presently selected.

Required Fields 

These tagged fields (yellow background) require entry before continuing to the next screen. If the user continues with no entry, a pop-up window states, “These fields are required: x,x,x” “Enter to continue” The cursor returns to the first required field if not entered.

Check Boxes 

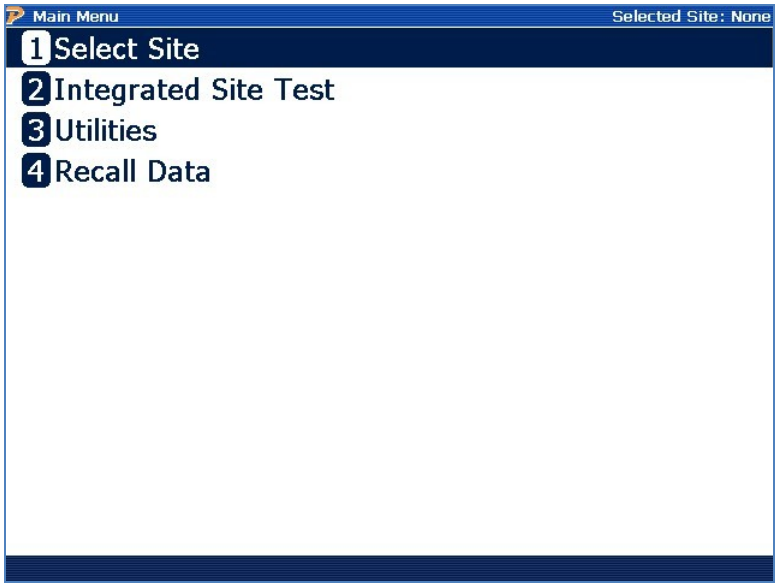
When the user tabs ( or ) into a check box, the label highlights in orange. The user can then press  or  key to change the state of the check box.

4 Splash Screen

At power up, the PowerMaster® displays a “splash” screen briefly. If the user has a USB mouse connected to one of the USB Peripherals, the screen can be paused for 10 more seconds. After the 10 seconds are complete, the analyzer will boot up to the main menu as normal.

This screen gives useful information about contact information from the manufacturer, the current date and time, and the installed version of application firmware.

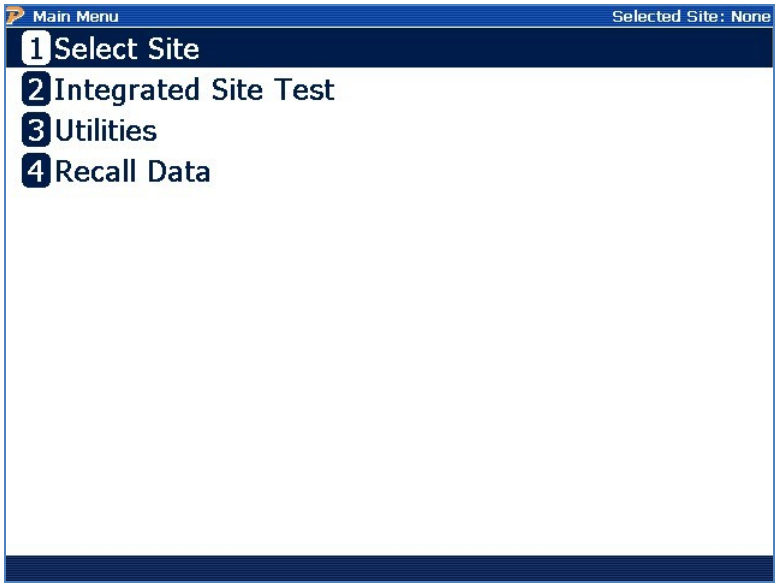
5 Menu System



All menus in the system operate in the same manner. A menu entry may be selected by using the ▲ and ▼ keys may be used to move up and down between items. Pressing the Enter key then causes the selected item to be executed.

Alternately pressing the numeric key of the label next to the menu item executes it immediately.

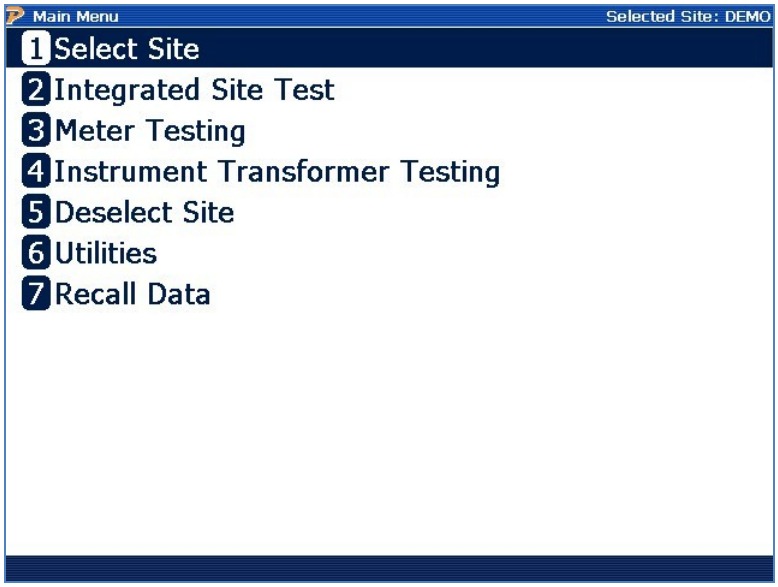
6 Main Menu (Pre Site Selection)



Prior to selecting a site for testing from the database only a limited number of menu items are selectable. These are:

1) Select Site (select a site for analysis or access the site manager database editor)
2) Integrated Site Test (goes to the site selection screen to pick a site that has already been created, then begins the test)
3) Utilities (view or edit user preferences, other applications)
4) Recall Data (view previously saved data).

6.1.1 Main Menu (After Site Selection)



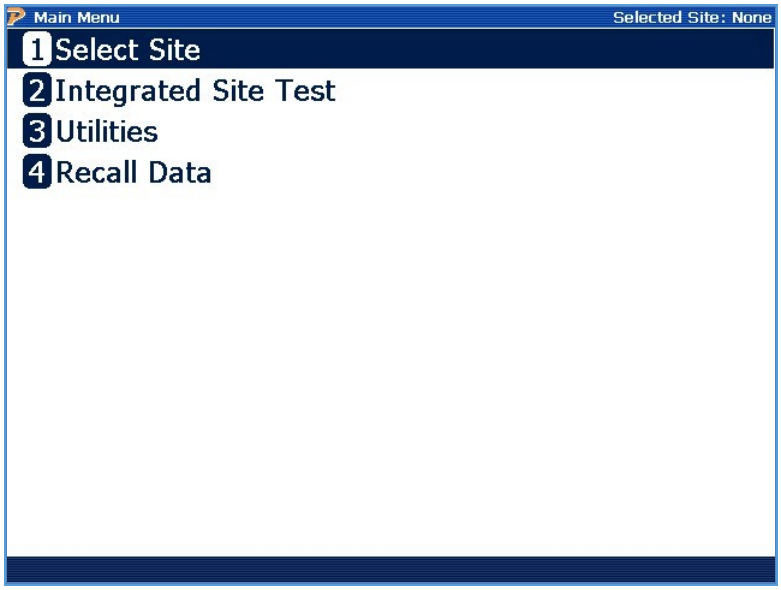
Once a site is selected all system test capabilities are selectable. These are:

1) Select Site (select a site for analysis or access the site manager database editor)
2) Integrated Site Test (automated test procedure which takes the user step-by-step through a predefined test sequence.)
3) Meter Testing (takes the user to the meter testing menu where various meter tests methods are available)
4) Instrument Transformer Testing (takes the user to the CT/PT testing options)
5) Deselect Site (deactivates selected site and returns the user to a pre-site selection Main Menu)
6) Utilities (view or edit user preferences, other applications)
7) Recall Data (view previously saved data).

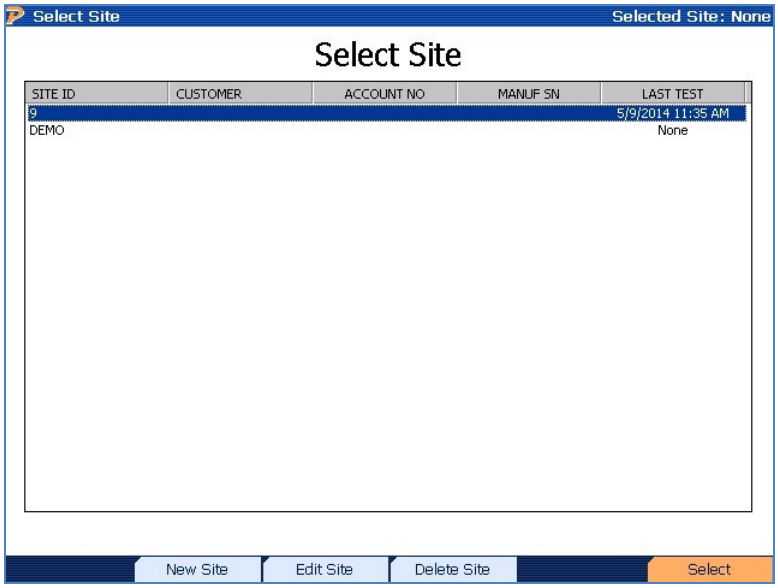
7 Site Selection and Editing

All test performed by the 3 Series are directly related to sites. A Site is described best as a meter and all corresponding instrumentation transformers, wires, and connections. When creating a site, the site ID must be specific to that site, cannot be duplicated, and once data is saved, cannot be deleted. It is for this reason that the usage of meter numbers is discouraged. Typical Site ID's that are used are locator ID's, Location ID's, or anything else already used internally in a customer information system.

To select, create, or delete (with no data saved) a site, from the main menu either option 1 or 2 will bring up the site menu screen. Selecting option 2 will continue with the test once the site has been selected/edited/created, while option 1 returns the user to the main menu.



Once either has been selected, the site selection screen will be shown, allowing users to create their sites, or select sites.



Key Functionality:

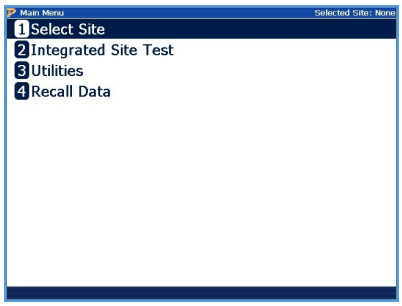
▲ ▼	Moves cursor up and down to a preferred site
F2	Creates a new site in the database (see section 7.4)
F3	Edits a pre-existing site in the database (see section 7.2)
F4	Deletes a pre-existing site in the database (see section 7.3)
F6	Selects the site and goes to the Main Menu (see section 7.1)
PAGE UP	Goes up one page (available if sites exceed the first page)
PAGE DOWN	Goes down one page (available if sites exceed the first page)
PREV (END)	Returns to the Main Menu

Description:

This screen allows the user to 1) select a site for testing, 2) edit a site's information, 3) delete a site from the database, or 4) create a new site database record. All information related to a site is contained in the PowerMaster® database. This information can also be synchronized to a PC database using Meter Site Manager. Sites can only be deleted if there is no data saved to it.

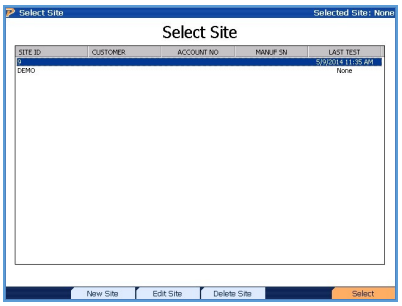
7.1 How Do I Select A Site?

STEP 1



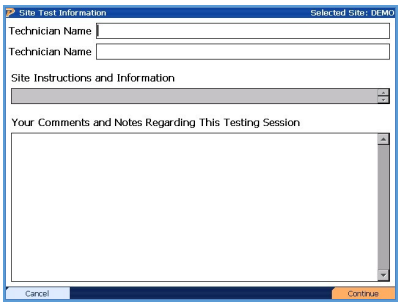
Press #1 or Enter at Main Menu

STEP 2



Press F6 to Select Site

STEP 3

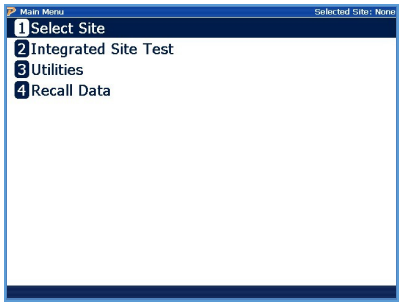


Edit Tech and Test Comments if desired. F6 to Continue.

You are now ready to test the site. All testing options are available at this point. The site is now ready to begin testing and saving data. The data from all tests performed are recorded in the database referenced to this site.

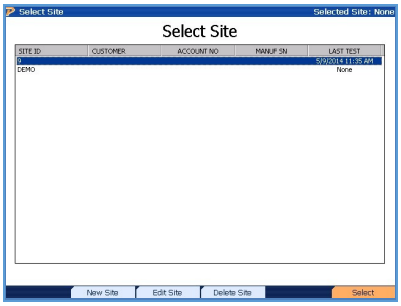
7.2 How Do I Edit A Site?

STEP 1



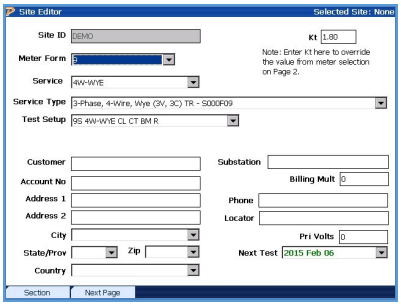
Press #1 or Enter at Main Menu

STEP 2



Press F3 to Edit the Site

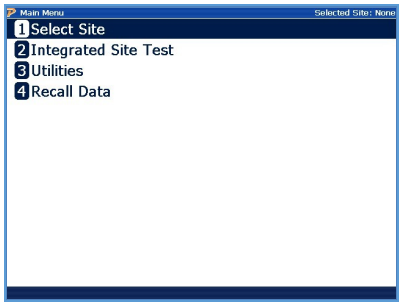
STEP 3



Make changes to information for this site or any of the supporting data tables then press F6

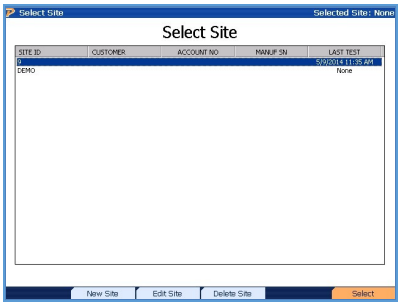
7.3 How Do I Delete A Site?

STEP 1



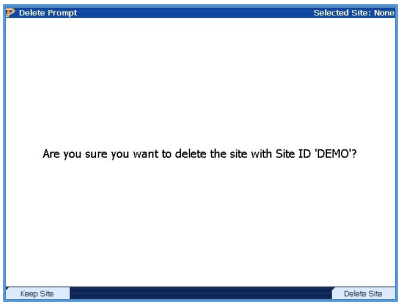
Press #1 or Enter at Main Menu

STEP 2



Press F4 to Delete the Site

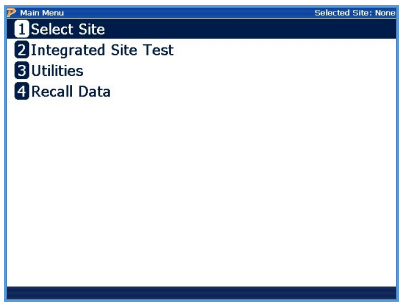
STEP 3



Confirm Delete by pressing F6

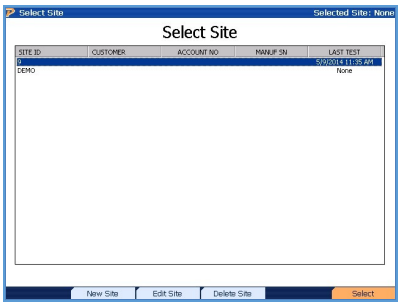
7.4 How Do I Create A New Site?

STEP 1



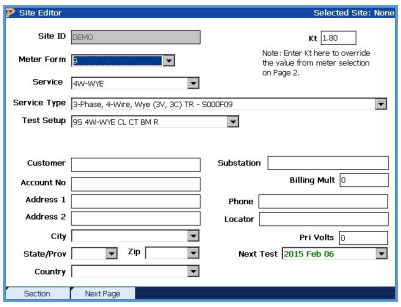
Press #1 or Enter at Main Menu

STEP 2



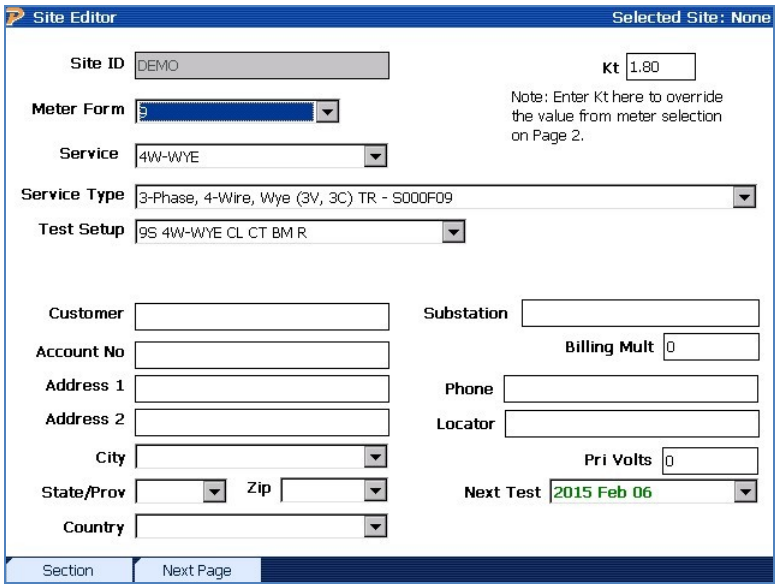
Press F2 to Create a New Site

STEP 3



Enter Information, then press F6

7.4.1 Details on Creating a New Site



Functionality:

F1	Quickly moves to the next section of information
F2	Moves to the next page (see Section 7.4.2)
F3	Displays the appropriate editor for the selected drop-down box, i.e. CT Editor, PT Editor, and AMR Editor
F6	Saves and exits the Site Editor form
PREV (END)	Backs up to "Select Site" screen. No changes made during this editing session are saved.

Description:

This screen allows the user to enter information about the site. This information may include the customer's address, billing multiplier, installed meter, installed CT's and PT's, etc. A few fields are required (which are noted in yellow), but most fields are not. It is up to the user to determine how much information they would like to use.

Required Fields:

The following fields are required before the user saves and exits (F6) the Site Editor screen. They are noted in yellow:

Site ID: This field is the site identifier. This field is 30 characters long and accepts both numerical and alphabetical characters. Normally, an identifier must be chosen which is unique for the site. It is also helpful if the identifier is easily recognized by the technician. Powermetrix does not recommend the use of the meter serial number, because the meter can always be changed.

Meter Form: This field is for the meter form that is to be tested. Entering the drop-down box will display all available meters in the PowerMaster® database.

Service: This field is the configuration the meter operates at the site. Depending on the Meter Form selected, various options may be available.

Service Type: This is the file that refers to the wiring configuration and the meter being used at the site. It includes the type of service (such as 4-wire Wye or 3-wire delta), It identifies the instrument transformer configuration of the site using primary current ("PC") probes (such as 2PC or 3PC). It also identifies whether a self-contained or transformer rated meter is being used (SC or TR respectively).

Kt: This field is required ONLY if a meter is NOT selected from page 2. Otherwise, the Kt (test constant) will be automatically populated using the Kt value from the selected meter in the database.

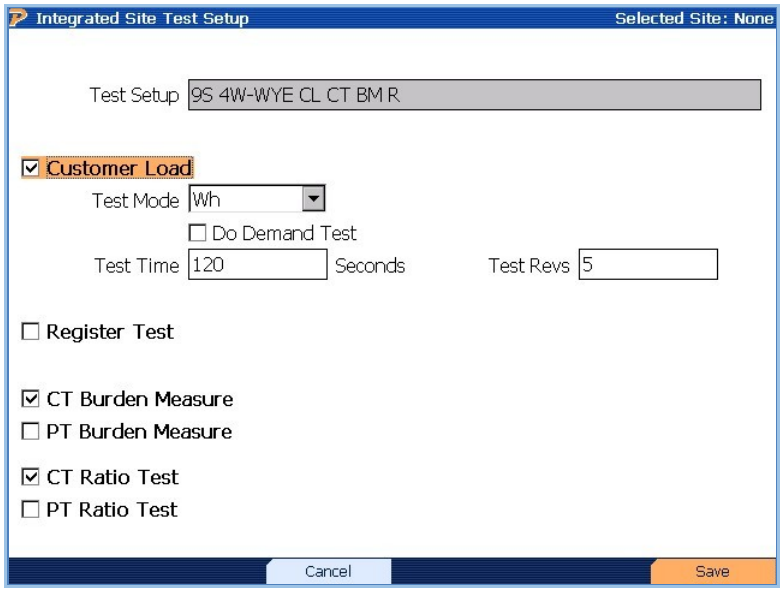
Other Fields:

Billing Mult: This field is for the site's billing multiplier. To calculate the billing multiplier, take the CT ratio to 1 (i.e. 200:5 = 40:1). Multiply that number by the PT ratio. If there are no PT's installed, multiply by 1. For example, an installation with 200:5 CT's and 4:1 PT's, the billing multiplier is 160.

Next Test: This field allows the user to set a date at which this site is to be tested again. The date is generated off of today's date. The user has the option to select 6 months to 5 years from today's date to test again.

Locator: A user field of 30 characters which can be used as a location reference.

7.4.1.1 Details on Creating and Editing a Test Setup



Description:

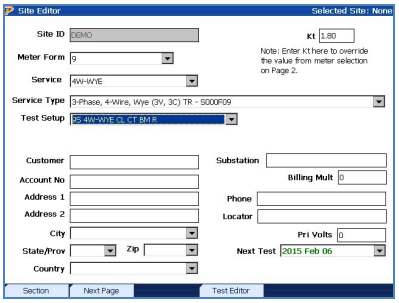
The Test Setup helps the user simplify the testing process and drives Integrated Site Testing. This setup allows the user to pre-define all necessary testing functions before the actual step-by-step process begins. This prevents the user from having to define every test criteria for every individual test. This information is saved to the internal database. Any test setup can be selected for use by site. This allows uniform test procedures to be established and consistently performed.

Two default Test Setups are predefined in the database. These setups can be used but cannot be edited. By default, each new site installation that is created in the Site Editor form has a Test Setup of "Default 1." Powermetrix strongly suggests the user establish their own procedures by creating them in the database.

There is an option to perform a Register Test, and a CT/PT Burden measurement test. By making connections as detailed in Sections 11.2 and 11.3, the actual burden of the circuit is measured.

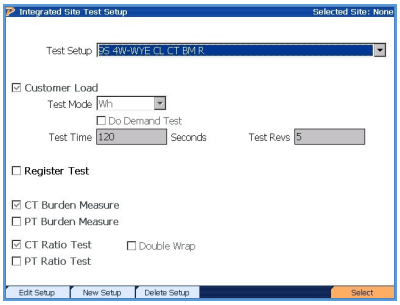
How Do I Edit a Test Setup?

STEP 1



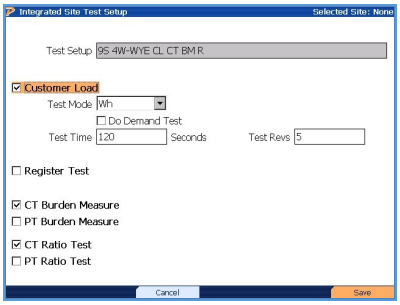
Tab to "Test Setup," press F4

STEP 2



Press F1 to edit the Test Setup

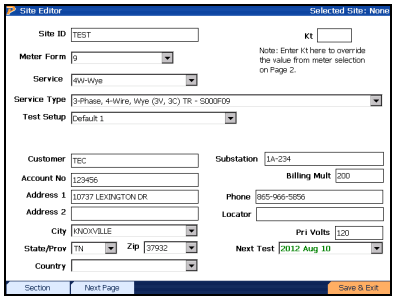
STEP 3



Make changes, then press F6

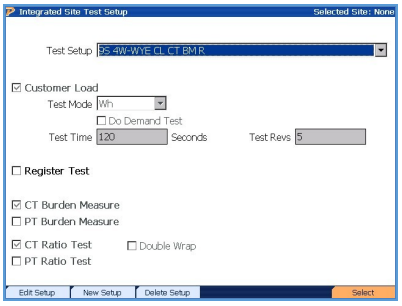
How Do I Create A New Test Setup?

STEP 1



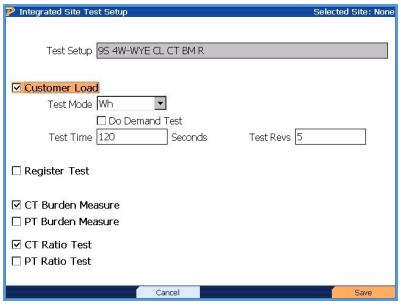
Tab to "Test Setup," press F4

STEP 2



Press F2 to edit the Test Setup

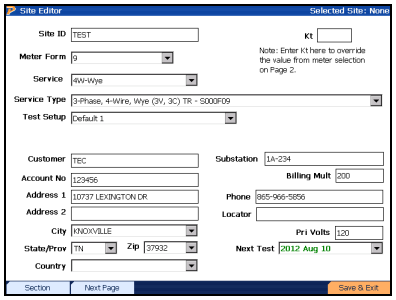
STEP 3



Make changes, then press F6

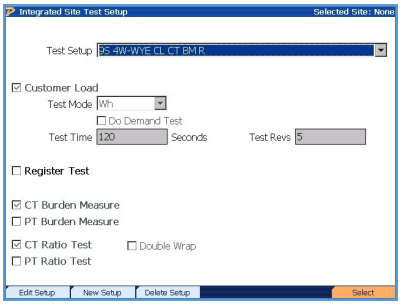
How Do I Delete A Test Setup?

STEP 1



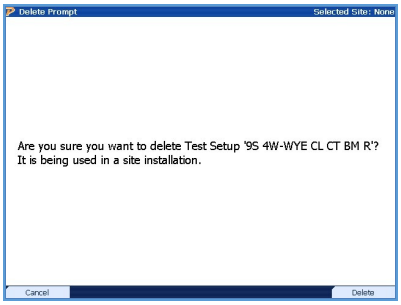
Tab to "Test Setup," press F4

STEP 2



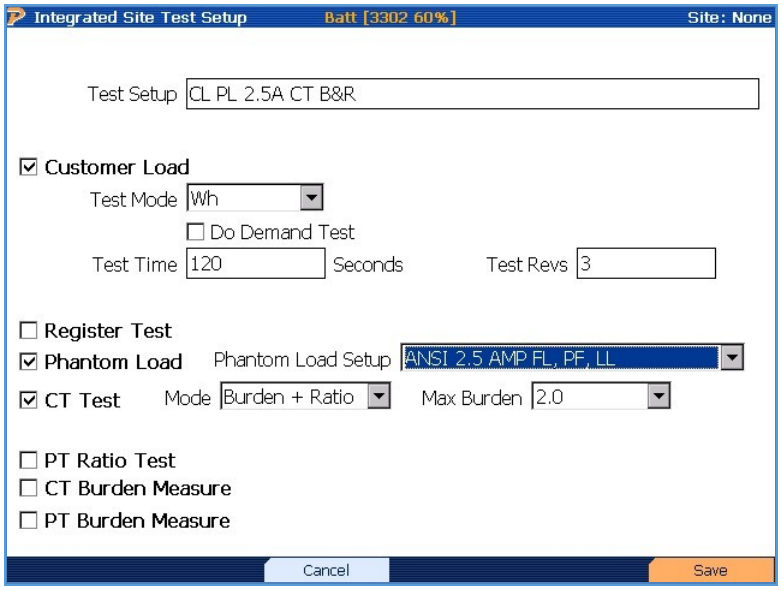
Press F3 to delete the Test Setup

STEP 3



Press F6 to confirm deletion

7.4.1.2Details on Creating and Editing a Phantom Load Setup



Functionality:

F3	Cancels selection
F4	Creates a new Phantom Load Setup (PLS)
F5	Edits an existing Phantom Load Setup (PLS)
F6	Saves and exits Test Setup

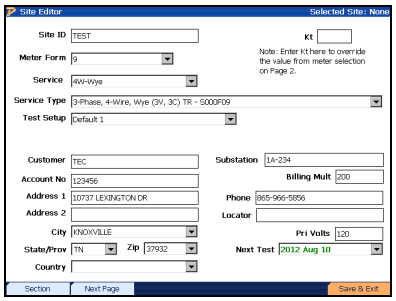
Description:

When using the Models 305 or 335 only, the Phantom Load Setup (PLS) is used to select a setup, create a new setup, or edit an existing setup. Two default setups are included and cannot be edited. To view all setups, verify check box for “Phantom Load” is selected first. For a method without using the Site Editor, refer to Quick Edit.

Procedures to create, edit, or delete setups are included in the following pages. Refer to Section 3.1 for instructions on how to use the grid control in the Phantom Load Setups.

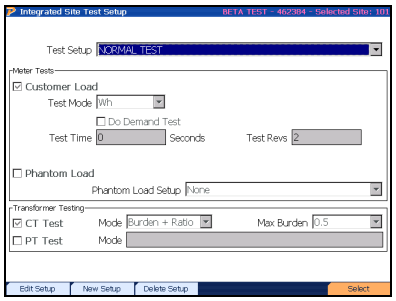
How Do I Create A New PLS?

STEP 1



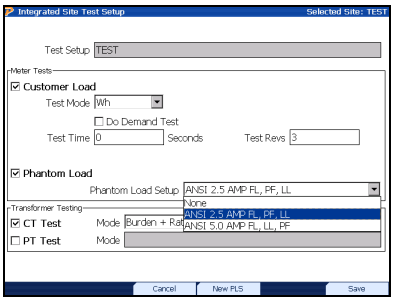
In Site Editor, tab to “Test Setup” then press F4

STEP 2



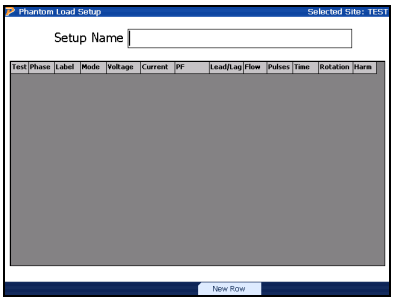
Select then press F2 to edit the Test Setup

STEP 3



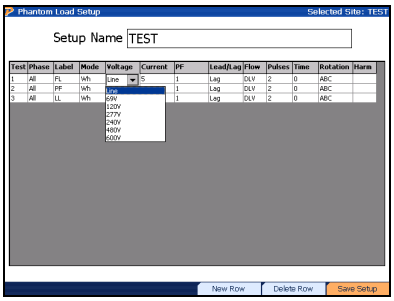
Tab to “Phantom Load Setup,” then press F4

STEP 4



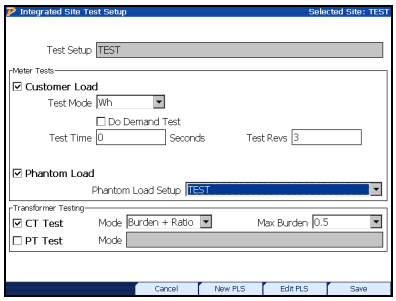
Enter name and press F4 to create a new row(s)

STEP 5



Edit fields accordingly, then press F6 to exit and save

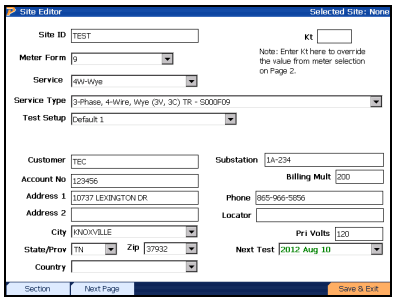
STEP 6



Press F6 to save Test Setup

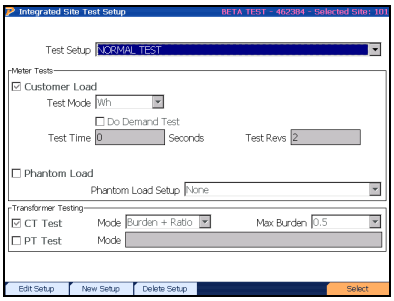
How Do I Edit a PLS?

STEP 1



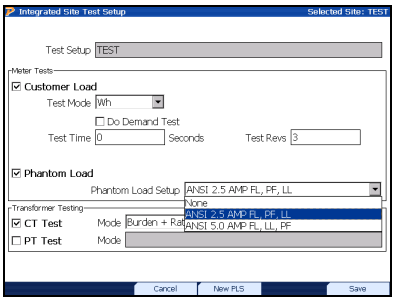
In Site Editor, tab to “Test Setup” then press F4

STEP 2



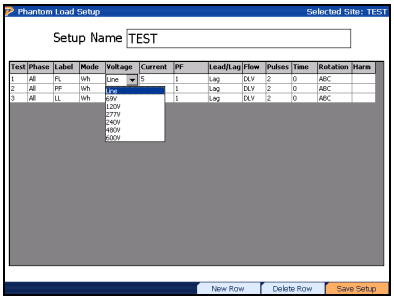
Select then press F2 to edit the Test Setup

STEP 3

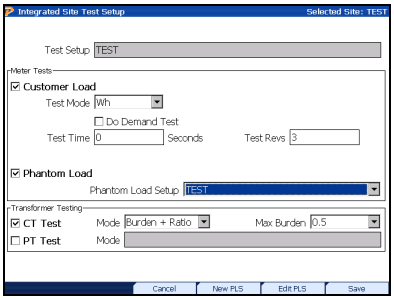


Tab to “Phantom Load Setup,” select correct PLS, then press F5

STEP 4



STEP 5

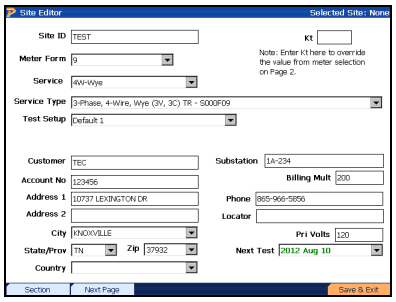


Edit fields accordingly, then press F6 to exit and save

Press F6 to save Test Setup

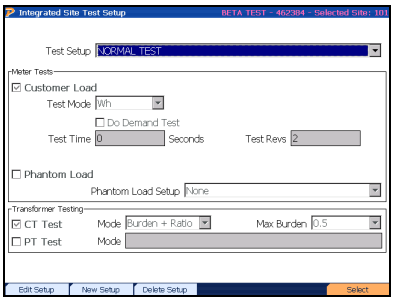
How Do I Delete a PLS?

STEP 1



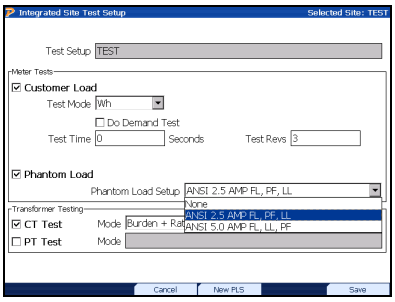
In Site Editor, tab to “Test Setup” then press F4

STEP 2



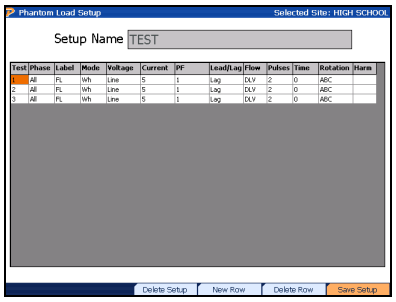
Select then press F2 to edit the Test Setup

STEP 3



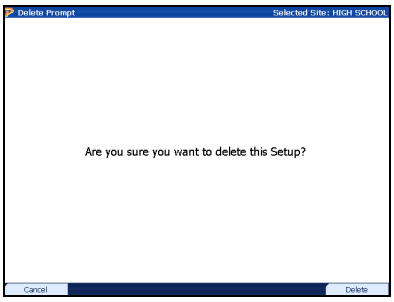
Tab to “Phantom Load Setup,” select correct PLS, then press F5

STEP 4



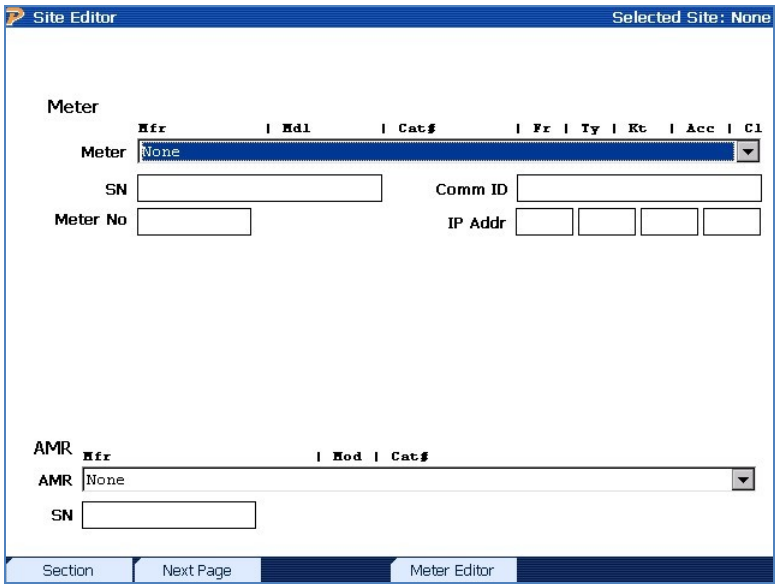
Press F3 to delete PLS

STEP 5



Press F6 to confirm deletion

7.4.2 Creating a New Site (Page 2)

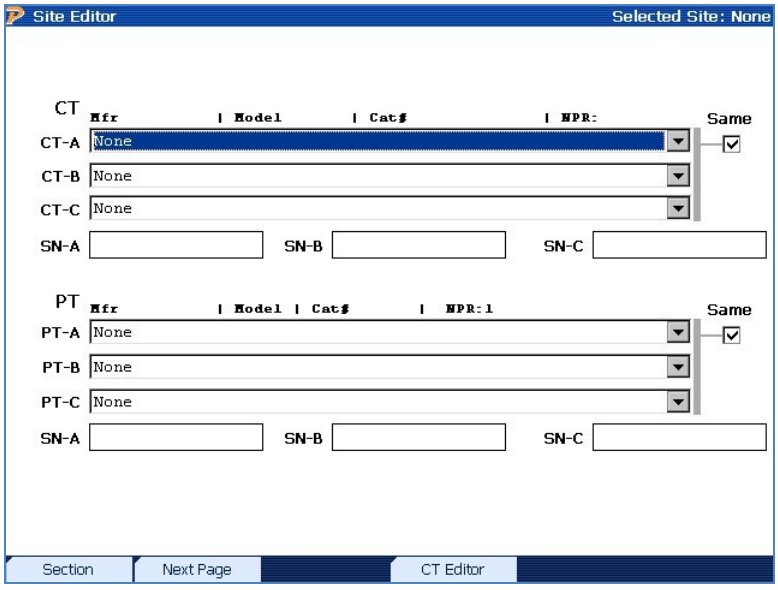


Functionality:

	Moves to next field

←	Moves to previous field
▼	Enters drop down box
▲ ▼	View selections in drop down box
F1	Quickly moves to the next most important section
F2	Moves to the next page
F4	Displays the Meter Editor and AMR Editor when selected
F6	Saves and exits the Site Editor form
PREV (END)	Backs up to Site Editor page 1

Creating a New Site (Page 3)

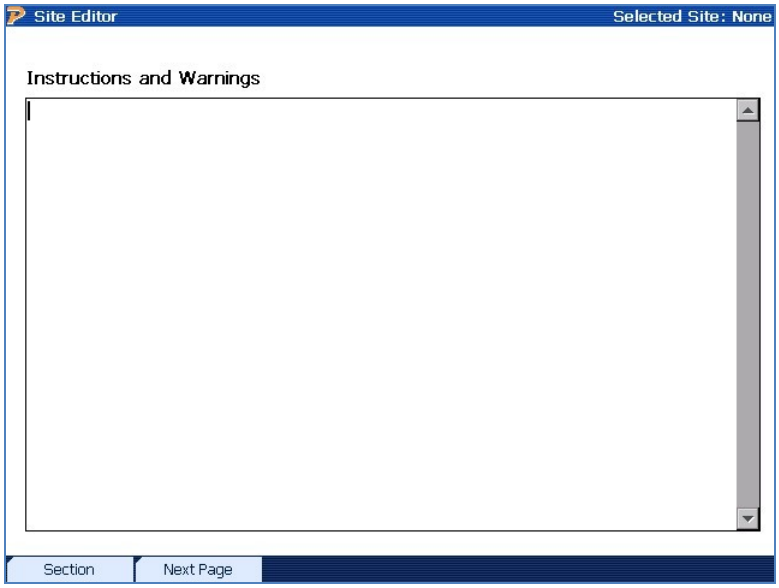


Functionality:

F1	Quickly moves to the next most important section
F2	Moves to the next page
F3	Displays the CT Editor and PT Editor when selected
F6	Saves and exits the Site Editor form

PREV (END)	Backs up to Site Editor page 2

7.4.3 Creating a New Site (Page 4)



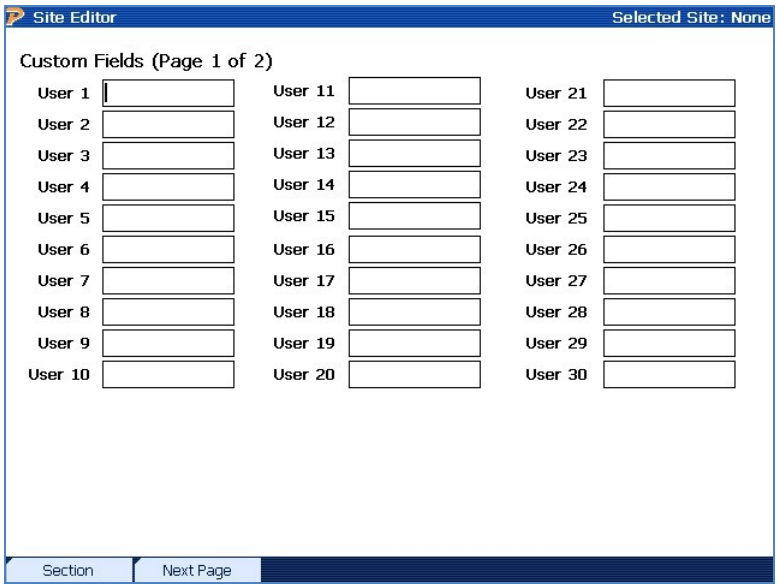
Functionality:

F1	Quickly moves to the next most important section
F2	Moves to the next page
F6	Saves and exits the Site Editor form
PREV (END)	Backs up to Site Editor page 3

Description:

This screen allows the user to enter notes and comments about the site installation before testing begins.

7.4.4 Creating a New Site (Page 5 & 6)



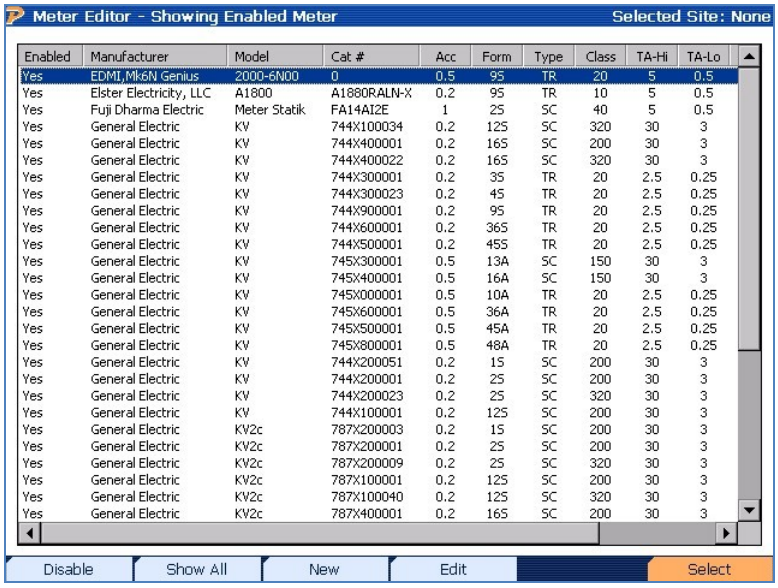
Functionality:

F1	Quickly moves to the next most important section
F2	Moves to the next page
F6	Saves and exits the Site Editor form
PREV (END)	Backs up to Site Editor page 4

Description:

These screens allow the user to enter up to 60 custom fields that are directly associated with the site (not test). The interface to change the names of the fields can be found in the User Preferences.

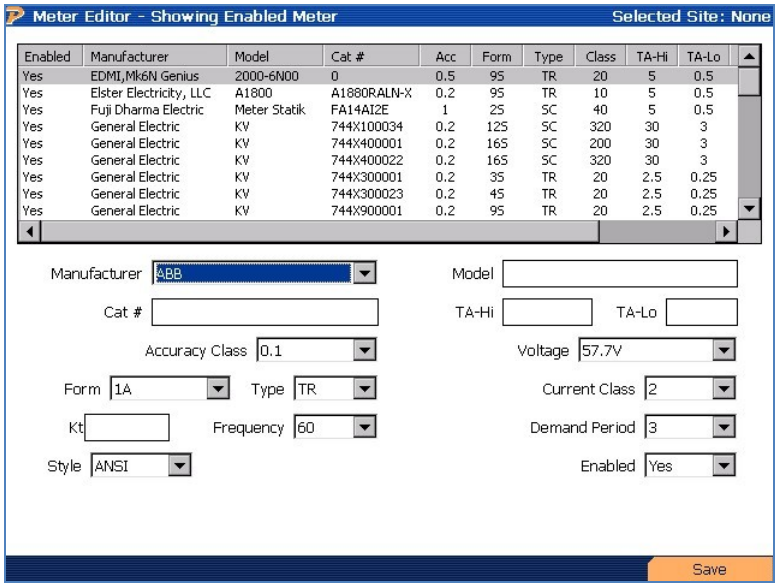
7.5 Meter Editor



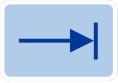
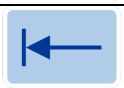
Functionality:

▲ ▼	Moves cursor up and down for selecting a meter
F1	Disables the selected meter (see Section 7.5.1)
F2	Shows all enabled and disabled meters in database (default = enabled only)
F3	Creates a new meter (see Section 7.5.1)
F4	Opens the selected meter to be edited (see Section 7.5.1)
F5	Deletes the selected meter
F6	Selects the meter for the site and exits

7.5.1Creating or Editing a Meter



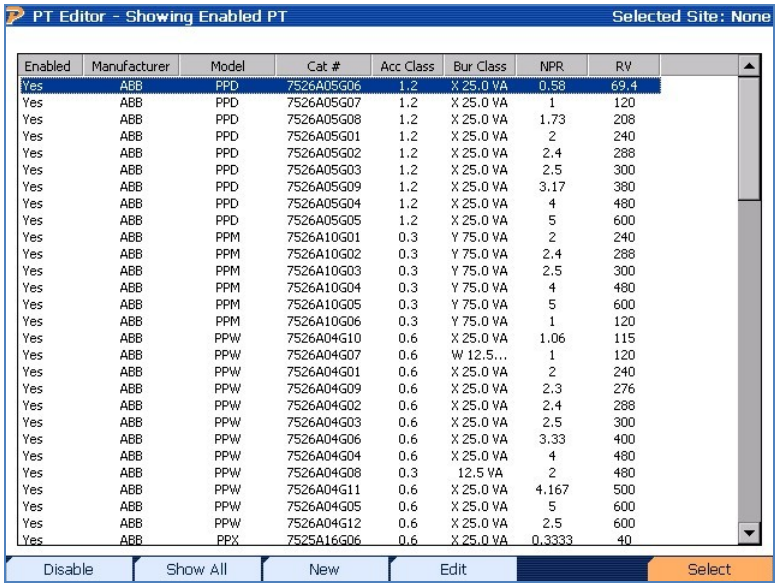
Functionality:

	Moves cursor up and down for selecting a meter and for selecting options in the drop down boxes
	Moves to next field
	Moves to previous field
	Enters drop down box
F6	Saves changes and exits
PREV (END)	Backs up to Meter Editor (Section 7.5)

Description:

This screen allows the user to either 1) make changes to an existing meter in the database, or 2) create a new meter in the database.

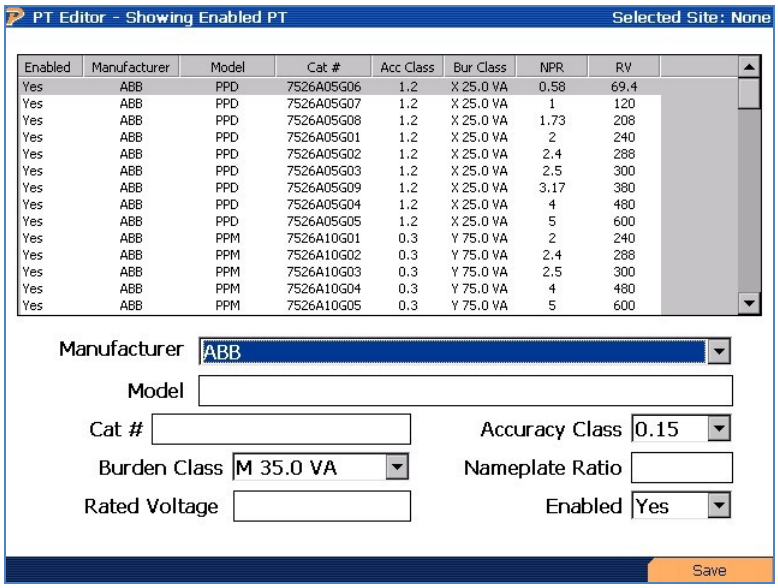
7.6 PT Editor



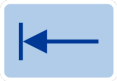
Functionality:

▲ ▼	Moves cursor up and down for selecting a PT (voltage transformer)
F1	Disables the selected PT (see Section 7.6.1)
F2	Shows all enabled and disabled PT's in database (default = enabled only)
F3	Creates a new PT (see Section 7.6.1)
F4	Opens the selected PT to be edited (see Section 7.6.1)
F5	Deletes the selected PT
F6	Selects the PT for the site and exits

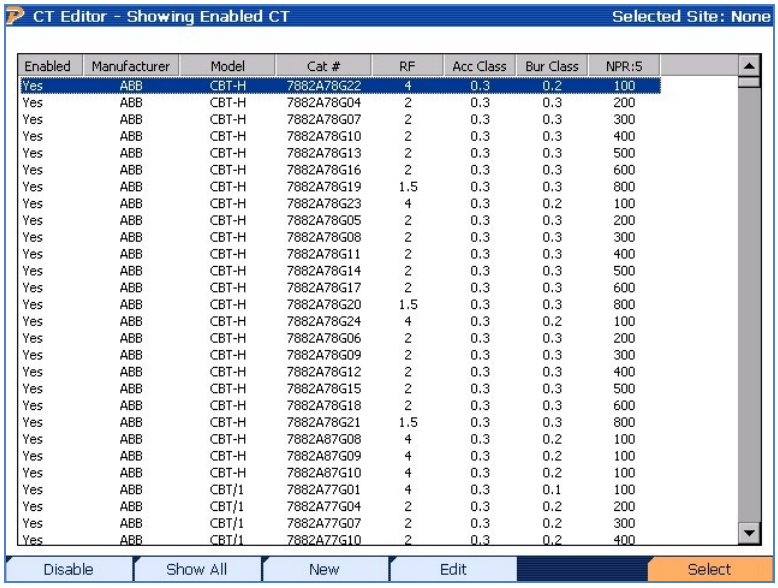
7.6.1 Creating or Editing a PT



Functionality:

	Moves cursor up and down for selecting a PT and for selecting options in the drop down boxes
	Moves to next field
	Moves to previous field
	Enters drop down box
F6	Saves changes and exits
PREV (END)	Backs up to PT Editor (Section 7.6)

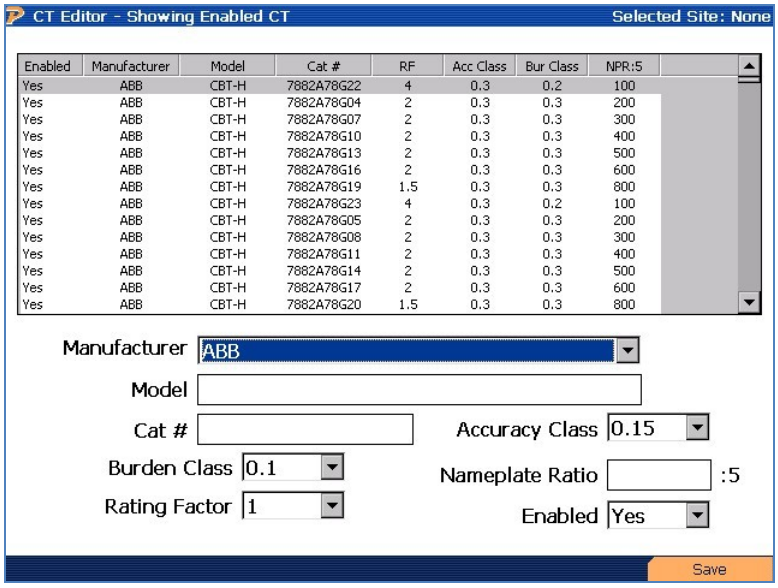
7.7 CT Editor



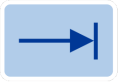
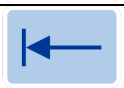
Functionality:

▲ ▼	Moves cursor up and down for selecting a CT (current transformer)
F1	Disables the selected CT (see Section 7.7.1)
F2	Shows all enabled and disabled CT's in database (default = enabled only)
F3	Creates a new CT (see Section 7.7.1)
F4	Opens the selected CT to be edited (see Section 7.7.1)
F5	Deletes the selected CT
F6	Selects the CT for the site and exits

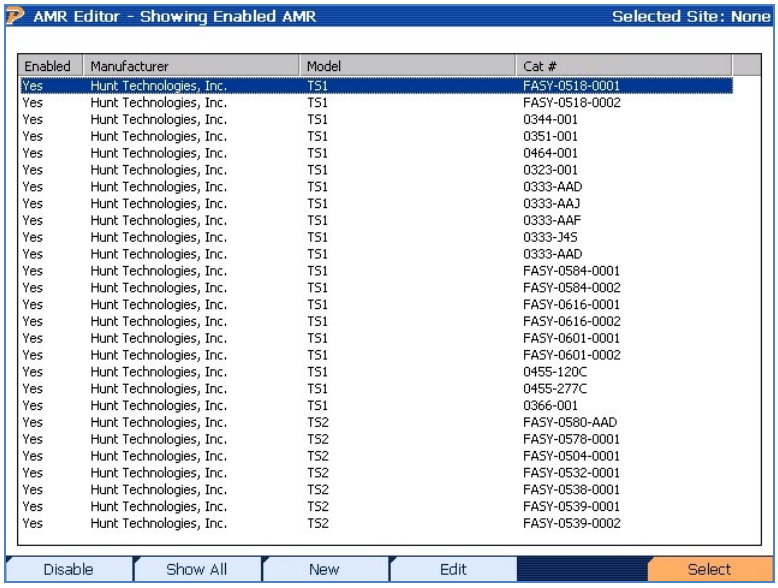
7.7.1Creating or Editing a CT



Functionality:

	Moves cursor up and down for selecting a PT and for selecting options in the drop down boxes
	Moves to next field
	Moves to previous field
	Enters drop down box
F6	Saves changes and exits
PREV (END)	Backs up to CT Editor (Section 7.7)

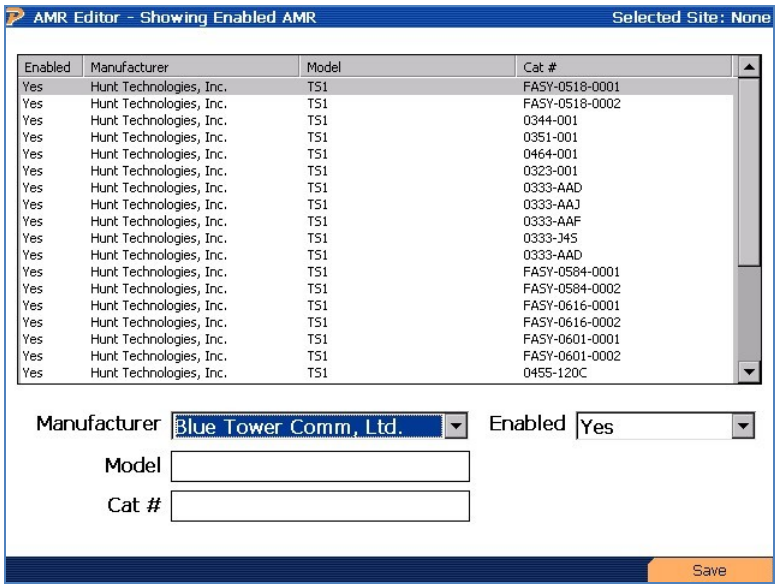
7.8 AMR Editor



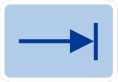
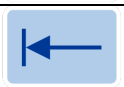
Functionality:

▲ ▼	Moves cursor up and down for selecting an AMR (Automatic Meter Reading)
F1	Disables the selected AMR (see Section 7.8.1)
F2	Shows all enabled and disabled AMR's in database (default = enabled only)
F3	Creates a new AMR (see Section 7.8.1)
F4	Opens the selected AMR to be edited (see Section 7.8.1)
F5	Deletes the selected AMR
PREV (END)	Backs up to Site Editor page 2

7.8.1 Creating or Editing an AMR



Functionality:

	Moves cursor up and down for selecting an AMR and for selecting options in the drop down boxes
	Moves to next field
	Moves to previous field
	Enters drop down box
F6	Saves changes and exits
PREV (END)	Backs up to AMR Editor (Section 7.8)

7.9 Site Editor FAQs

Where do I find the information for the Meter, CT, PT, and AMR?

These specifications that are entered in this screen are normally found on the product nameplate. If a manufacturer catalog is available, this information may be found there as well.

In Type, what does "TR" and "SC" stand for?

TR = transformer rated, SC = self-contained

What is "Kt"?

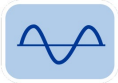
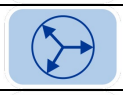
The value Kt is the test pulse register. In most situations, the Kh value on the meter nameplate is the same as Kt.

What does "Enabled" mean?

"Enabled" means that the component will always show in the Editor drop down box. Most utilities have a few manufacturers in their entire system. Since this is true, the user may not want to view ALL components that the PowerMaster® holds in the database. This is especially true if the utility has one or two components they presently use. When you "disable" a component, it will not show in the Editor's drop down box. In short, if the user uses a component (Meter, CT, PT, or AMR) that is in the database, make sure it is "enabled." All others should be "disabled."

8 Hot Keys

Hot keys are used as “shortcuts” to get to a specific screen in the PowerMaster®. The PowerMaster® 3 Series supports (4) hot keys accordingly:

Waveform	
Vector Diagram	
Power Meter	
Harmonics	

When a hot key is pressed, the form will populate the screen. A hot key is accessible at ANY time in the application. All of the function keys are accessible (F1-F6) when applicable. When the form is on screen, the PowerMaster® will remember the last form the user was on before the hot key was pressed. Once the same hot key is pressed a second time, the form will go away and the last form remembered is re-displayed.

For all “Hot” displays pressing 

also takes you back to the screen you were at before you pressed the first hot key. It is equivalent to pressing the same hot key twice in a row.

Common Function Keys:

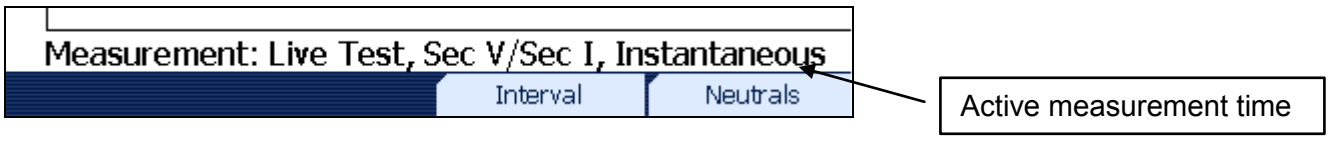
F3	Instantaneous, Interval, Test Period

This function key can be found on the vector diagram, power meter, and harmonics. The main job for this key is to allow the user to view measurements in three different time bases:

Instantaneous: This is the default time base. Measurements are displayed every 4 cycle interval. The PowerMaster® screen updates once per second. **NOTE**: This mode is not meant to be used for calibration verification.

Interval: This is a user defined time base set in Preferences. By default, values are displayed every second. During and after a meter test, this time is based on the last meter pulse seen.

Test Period: This time base takes measurements until the user tells it to stop (F6). During this time base, power is accumulated (summed) and all other signals are averaged.



F4	Sec V, Sec I; Sec V, Pri I; Pri V, Pri I; Neutrals

This function key can be found on the waveforms, vector diagram, power meter, and harmonics. The main job for this key is to allow the user to view different probe sets that are attached to the

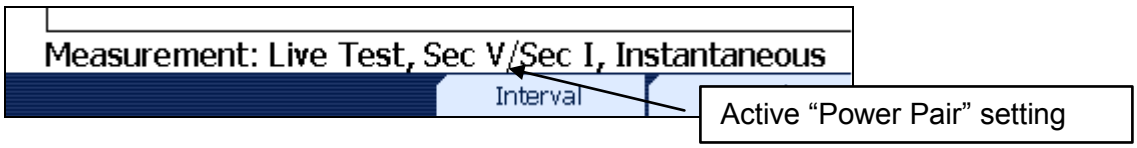
PowerMaster®. This process may include viewing a single probe for a certain application, or it may be to change the “power pairs” altogether.

Sec V, Sec I: This is the default selection. This setting corresponds to the secondary voltage probes and the secondary current probes (test switch probes, clamp-on probes, etc.). For metering, this is the “power pair” that is used for calculating power and registration.

Sec V, Pri I: This setting corresponds to the secondary voltage probes and the primary current probes (flexible current probes, Amp Litewire, etc.). If the user wants to view the relationship between the secondary voltage and the primary current, this is the correct selection. This setting will change the “power pair” and power (W, VA, VAR) is calculated accordingly to the inputs selected. If no primary probes are detected, this setting is not available.

Sec V, Pri V: This setting corresponds to the secondary voltage probes, and the primary voltage probes (Volt LiteWires).). If the user wants to view the relationship between the secondary voltage and the primary voltage, this is the correct selection. This setting will change the “power pair” and power (W, VA, VAR) is calculated accordingly to the inputs selected. If no primary probes are detected, this setting is not available.

Neutrals: This setting corresponds to a single secondary voltage probe and a secondary clamp-on current probe (MN353 or MN375). This allows the user to view the secondary neutral phase for the voltage and current. If no single clamp-on probe is detected, this setting is not available.

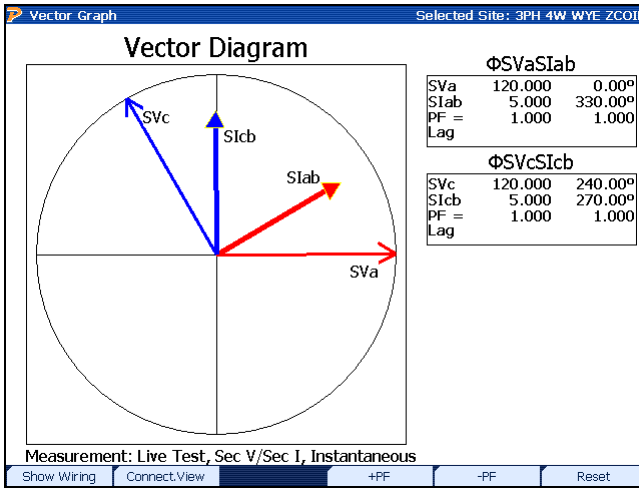


F5	Enable Ratios

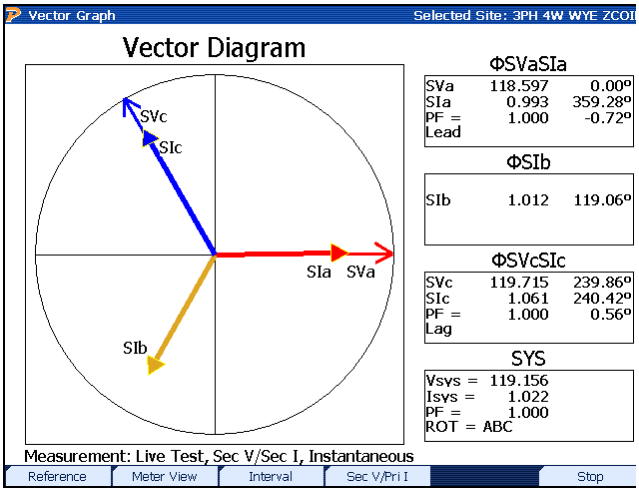
This function key can be found on the vector diagram and the power meter. The main job for this key is to allow the user to view measurements with the CT and PT ratios enabled. When a CT and PT are selected in the Site Editor, the ratios are used to calculate all power measurements without the requirement of primary current and voltage probes.

F2	Toggles between Connection View and Meter View

This function key can be found on the waveforms, vector diagram, power meter, harmonics, and full analysis. The main job for this key is to allow the user to view the different signals according to the meter installation. Meter View is the default display, and it displays the signals that are internal to the meter. Connection View displays the signals as they are connected at the actual terminals (i.e. test switch). While in Connection View, power is not calculated. Below is an example of a 3-Phase, 4-Wire WYE (2V, 3C) Z-coil TR – S009F06 using both Meter View (default) and Connection View:

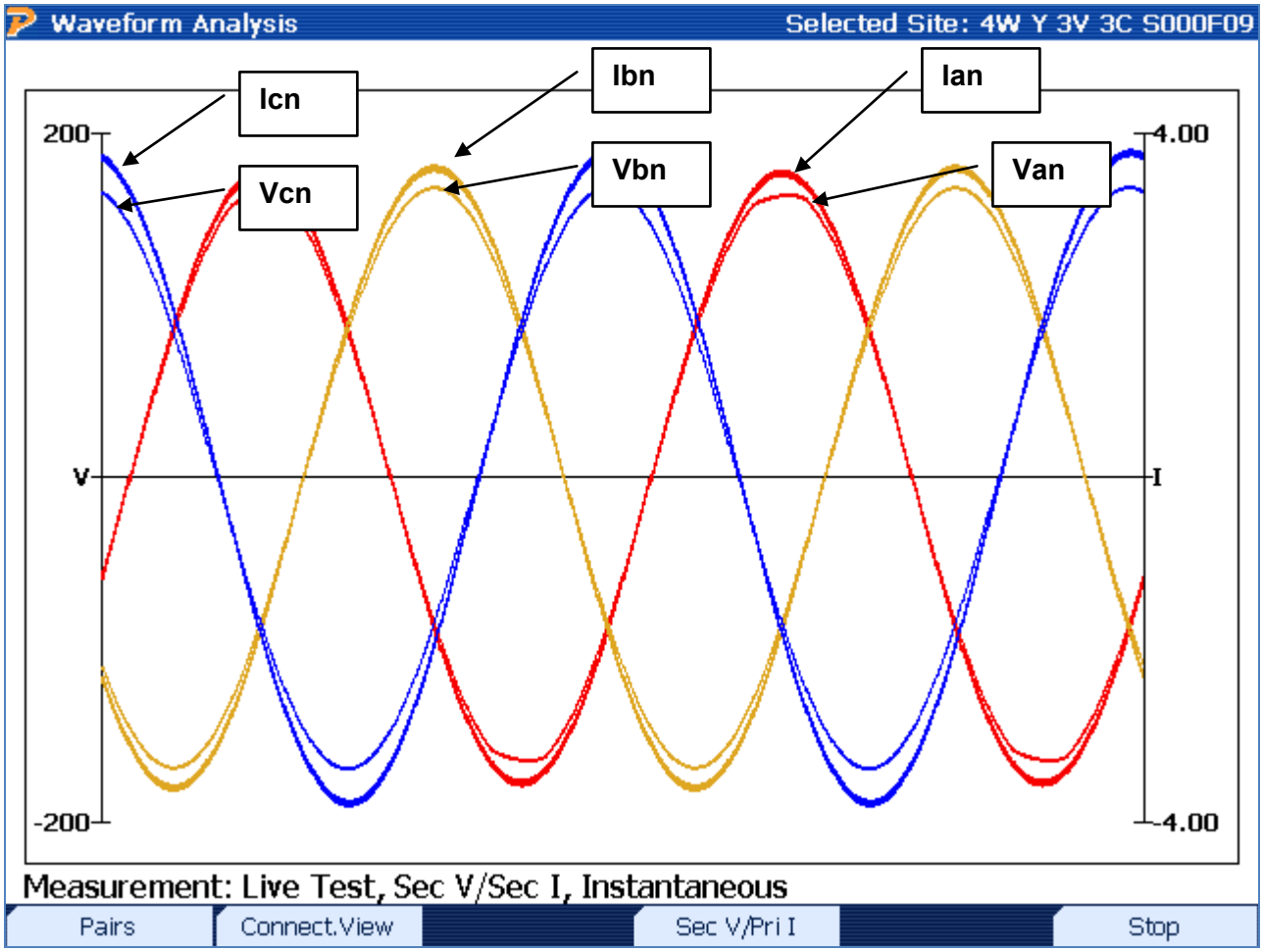


Meter View



Connection View

8.1 Waveforms



Functionality:

F1	Toggles between waveform pairs and full waveform displays
F2	Toggles between Connection View and Meter View (see Section 8 for details)
F4	Toggles between Sec V, Sec I, Sec V, Pri I, Pri V, Pri I, Neutrals (if correct probes are detected; see Section 8 for details)
F6	Stops all active measurements for display
	Closes waveforms screen

Description:

This oscilloscope-type display shows the user the amplitude and phase relationships in time between the voltage and current. All phases are color-coded (A = red, B = yellow, C =blue). The line weight for each phase is used to differentiate between the voltages and currents. The voltage lines are graphically displayed with a thinner weight than the currents (see graph labels above).

The x-axis is time (in a 4-cycle measurement) and the y-axis is amplitude (i.e. volts & amps). The primary y-axis is for the amplitude for voltage, and the secondary y-axis is for current.

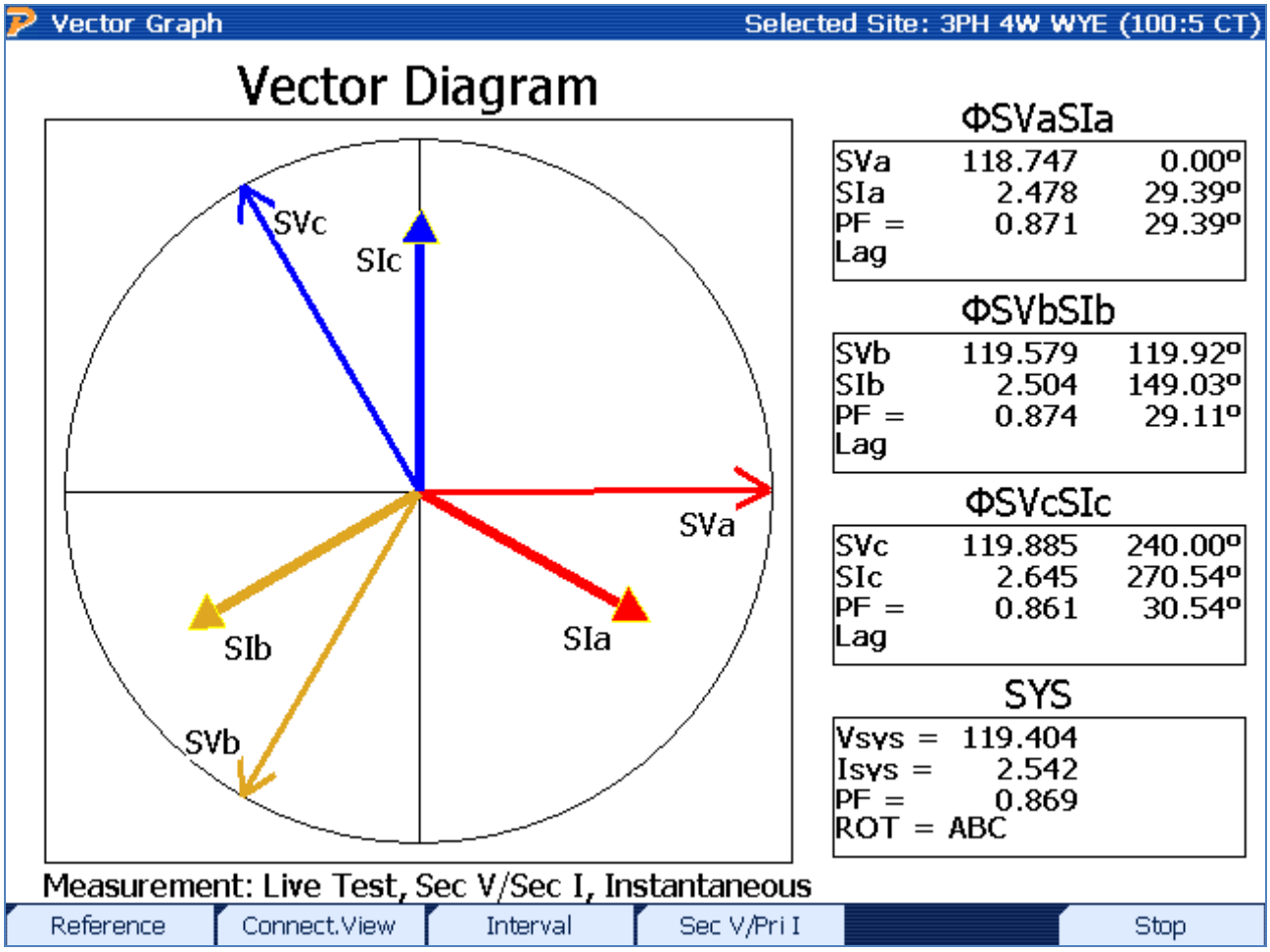
The waveform display uses an auto-scaling function. This gives the user the ability to view both currents and voltages efficiently when amplitude is much greater than the other.

When harmonic distortion is present, the waveform lines will appear uneven to display non-linear load situations.

Leading or lagging power factor is displayed here. When the current waveform peaks after the voltage waveform, the power factor is considered to be “lagging” and termed as an inductive load. This is normal in most metering installations. When the current waveform peaks before the voltage waveform, the power factor is considered to be “leading” and termed as a capacitive load. A leading power factor is not as common in metering, but is normally seen when capacitor banks are used in service installations when no load is present.

Phase rotation can easily be seen in this graph as well. Whichever phase voltage “peaks” first in time determines the phase rotation. If the A phase voltage displays its peak first in the waveform, the rotation is considered to be ABC. In the graph above, the rotation is ABC since A phase voltage displays its full peak first.

8.2 Vector Diagram



Functionality:

F1	Goes to the reference vector diagram
F2	Toggles between Connection View and Meter View (see Section 8 for details)
F3	Toggles between Instantaneous, Interval, and Test Period (see Section 8 for details)
F4	Toggles between Sec V, Sec I, Sec V, Pri I, Pri V, Pri I, Neutrals (if correct probes are detected)
F5	Displays calculated values with CT and PT ratios enabled (defined in the Site Editor page 2)
F6	Stops all active measurements for display, enables F1 to manually save data
	Closes vector diagram screen

Description:

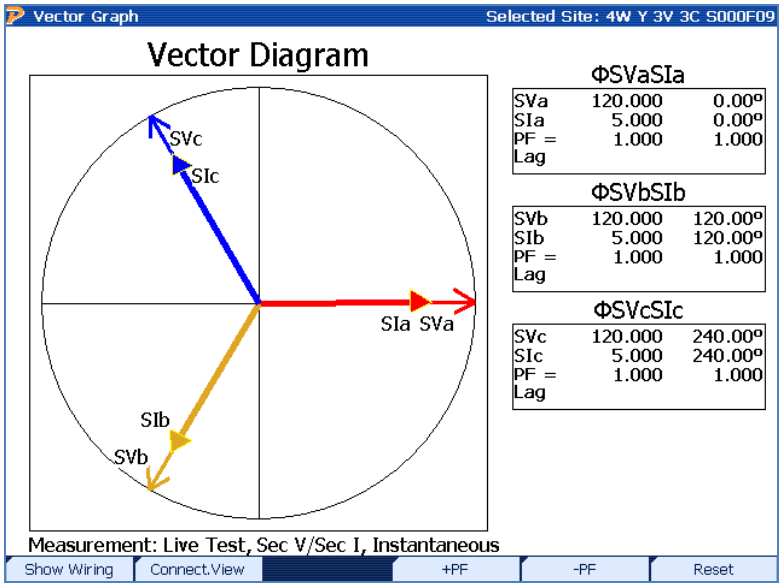
The vector diagram is arguably the best tool for site analysis. In one screen, the PowerMaster® displays the phase relationship between the current and voltages. The PowerMaster® considers this relationship to be the “power pair” where all power is calculated. The amplitude of the voltage and current (i.e. length of the displayed line) is proportionate to the current and voltage readings. In other words, as the current increases the line will increase in length. The phase angle is displayed to show the relationship in time (by convention it is displayed in degrees) according to the way the service transformers are wired. In the USA, Van or Vab is always displayed at the 0° line (i.e. 3 o’clock position). In Canada, service types typically plot Ean at 330° and Eab at 270°.

The user is allowed to change the “power pair” when primary probes are detected (voltage and/or current). For secondary currents, the vector displays “SVan” to signify the secondary current for A voltage in reference to Neutral. Similarly, the secondary currents are labeled “SIa” to signify the secondary current for A phase. If primary probes are detected, the user can press F4 to switch the “power pair” to view the relationship between the secondary voltages (SVan) and the primary currents (PIa). The user can press the F4 key again to view the relationship between the primary voltages (PVan) and the primary currents (PIa) as well. Power will be calculated accordingly.

Leading or lagging power factor is also displayed here. As the current vector shifts to the right of the voltage vector, the power factor is considered to be “lagging” and termed as an inductive load. This is normal in most metering installations. As the current vector shifts to the left of the voltage vector, the power factor is considered to be “leading” and termed as a capacitive load. A leading power factor is not as common in metering, but is normally seen when capacitor banks are used in service installations when no load is present.

Rotation (“ROT”) is displayed in the System (SYS) box to signify the rotation of the service transformers (ABC or CBA). The “SYS” values are the averages of the voltage, current, and power factor for all active phases.

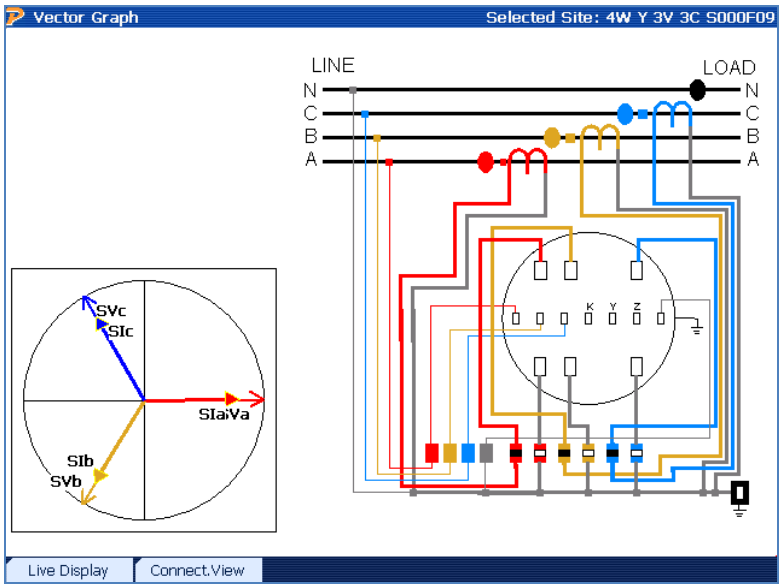
8.2.1 Vector Diagram Reference



Functionality:

F1	Goes to Wiring Display
F2	Toggles between Connection View and Meter View (see Section 8 for details)
F4	Rotates current vectors clockwise by 5°
F5	Rotates current vectors counterclockwise by 5°
F6	Resets rotation to zero, default values from service type
	Closes vector diagram screen

8.2.2 Vector Diagram Wiring Display



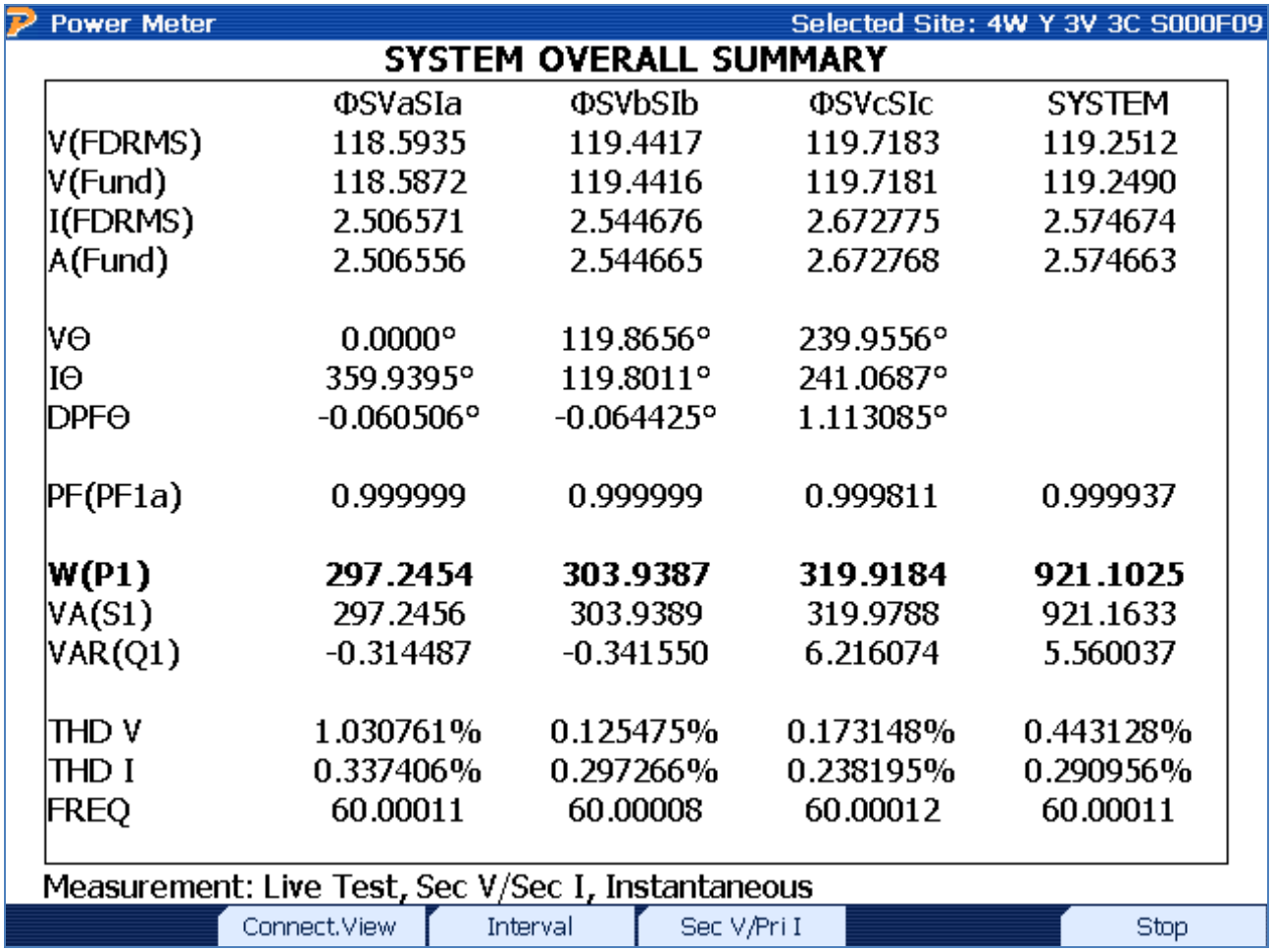
Functionality:

F1	Goes back to live vector diagram display
F2	Toggles between Connection View and Meter View (see Section 8 for details)
	Closes vector diagram screen

Description:

This screen allows the user to view the service type connections (along with color-coded PowerMaster® probe connections) and the associated vector diagram. The vector diagram is always displayed to the bottom left and is show in a “unity” situation (power factor = 1.00).

8.3 Power Meter



Functionality:

F2	Toggles between Connection View and Meter View (see Section 8 for details)
F3	Toggles between Instantaneous, Interval, and Test Period (see Section 8 for details)
F4	Toggles between Sec V, Sec I, Sec V, Pri I, Pri V, Pri I, Neutrals (if correct probes are detected; see Section 8 for details)
F5	Displays calculated values with CT and PT ratios enabled (defined in the Site Editor page 2)
F6	Stops all active measurements for display, enables F1 to manually save data
	Closes power meter screen

Description:

V(xx)	Voltage measurement per phase (calculation defined in Measurement Calculations)

V (Fund)	Fundamental voltage measurements per phase (inside 50 or 60 Hz)
I(xx)	Current measurement per phase (calculation defined in Measurement Calculations)
A (Fund)	Fundamental current measurement per phase (inside 50 or 60 Hz)
VΘ	Phase angle measurement for voltage (reference phase is service type dependent)
IΘ	Phase angle measurement for current (reference phase is service type dependent)
DPFΘ	Displacement Power Factor (difference between VΘ and IΘ)
PF (xx)	Power Factor for each phase (calculation defined in Measurement Calculations)
W(xx)	Watts per phase, accumulative in System (calculation defined in Measurement Calculations)
VA(xx)	Volt-Amperes per phase, accumulative in System (calculation defined in Measurement Calculations)
VAR(xx)	Volt-Amperes Reactive per phase, accumulative in System (calculation defined in Measurement Calculations)
THD V	Total Harmonic Distortion for voltage (displayed in %)
THD I	Total Harmonic Distortion for current (displayed in %)
FREQ	Frequency (50 or 60 Hz)

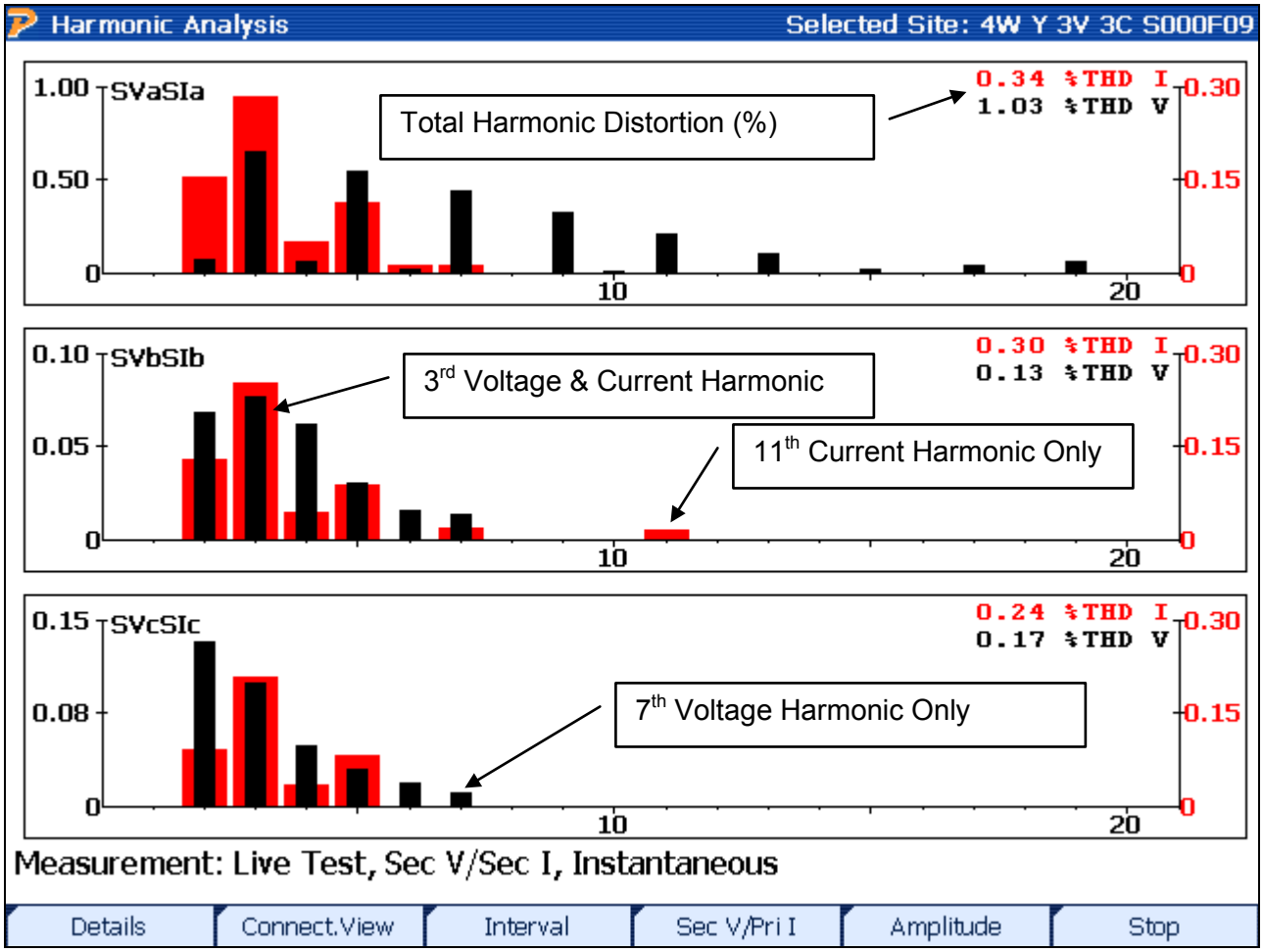
Column Labels

The labels for each column are determined by the active “power pairs” selected by the F4 key. For example, the first column has a label of “**ΦSVanSIa**”. This corresponds to the secondary voltage (in reference to neutral) and the secondary current for A phase. A label at the bottom of the screen also lets the user know what “power pair” is active (i.e. “Sec V, Sec I”). Further details of the “power pairs” can be found in Section 8.

Pulse Output

One of the functions of the Power Meter is to display power information during a W-hr/Var-hr standard accuracy check against the PowerMaster®. The pulse output on the PowerMaster® is always active, so the power calculation option selected in the User Preferences (see Section 14.3) will be noted in bold-faced type on this screen. This allows the user to view the measured power (default “Instantaneous”) or actual consumption (press F3 to change to “Test Period”). The user can press F6 to stop measurements. The user then has the option of saving the data (F1) or restarting power consumption (F6). For more detailed information on the pulse output, see Appendix 1.

8.4 Harmonics Analysis



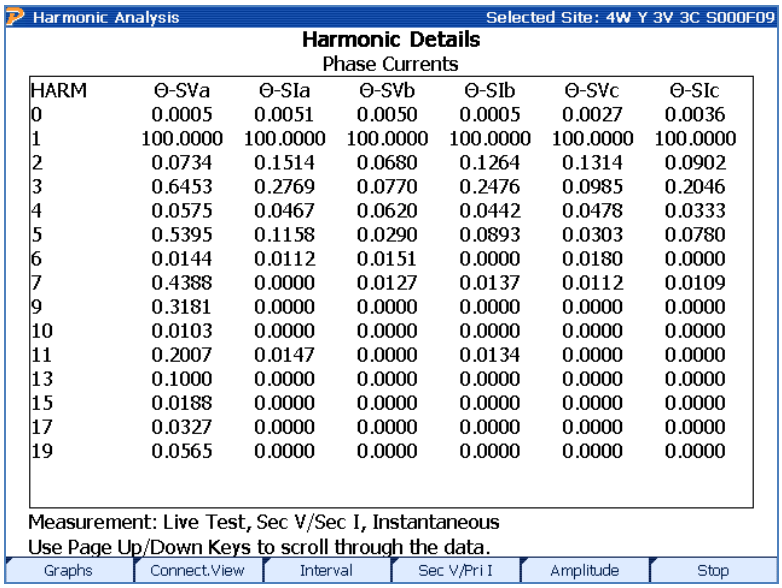
Functionality:

F1	Displays the data for each harmonic (up to 50th) per phase
F2	Toggles between Connection View and Meter View (see Section 8 for details)
F3	Toggles between Instantaneous, Interval, and Test Period (see Section 8 for details)
F4	Toggles between Sec V, Sec I, Sec V, Pri I, Pri V, Pri I, Neutrals (if correct probes are detected)
F5	Toggles between % (of the fundamental) and amplitude (volts and amps)
F6	Stops all active measurements for display, enables F1 to manually save data
	Closes harmonics screen

Description:

This screen allows the user to view the harmonics present in the measurement circuit. For each phase, both the voltage and current harmonics can be seen. The current harmonics are shown as a bold red bar, and the voltage harmonics are shown as a thinner black bar. The THD (Total Harmonic Distortion) for both voltage and current can be seen at the top right of each graph per phase.

8.4.1 Harmonics Details



Functionality:

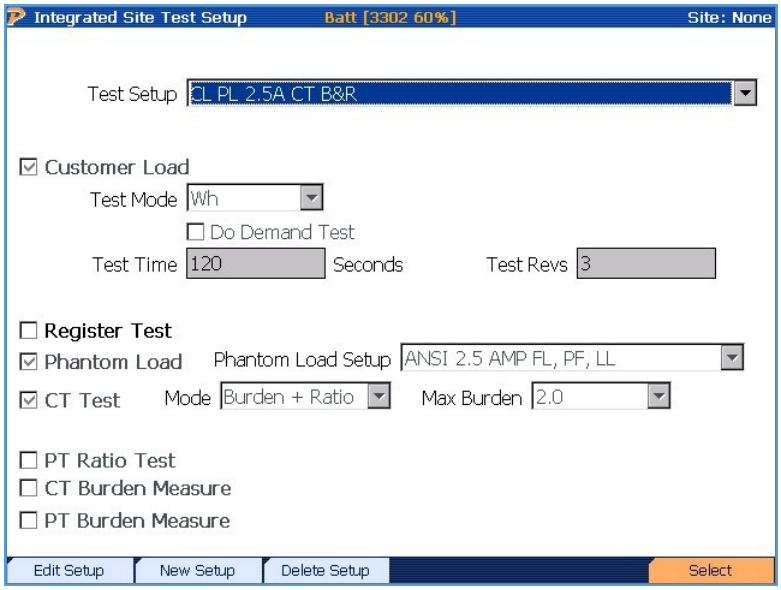
F1	Views graphical harmonic data
F2	Toggles between Connection View and Meter View (see Section 8 for details)
F3	Toggles between Instantaneous, Interval, and Test Period (see Section 8 for details)
F4	Toggles between Sec V, Sec I, Sec V, Pri I, Pri V, Pri I, Neutrals (if correct probes are detected)
F5	Toggles between % (of the fundamental) and amplitude (volts and amps)
F6	Stops all active measurements for display, enables F1 to manually save data
PAGE UP	Goes up to the previous set of data
PAGE DOWN	Goes down to the next set of data
	Closes harmonics screen

Description:

This screen gives the user the ability to view each individual harmonic in accordance to the respective phase current and voltage. By pressing F5, the user can toggle between the percent of the fundamental and the amplitude of the voltage and current. Pressing the PAGE UP and PAGE DOWN keys will allow the user to move up and down the table.

In Preferences (Section 16.1), the user can select how many harmonics are displayed and how many harmonics are saved. The user can select from 0, 5, 20, 30, and 50. The user can also set the minimum threshold which sets the minimum harmonic content to be saved. For example, if the user sets the minimum to 1%, all harmonics that are 0.9% and below will not be saved. This prevents the user from saving too much unnecessary data to the database.

9 Integrated Site Test



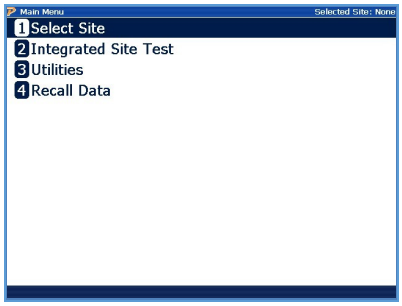
Functionality:

F3	Resets any changes made
F6	Continues

Description:

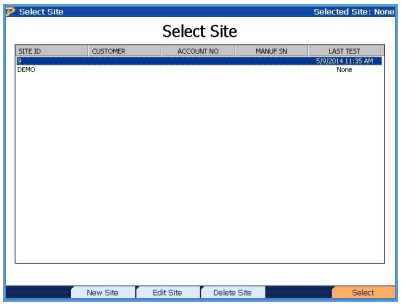
Integrated Site Test is a step-by-step procedure that guides the user through the testing process. This process eliminates setup mistakes and simplifies the entire testing procedure. This screen allows the user to make changes to the setup that was selected in the Site Editor (see Section 7.4.1.1). To help users verify their wiring connection, once the site has been built, and the Service and Service type has been selected correctly, proceeding with the Integrated Site Test through Step 5 will show the wiring diagram for how the connections should be made. This give users who may have not seen a particular service type before the ability to learn how to make connections. For more information on Integrated Site Testing, see Application Notes (website).

STEP 1



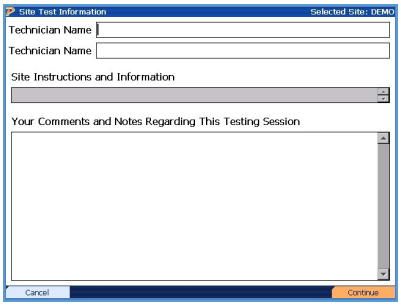
Press #2 or Highlight #2 and Press Enter at Main Menu

STEP 2



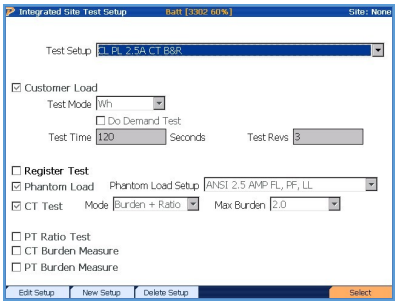
Highlight Desired Sight and Press F6 “Select”

STEP 3



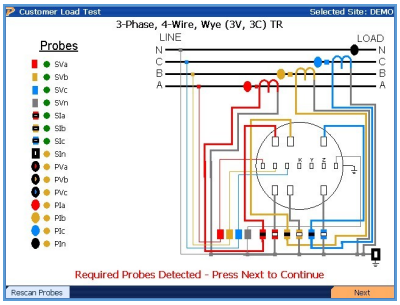
Enter Information, then press F6, “Continue”

STEP 4



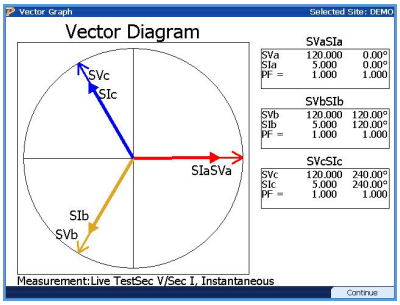
Verify Test Information is Correct, Press F6 “Next” to Continue

STEP 5



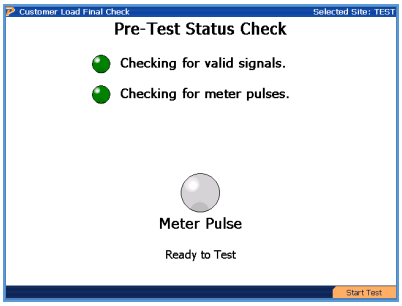
Verify Wiring is Correct and Press F6 “Next”

STEP 6



Verify Vector then press F6, “Continue”

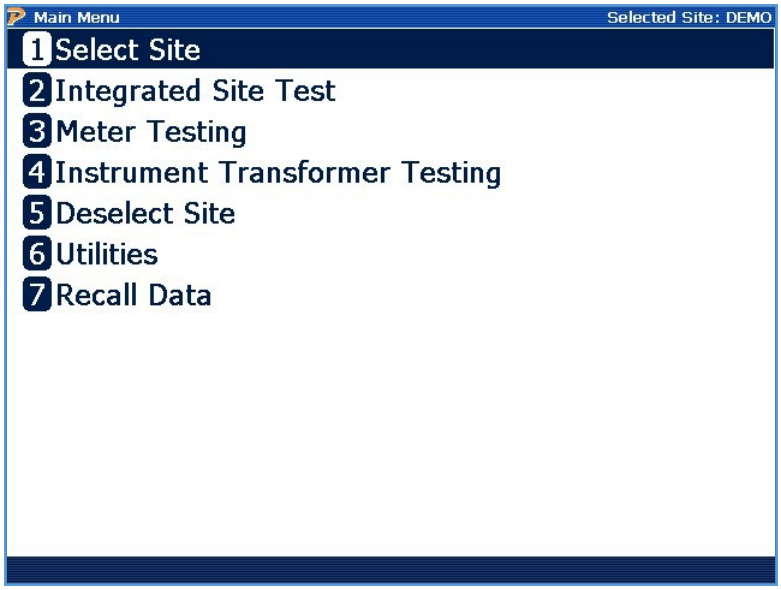
STEP 7



Wait for meter pulse, then press F6 “Start Test”

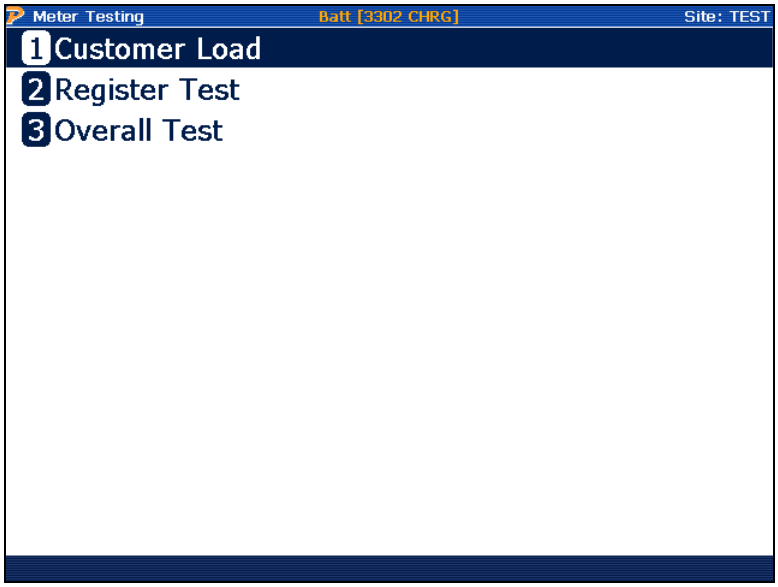
10 Meter Testing

To perform a meter test without performing the full integrated site test(either because it has been performed, or is not required to be performed), select the site you will be testing, then once the menu changes to the one below, either press the number “3”, or highlight the number 3 and press enter.



Functionality:

▲ ▼	Moves cursor up and down to a menu selection
ENTER	Accepts and enters menu selection



Customer Load

"Customer Load" is a meter test that is performed using the customer's active (W-hr), reactive (Var-hr), or apparent energy (VA-hr). This test is considered to be "passive" since the PowerMaster® only measures what the meter is registering. So, for instance, if the load changes during the meter test, the PowerMaster® will accurately measure the change and reflect it in the completed registration test. What makes this test so valuable is the fact that the PowerMaster® measures the meter under conditions the customer is actually being billed. A site is required to be entered and selected to perform this test.

Phantom Load (With the Model 305 or 335 only)

"Phantom Load" is a meter test that is performed simulating current. Since this test is considered to be an "active" test, the user has the ability to simulate different circumstances for each test. This is in contrast to a "customer load" test. A site is required to be entered and selected to perform this test.

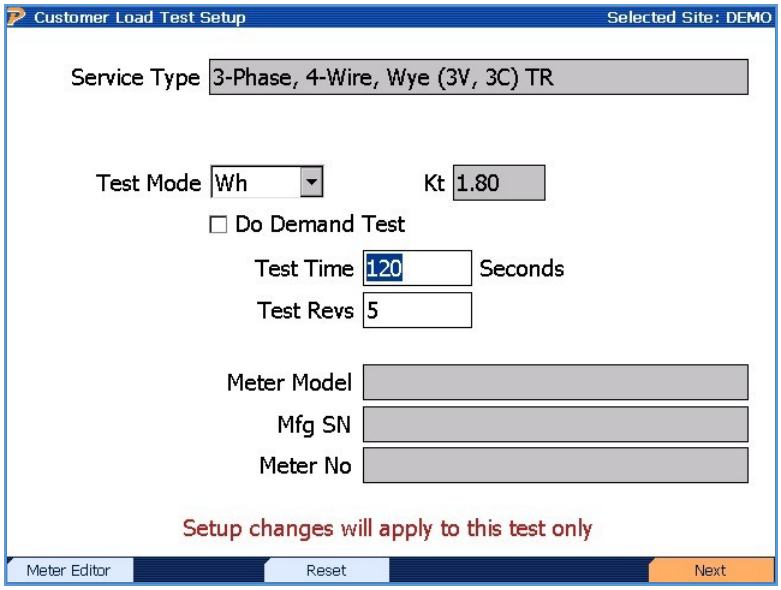
Register Test

Register testing is a new test available with the 3 Series. This test requires the register value on the meter to be entered into the 3 series. Once the test ends, the ending value of the register is entered in, and the difference is calculated. Testing in this manner checks the validity of the meter's ability to accurately display register results. A site is required to be entered and selected to perform this test.

Overall Test

"Overall Test" has the same parameters as the Customer Load test, but the 3 Series allows the ability to perform measurements using the primary currents instead of secondary currents. This valuable feature allows the user to detect problems at the CT before the secondary connections are made at the meter. These problems can include cross phase wiring on or detection of high harmonic content isolated to the primary inputs. Much like the Customer Load test, a site is required to be entered and selected to perform this test. Probes to measure primary currents (Flexible Current Probe, Amp Litewire, or clamp-on) are required.

10.1 Customer Load Setup



Functionality:

	Moves to next field
	Moves to previous field
	Enters drop down box and views test mode selections; checks/unchecks check boxes
	Moves cursor up and down for selecting a test mode in the drop down box
F3	Resets any changes made back to default database values
F6	Continues

Description:

This screen allows the user to perform a meter test using the customer's load. This means that the PowerMaster® will calculate the registration or error (based on user preference) over a set timed period (either time or pulses). The end result is expressed as a percent.

FAQ's

What is the difference between "Test Time" and "Test Revs"?

Test Time is the amount of seconds the user defines for the test. If the time exceeds before a pulse is expected, the PowerMaster® will wait until the last pulse is seen before completing. Test Revs is the amount of pulses or revolutions the meter test will count before completing. If both

fields have values present, the meter test will complete when either value comes first (whether it is time or revs).

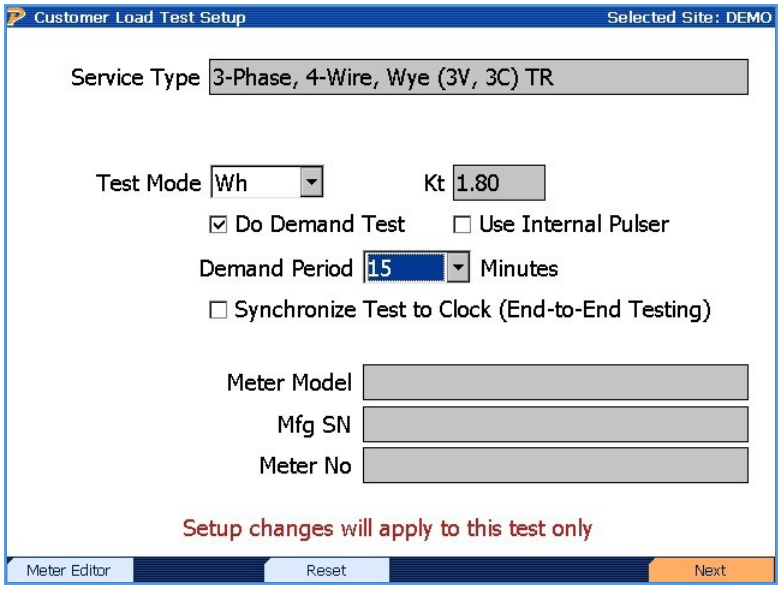
How many "Revs" does Powermetrix recommend to perform an accurate meter test?

If time permits, 10 revs or more is ideal.

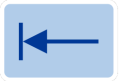
How do I perform a Var-Hr meter test?

First, make sure Test Mode is set to "VARh". Next, verify the meter pulse pickup is aligned to view Var-hr pulses and not Watt-hr. This may incorporate a meter programming change to do this.

10.1.1 Customer Load Setup With Demand Test



Functionality:

	Moves to next field
	Moves to previous field
	Enters drop down box and views test mode selections; checks/unchecks check boxes
	Moves cursor up and down for selecting a test mode in the drop down box
F3	Resets any changes made to default database values
F6	Continues

Description:

This screen allows the user to perform a demand test using the customer's load. This means that the PowerMaster® will accumulate the power (and accuracy of the meter under test) over a set timed period (defined by the demand interval). Min, max, and average values are given over the entire test period.

FAQ's

What selection do I use for "Demand Interval"?

This value can usually be found on the meter nameplate.

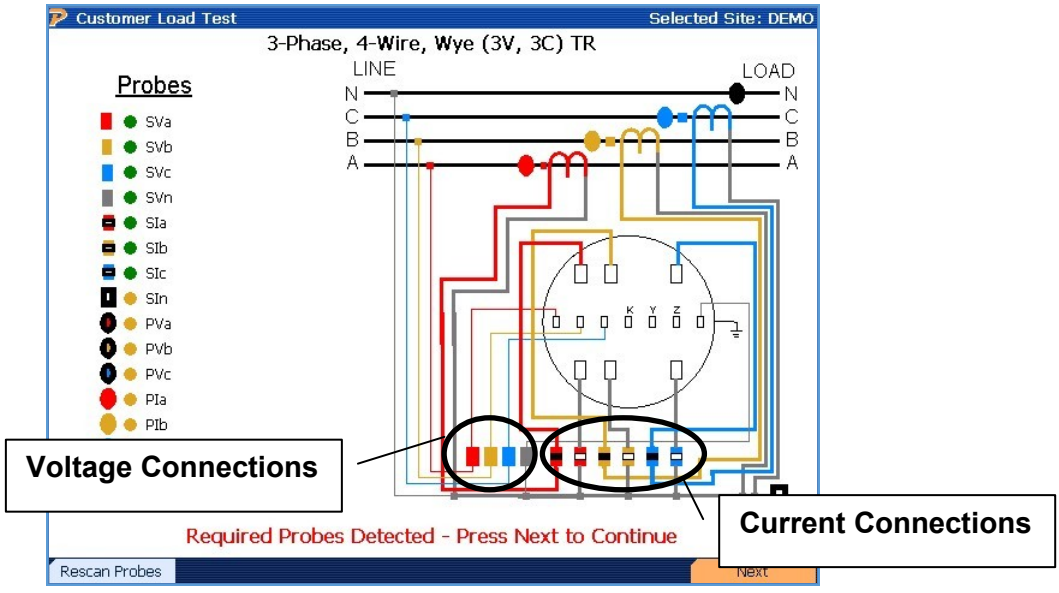
What is "Synchronize Test to Clock (End-To-End Testing)"?

This feature is normally used for Canadian customers. The first demand interval (5 min) will begin when the PowerMaster® clock is at a minute mark that is divisible by 5. For example, if the demand test starts at 11:03am, the first interval will not start until 11:05am. The next interval will start at 11:10am, and so on. This is used to precisely time the demand intervals for comparison to meter data acquisition systems (ex. MV-90).

What is the "Internal Pulser" option?

The Internal Pulser is used when the meter pulses from the meter cannot be used or accessed. Using the internal clock in the analyzer, it simulates a constant pulse count to synch the data acquisition. No meter registration will be displayed when this option is selected.

10.1.2 Customer Load Probe Setup



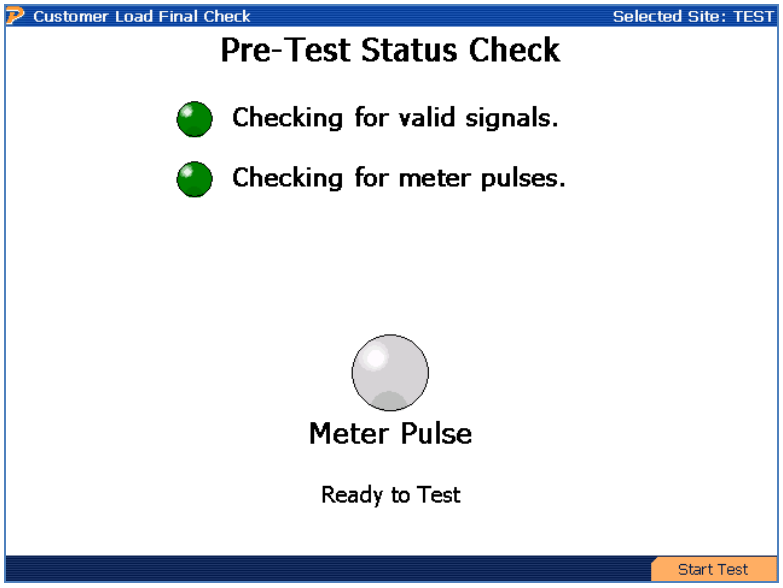
Functionality:

F1	Verifies connected probes if a problem occurs
F6	Continues

Description:

When entering this screen, the PowerMaster® performs both a “Probe Scan” (see Section 13.8.2) and allows the user to verify probe connections. A key is displayed at the left of the screen and shows what probes are active and required for this test. Color codes are also displayed (A = red, B = yellow, C = blue, N = gray).

10.1.3 Customer Load Final Check



Functionality:

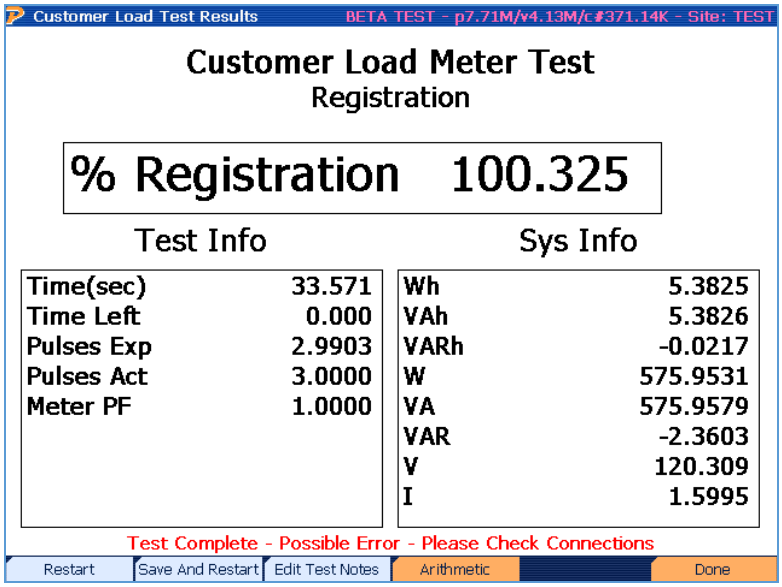
F6	Continues

Description:

When entering this screen, the PowerMaster® verifies all current and voltage signals are reasonable and allows the user to align the meter pulse pickup at this time. When meter pulses are detected, the signal for “Checking for meter pulses” displays green. Each time a pulse is detected, the “Meter Pulse” signal will light green and display “Ready to Test.” At this time, the user presses F6 to continue to the meter test.

When testing a solid state meter, the meter may be required to be in “test mode.” This normally is done by a toggle switch underneath the meter glass, but in rare cases the user may be required to change the programming of the meter.

10.1.4 Customer Load Test Results



Functionality:

F1	Clears all data and restarts meter test
F2	Saves data and restarts meter test
F3	Adds notes to the current test
F4	Toggles between Arithmetic and Vector calculations for PF
F6	Completes meter test and saves data

Description:

When entering this screen, the PowerMaster® begins the meter accuracy test. This screen updates when every pulse is detected. By following the testing parameters set in the setup screen (Section 10.1), the meter test stops when either time or pulses required is met. Meter accuracy results are displayed at the top center of the screen. Other information during the test is displayed in the bottom right and left sections of the screen. The voltage and current amplitude along with energy is displayed using the System values (see Section 8.3). Also, the meter accuracy calculation is based off the settings found in the Configuration menu (see Section 13.9.2).

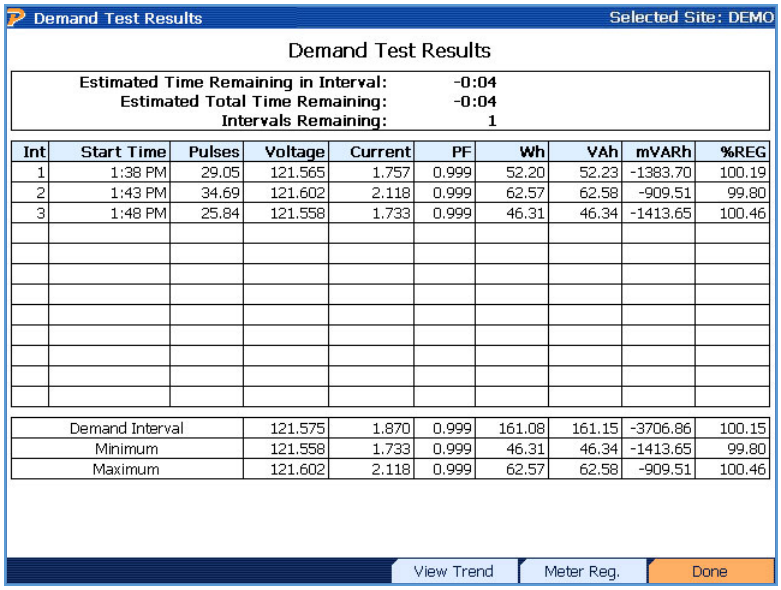
FAQ's:

What does Powermetrix consider to be a bad customer load meter test?

Powermetrix believes a good customer load meter test should be within ±2%. Most ct-rated meters are classified at 0.2%, but that accuracy class is based off of lab conditions and under artificial load points (120V @ 2.5 amps). With customer load, the load will vary between the

designated test points (FL, PF, LL), and the PowerMaster® helps the user determine how well the meter performs under existing conditions (including harmonic content).

10.1.5 Customer Load Demand Register



Functionality:

F1	Clears all data and restarts demand test
F2	Quits data collection and returns to the Meter Testing menu
F3	Stops data collection
F4	Views the voltage, current, and power (W, VA, VAR) data during the total time interval for the meter test. See section 10.1.5.1.
F5	Views the meter registration during the entire demand test
F6	Completes demand test and saves data

Description:

When entering this screen, the PowerMaster® begins the demand test. The screen updates at every five (5) minute interval from start time. Based on the "Demand Period" selected (see Section 13.9.1), the demand test will stop after time is relinquished. For example, if a 15 minute demand period is selected, the test performs for the next 15 minutes and displays values at each 5 minute interval (15 minutes = 3 intervals). Meter registration is also displayed at each interval.

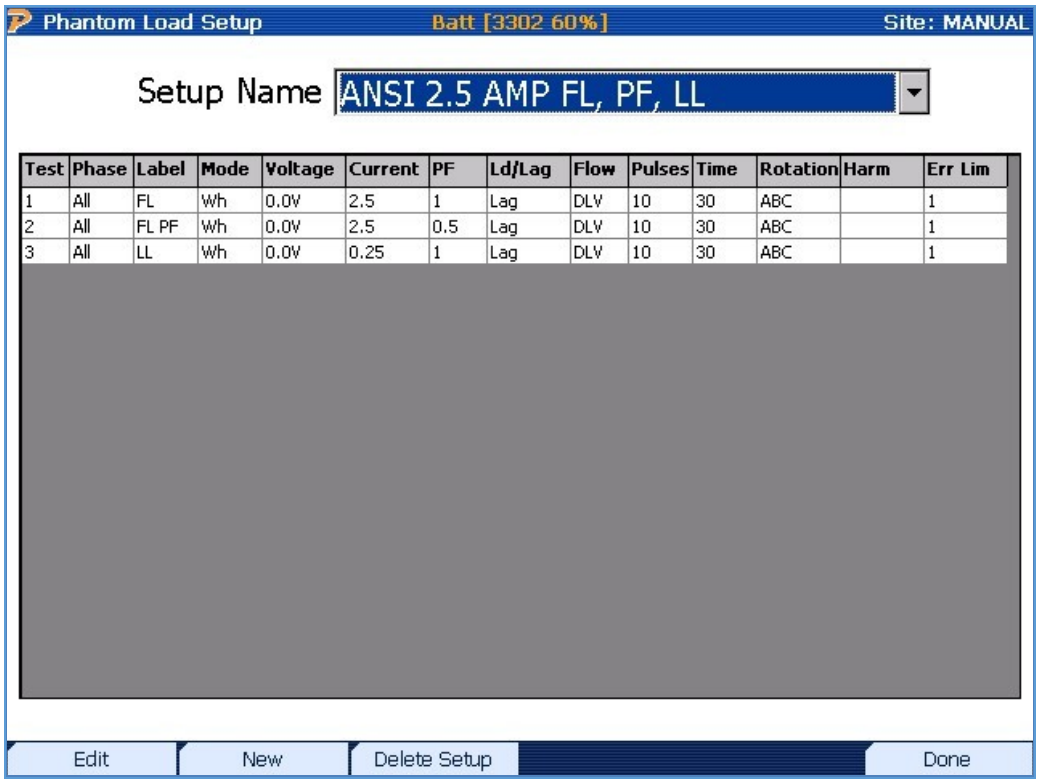
Synchronize Test to Clock (End-to-End Testing)
When using the "Synchronize Test to Clock (End-to-End Testing) feature, the first demand interval (5 min) begins when the PowerMaster® clock is at a minute mark that is divisible by 5. For example, if the demand test starts at 11:03am, the first interval will not start until 11:05am.

The next interval will start at 11:10am, and so on. This is used to precisely time the demand intervals for comparison to meter data acquisition systems.

Synchronize To Meter

If the user would like to compare accumulated results from the PowerMaster® and the meter, enter the Demand Test screen as normal. To synchronize both the meter and the PowerMaster®, do the following: press the RESET on the meter to reset all accumulated demand results and press the F1 (Restart) button then F6 (Start Testing) on the PowerMaster® SIMULTANEOUSLY. This will synchronize the results and accumulate power accordingly. After the test is complete, compare the “Demand Interval” results against the meter. These results are the accumulated power during the demand period.

10.2 Phantom Load Setup



Functionality:

	Enters drop down box and views stored Phantom Load Setups
	Views selections in drop down box
F3	Allows the user to edit/delete an existing setup or create a new setup
F6	Selects test and continues

Description:

This screen verifies to the user the details of each test and what order each test will be administered. This is a read-only screen, so any changes must be made in the Site Editor (see Section 7.4.1.2).

Phase: This corresponds to the particular phase(s) to be tested. Selections are A, B, C, or All. "All" applies to 3-phase simultaneous measurements. When a 1 or 2 element meter is testing, "All" will still apply. When testing single elements, the user will select only the appropriate phase that corresponds to the particular service type.

Label: This generates a label for the test. Selections are FL, PF, LL, FL PF, and LL PF. Labels can be edited and created in the User Preferences menu (see Section 15.4).

Mode: This corresponds to the energy calculation for each test. Selections are Whr, VARhr, and VAhr. All energy calculations are based on the selected measurement calculations selected in the User Preferences menu (see Section 15.2). Note that selections for VARhr and VAhr will not automatically set the required phase shift. These values must be manually entered in the "PF" field.

Voltage: This corresponds to the desired generated voltage for all active phases. Selections are Line, 69V, 120V, 240V, 277V, 480V, and 600V. "Line" refers to the actual line voltage for the meter installation. "Line" is the only available option for Models 7302 & 7305.

Current: This corresponds to the desired generated current for all active phases. The user may enter a value between 0.1 to 20A for Models 7302 & 7332, and a value between 0.1 to 50A for Models 7305 & 7335.

PF: This corresponds to the cosine of the phase angle for the current for all active phases. The voltage phase angles are set by the selected service type. The user may enter a value between 0 to 1.00 for the desired power factor, positive or negative.

Lead/Lag: This corresponds to the desired phase shift for all active current phases.

Flow: This corresponds to the desired energy flow for all active phases. Selections are Delivered or Received. When "Received" is selected, all active current phases will automatically shift 180˚.

Pulses: This corresponds to the desired number of pulses to measure during each test.

Time: This corresponds to the desired time to measure during each test. If both Pulses and Time are selected, the test completes when either selection is first exceeded.

Rotation: This corresponds to the desired phase rotation for all active current phases. Selections are ABC or CBA. When using "Line" for voltage, it is important to match the desired rotation to the actual rotation of the meter installation.

Harm: This refers to the desired harmonic content available for each test (see Section 10.2.1).

Err Lim: This refers to a user defined error limit (expressed in percent) for each test point.

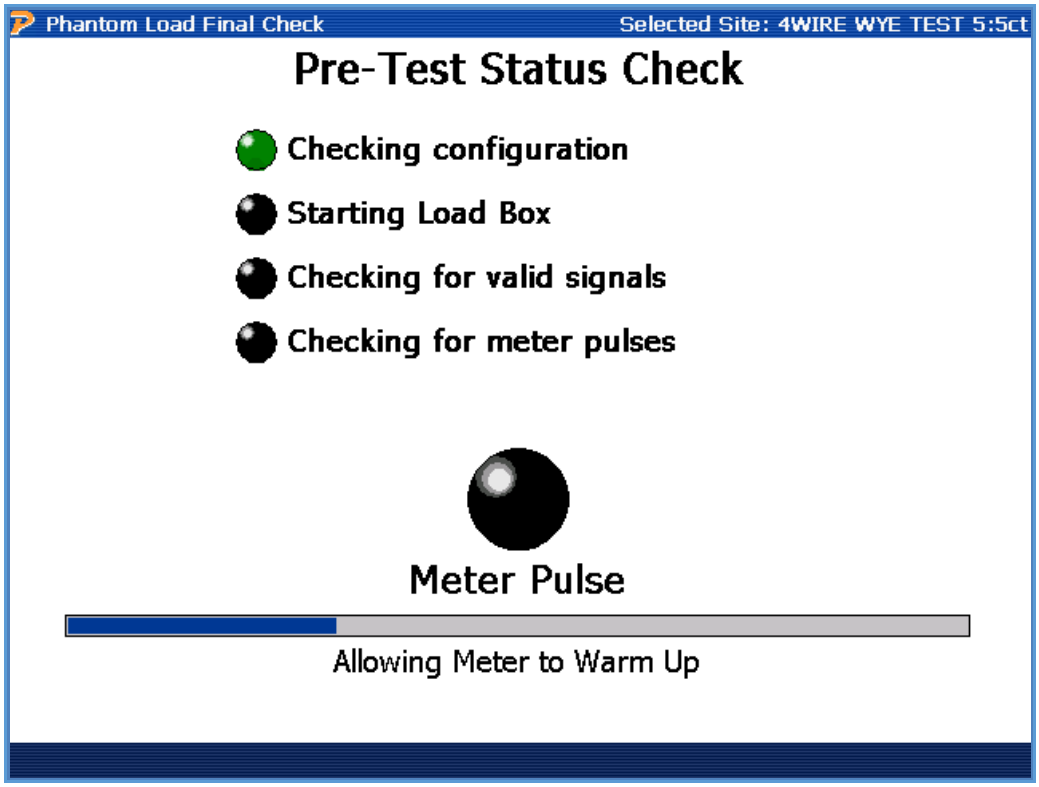
10.2.1 Phantom Load Testing with Harmonics

The Models 305 and 335 introduces the ability to generate different types of current waveforms to be utilized under phantom load field testing conditions. There are six different waveforms able to be utilized in field phantom load test, which are:

1. Sine: Pure Sine Wave, no distortion.
2. Phase Fired: This is typical of a current waveform on a thyristor controlled load. It energizes at 90° peak. (2.5A test max output current)
3. Quadriform: Typical of an industrial load with multiple drives operating. (2.5A test max output current)
4. Multiple Zero Crossings: Waveforms created that cross zero axis multiple times, results of industrial loads such as switching power supplies and triacs. (2.5A test max output current)
5. Standard:
6. Test:

By selecting one of these waveforms, the 335 will output the current waveform during phantom load testing. This will help alleviate concerns of meter testing that is performed in the field as not being "real-world scenarios".

10.2.2 Phantom Load Test Procedure



Functionality:

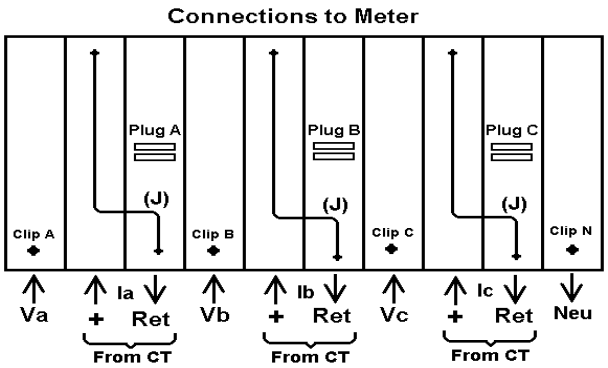
F6	Continues

Description:

This screen starts the Phantom Load test procedure. This process includes verifying the correct probes are connected, the service type is correct, and the jumpers are installed. Next, the load box will begin to generate current and voltage (model dependent) and allow time for the load to settle. Next, current and voltage readings are measured to verify everything is correct. Lastly, when meter pulses are detected the unit is ready to test.

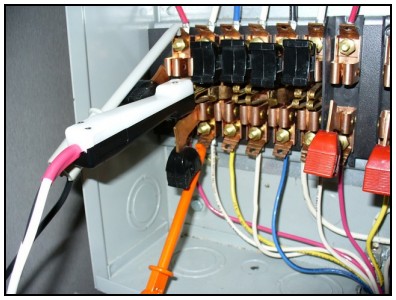
When current is detected an error screen will display. Correct the problem by installing the CT Jumpers, then press “Retry” to attempt the test again. The same applies if voltage is detected when generating a synthesized voltage. This process is done to prevent damage to the PowerMaster® unit and the meter installation.

CT Jumpers: These are used to create a path for the synthesized current to flow. The user will short the CT circuit by opening the current (+) path on the test switch. While this takes the CT out of service and the meter will register no current, a pathway is not in place. To accommodate this, the current jumpers are installed for each active phase current. While the CT is “open” (CT switch is in an open position), the user will connect one end of the current jumper (J) to the top of the test switch (+). The other end of the jumper (J) will connect to the bottom of the current return path (Ret). Each active phase current must have an installed jumper for the phantom load box to operate. See diagram below:



Procedure

STEP 1

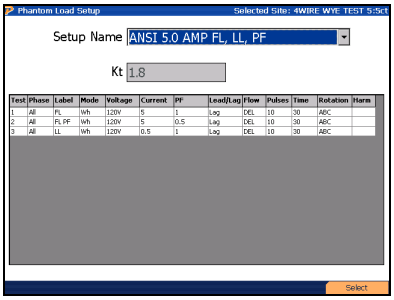


Connect CT jumpers

STEP 2

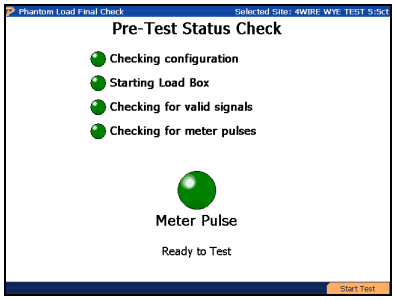
Hook up pulse pickup to meter

STEP 3



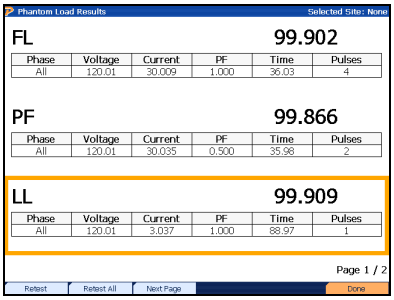
Select test, then press F6

STEP 4



After pulses detected, press F6

STEP 5



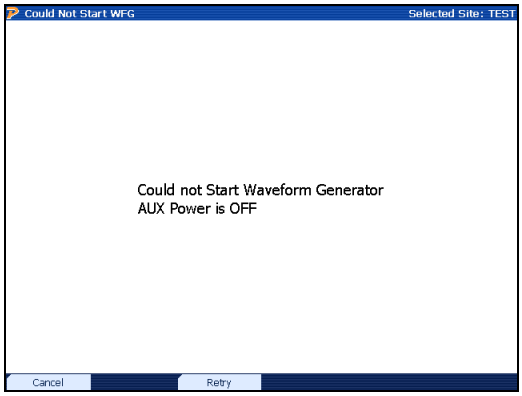
After test, press F6 to complete

Error Messages

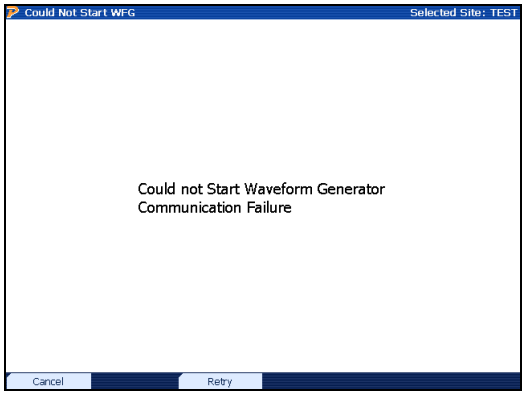
In some instances, the load box (WFG) will display errors when certain criteria are not met. These errors may also occur when a fundamental error with the setup is diagnosed. The load box will specify what phase is causing the error (ex. “Ia”).

If the user encounters one or more of these error codes, please check the setup again. Verify the current jumpers are installed correctly and the test switch is in a testing prepared method. For the PowerMaster® to correctly stabilize the currents, the Neutral voltage must be tied to an earth ground at the test switch.

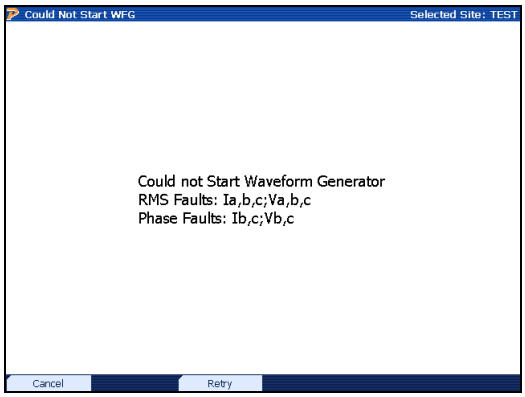
Examples:



The PowerMaster® cannot detect an auxiliary power source between 100-530VAC. Check the connections and/or verify the Auxiliary Power switch is in the “on” position (- = on).

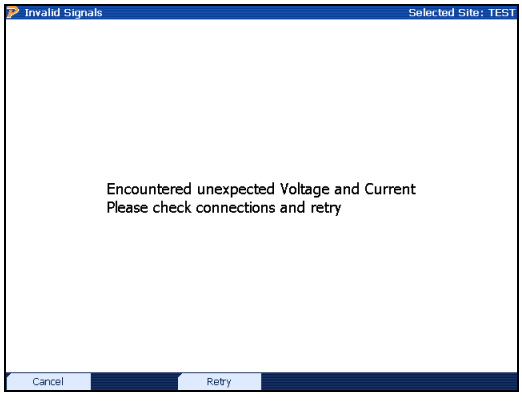


The PowerMaster® cannot communicate with the WFG board. Attempt to power off/on to fix the issue. If this is not successful, contact Technical Support.

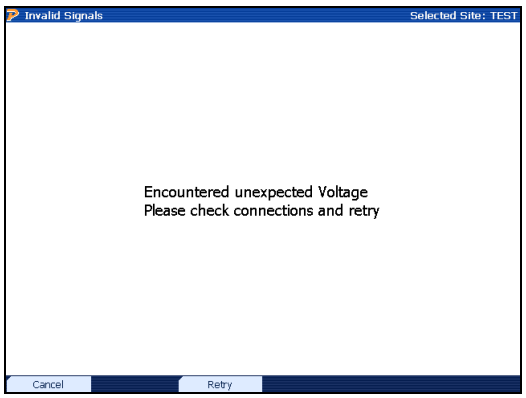


The PowerMaster® cannot stabilize the currents and/or voltages. Attempt the following:

1. Verify the CT jumper connections
2. Verify the green safety ground lead is connected to true earth
3. Attempt moving auxiliary leads to a different AC source
4. Attempt to uncheck “Stabilize Load Box Phases” in User Preferences (see Section 15.9.3)



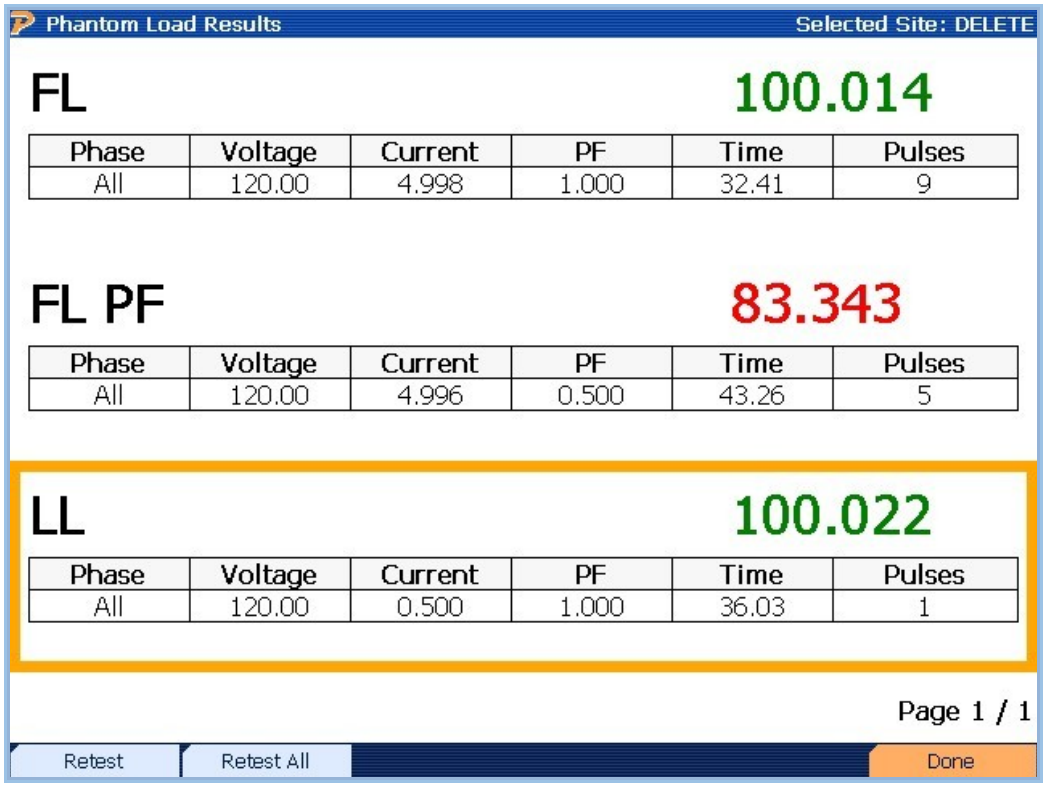
The PowerMaster® sees a voltage signal AND a current signal. Check the connections.



The PowerMaster® sees a voltage signal that is ±0.5% beyond the desired amplitude. Verify the following:

1. The voltage test switches are shunted and the alligator clips are moved to the top.
2. The selected setup may be incorrect. If attempting to drive voltage, verify the field is not set to “Line”.

10.2.3 Phantom Load Test Results



Functionality:

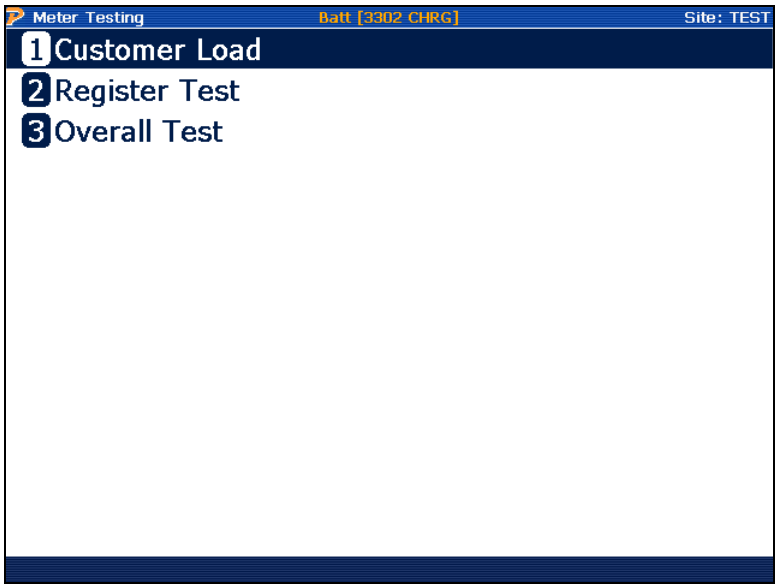
▲ ▼	Moves cursor up and down for selecting a point to retest
F1	Retest selected point
F2	Retest all points
F6	Completes test and shuts down load box

Description:

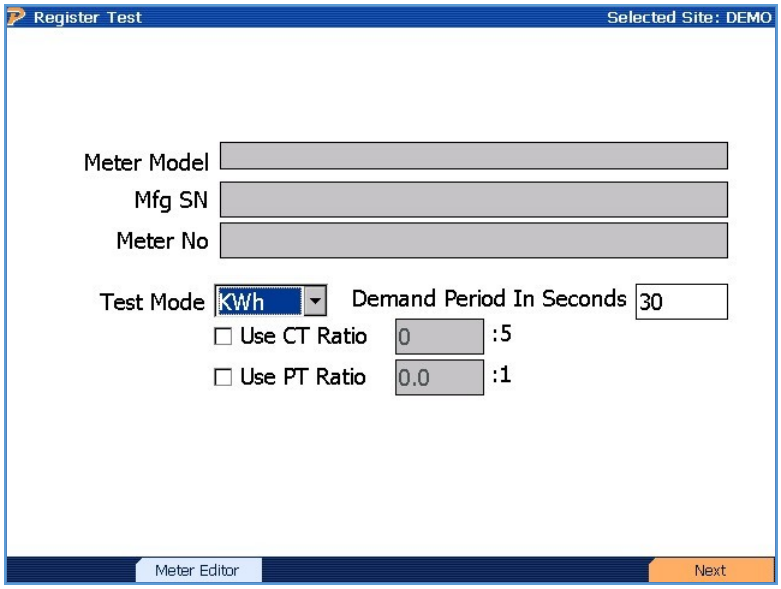
After results are complete, the ability to retest each point is offered to the user. If satisfied with the results, press F6 to complete the test.

10.3 Customer Load Register Test

To select the Register Test, verify a site has been selected and the option “3” on the menu says Meter Testing. Select option 3, and then option 2 for Register Test.



10.3.1 Register Test Setup



Functionality:

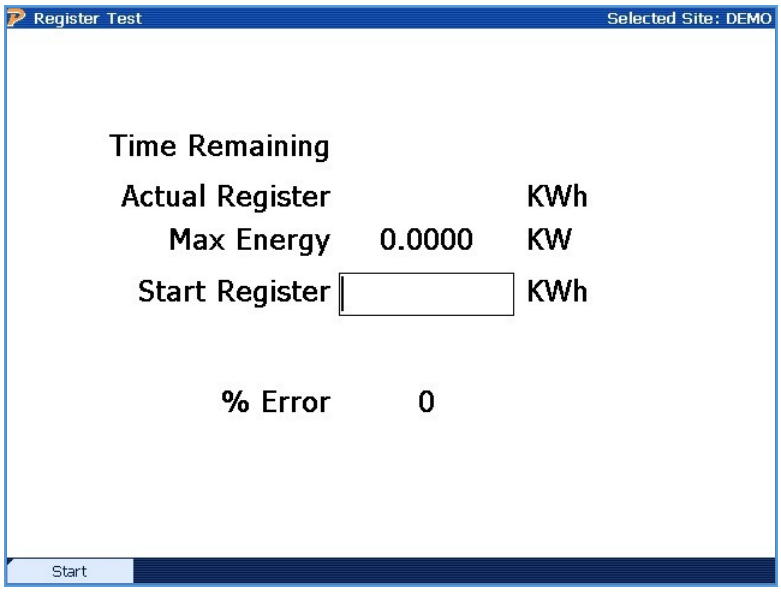
	Moves to next field
	Moves to previous field
	Enters drop down box and views test mode selections; checks/unchecks check boxes

▲ ▼	Moves cursor up and down for selecting a test mode in the drop down box
F2	Enters the Meter Editor Screen, See Section 7.5 for more details
F6	Continues

Description

Verify the settings are correct, and change the value of “Demand Period in Seconds” to the required value. Press F2 to access the meter editor to enter any meter values required.

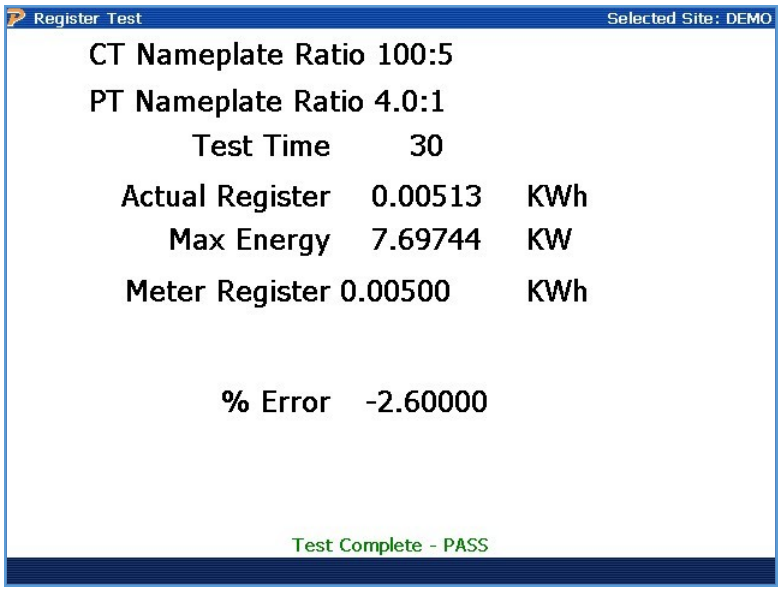
10.3.2 Begin Register Test



Description

Verify on the meter faceplate the current registration value. Enter that value into the “Start Register” Field. Press F1 “Start” to begin the test.

10.3.3 Register Test Results

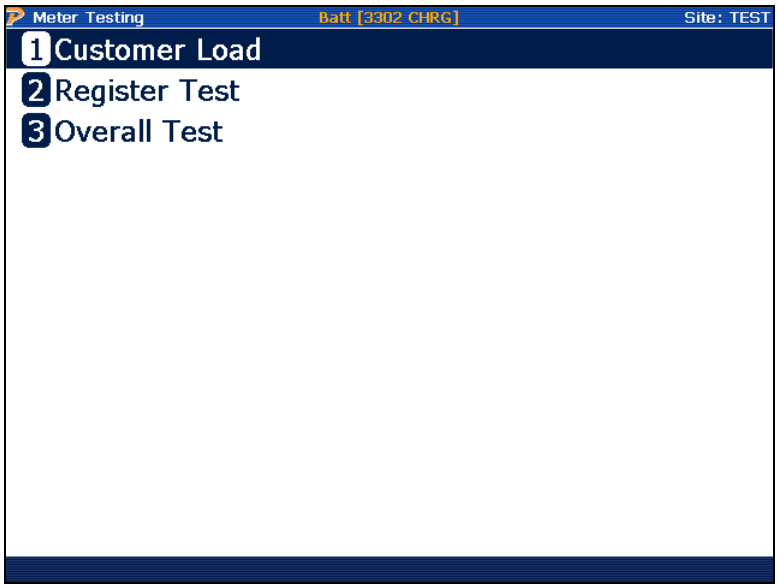


Description

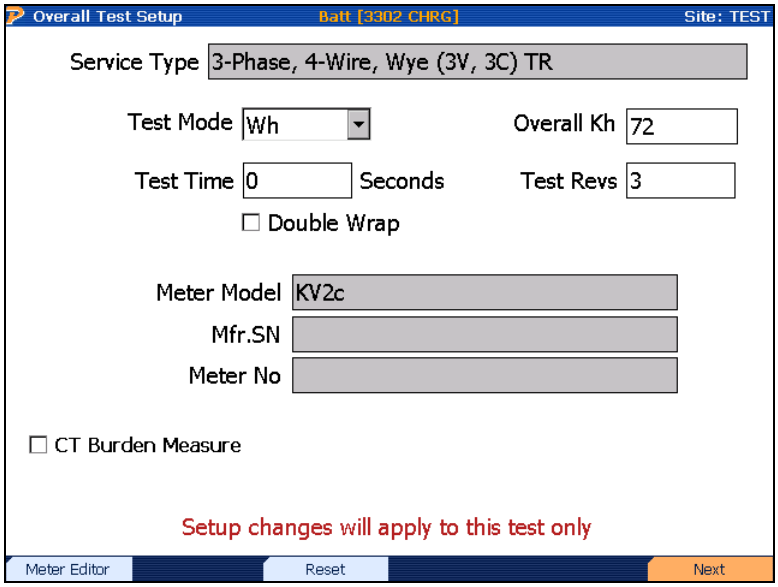
Once the test is complete, enter the register value from the meter faceplate again, and the % error will be calculated versus measured and calculated values.

10.4 Overall Test

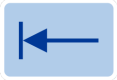
To select the Register Test, verify a site has been selected and the option “3” on the menu says Meter Testing. Select option 3, then option 3 for Overall Test.



10.4.1 Overall Test Setup



Functionality:

	Moves to next field
	Moves to previous field
	Enters drop down box and views test mode selections; checks/unchecks check boxes

▲ ▼	Moves cursor up and down for selecting a test mode in the drop down box
F2	Enters the Meter Editor Screen, See Section 7.5 for more details
F6	Continues

Description

This screen allows the user to perform a meter test using the customer's load using the primary inputs. Similar to Customer Load Test, this means that the PowerMaster® will calculate the registration or error (based on user preference) over a set timed period (either time or pulses). The end result is expressed as a percent.

The user has the option to select "Double Wrap" if using the Flexible Current Probes to measure the current inputs. Also, "CT Burden Measure" can be selected as a next test immediately after the Overall Test is complete.

How to Calculate "Overall Kh"

Much like in Customer Load test, the user must enter a meter constant to correctly calculate the energy values from the meter. Since primary currents are measured instead of secondary currents, the Kt value must be re-calculated to use the appropriate inputs. Using the installation's billing multiplier, the correct Kt can be used.

The formula to calculate a billing multiplier is such:

Billing Multiplier = (CT multiplier) x (PT multiplier)

To calculate the CT and PT multiplier, the primary current and primary voltage must be divided by its ratio. For example, a CT that has a nameplate of 200:5 has a CT multiplier of 40 (200/5=40). If no PTs are installed, the PT multiplier is "1".

For example, if the installation has 200:5 CTs and 4:1 PTs, our Billing Multiplier is 160:

160 = (200/5) x (4/1)

Next, the Kh value from the meter is multiplied by the Billing Multiplier:

Overall Kh = Meter Kh x Billing Multiplier

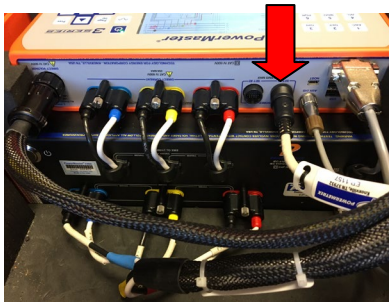
For example, if the meter Kh is 1.8, the Overall Kt value is 288 (1.8x160=288)

10.4.2 Performing an Overall Test

STEP 1

Connect voltage leads to test switch at meter. Place pulse pickup on meter.

STEP 2

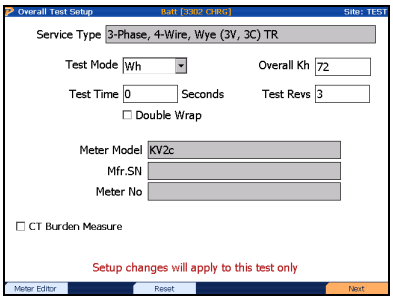


Connect Current Probe Adapter cable to PROBE SET 1. Connect probes to cable ends.

STEP 3

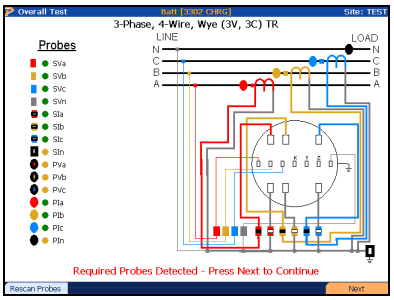
Wrap or connect primary probes around conductors at CT

STEP 4



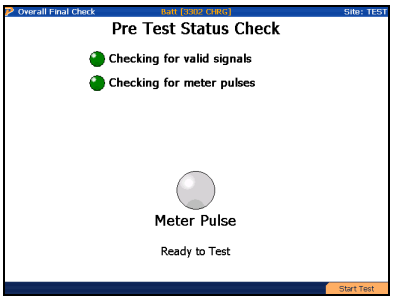
On PowerMaster, enter Kh and test parameters. Press F6 to continue.

STEP 5



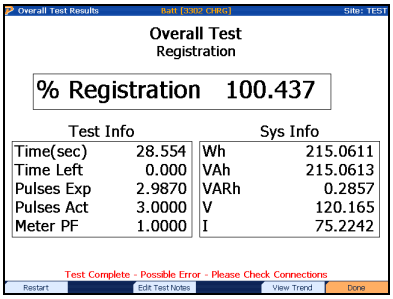
Verify primary probes are connected. Press F6 to continue.

STEP 6



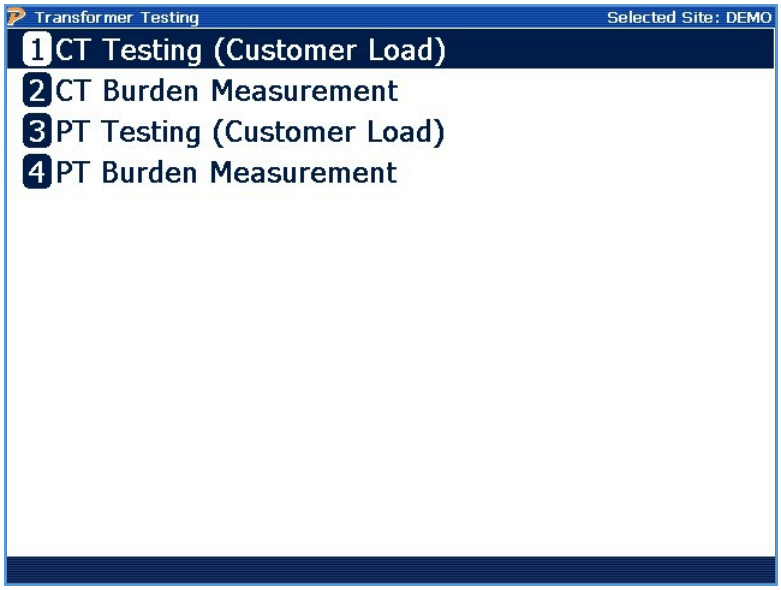
Once pulses are detected, press F6 to continue.

STEP 7



View results. Press F6 to complete test.

11 Instrument Transformer Testing



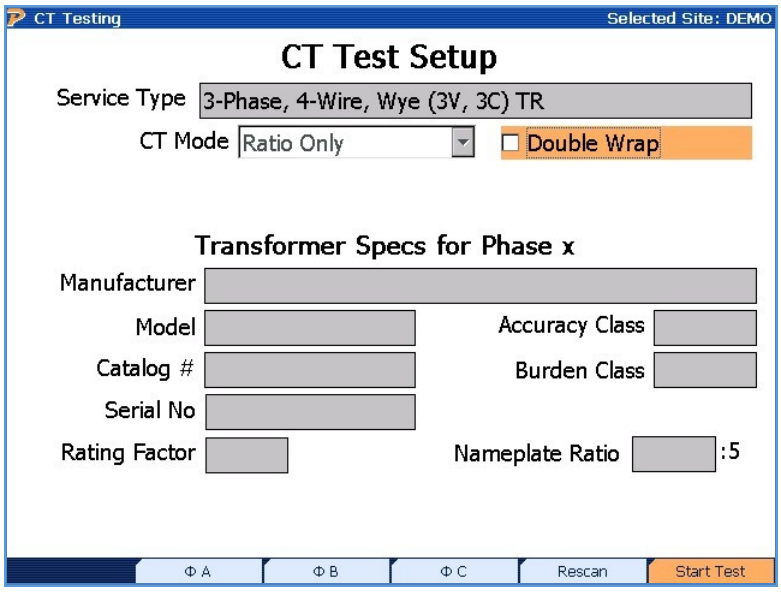
Functionality:

▲ ▼	Moves cursor up and down to a menu selection
ENTER	Accepts and enters menu selection

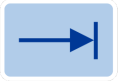
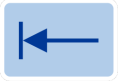
Description:

The screen allows the user to select the appropriate instrument transformer test. Both CT's and PT's can be tested under customer load conditions, or their circuit's burden can be measured.

11.1 CT Testing (Customer Load)



Functionality:

	Moves to next field
	Moves to previous field
	Enters drop down box and views test mode selections; checks/unchecks check boxes
	Moves cursor up and down for selecting a test mode in the drop down box
F2	Views the database information for CT phase A (default)
F3	Views the database information for CT phase B
F4	Views the database information for CT phase C
F6	Continues

Description:

This screen allows the user to perform a current transformer (CT) test using the customer's load. This test has several options to choose from:

1. **Burden Only (with Models 303, 305, 335):** Checks only the effect of additional burden (resistive load) on the CT secondary output current. Error readings are based off of the burden class rating of the CT.
2. **Ratio Only:** Checks only the CT ratio (and angle) as measured from the actual CT primary and secondary currents

3. **Burden + Ratio (with Models 303, 305, 335):** Simultaneously checks the CT secondary current and ratio as additional burden is applied. If practical, Burden + Ratio Testing is recommended since it provides ratio data that can be directly compared to the nameplate value.

The values for “CT Mode” and “Maximum Burden” are populated using the settings in the Test Editor that is associated with the site installation. These fields are editable, but the edits are never saved back to the database. These changes apply to this test only.

The “Transformer Specs” for each individual phase are populated using the information from the Site Editor. These fields cannot be edited in this screen, but must be edited in the Site Editor screen.

Burden and Burden + Ratio Testing Restrictions

The PowerMaster® will follow a designated set of rules to help protect the hardware under certain testing conditions.

Mode	Max Added Burden	Max Secondary Current
Burden Only & Burden + Ratio	≤ 2.0 Ω	≤ 6A
Burden Only & Burden + Ratio	≤ 1.0 Ω	≤ 8A
Burden Only & Burden + Ratio	≤ 0.5 Ω	≤ 10A
Ratio Only	N/A	≤ 20A

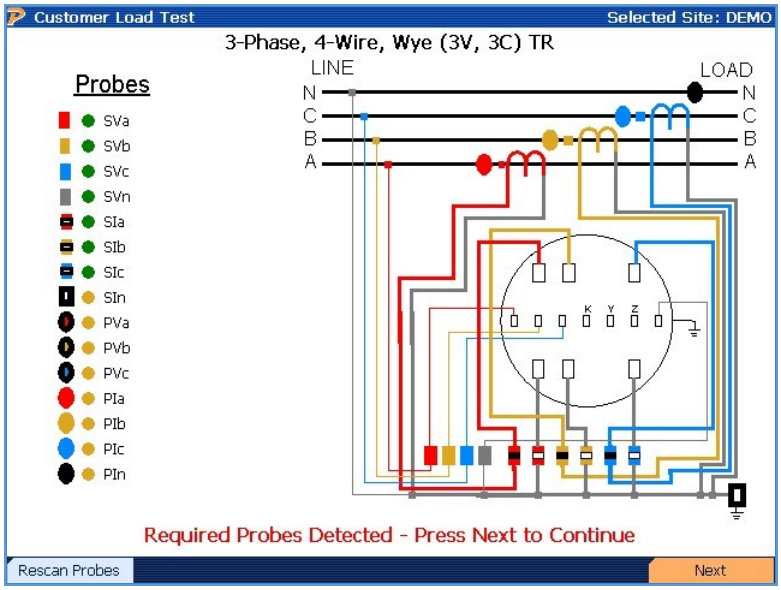
When the max added burden or secondary current is exceeded, an error message will display to the user. The user will be required to return to the CT Test Setup and change testing parameters based on the load present to complete the test.

Testing Tips:

1. Verify the probe is rated for the voltage and current being tested. Only use probes meeting the manufacturer’s specifications. Using probes that do not meet the manufacturer’s specifications may lead to a safety hazard.
2. Never connect a current probe around a conductor before terminating it to its cable and to the PowerMaster®.
3. For LiteWire probes, verify the optic cable is clean to prevent surface arcing.
4. Position the probe head perpendicular to the current carrying conductor as nearly in the center of the probe opening as practical.
5. For clamp-on probes, clean contact surfaces and then snap and release the jaws to verify a metal-to-metal contact of the jaws (dirt and grease may contaminate the surfaces.)
6. For flexible probes, the plastic closure connector should be fully closed and be positioned as far as possible from the conductor (also observe #7 below).
7. Position the probe as far as practical from other current carrying conductors. (All current probes will respond to external currents.)
8. For LiteWire probes, press the black button 2x on the head assembly to force the 2000A range when currents are above 100 amps. (Note that the decimal is not displayed on the receiver unit when the 2000A range is active.)

9. For LiteWire probes, position the open end such that it is not pointing toward other current carrying conductors.
10. IN GENERAL, if a CT Ratio test has an erroneous ratio result or a phase angle greater than ±1°, check the installation of the current probe before suspecting a CT problem.

11.1.1 CT Test Probe Setup



Functionality:

F1	Verifies connected probes if a problem occurs
F6	Continues

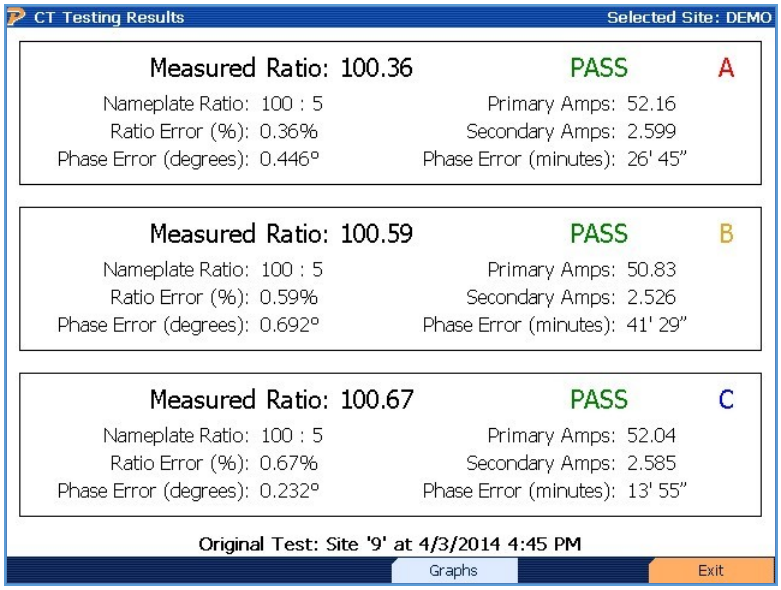
Description:

When entering this screen, the PowerMaster® performs both a “Probe Scan” (see Section 13.8.2) and allows the user to verify probe connections. A key is displayed at the left of the screen and shows what probes are active and required for this test. Color codes are also displayed (A = red, B = yellow, C = blue, N = gray).

If the primary probe(s) are not connected at this point, an error is displayed. The signal next to the Primary Current fields (PIa, PIb, PIc) displays red. To rescan the probe inputs, press F1. If the probes are detected, a green signal displays next to the primary probe fields

A single primary probe (Flexible current probe, Amp Litewire, or clamp-on probe) is required. The user has the option to connect up to three (3) primary probes for three-phase testing. These probes will connect to the 3-Phase Probe Adapter Cable. This cable is then connected to the PROBE SET 1 or PROBE SET 2 input on the front panel.

11.1.2 CT Ratio Testing Results



Functionality:

▲ ▼	Moves cursor up and down for selecting a CT to retest
F1	Performs a retest on a highlighted CT
F2	Retests all CT's
F4	Views the graphical test data for all CT's
F5	Views the numerical test data for all CT's
F6	Completes CT test and saves data

Description:

This screen displays the results of the CT test for each phase. A phase is always located at the top graph, then the other two graphs correspond to B phase and C phase respectively. If the user is testing a service type with only 1 or 2 CT's present, the PowerMaster® will only test the CT's that are active for the particular service type.

The measured CT ratio value is displayed as "Measured Ratio." This value is calculated from the current readings from the secondary probe(s) and primary probe(s). Phase angle information is also displayed as an angle or in minutes. Generally, the user desires the measured CT ratio value to be as close as possible to the CT nameplate value. Once this is determined, the user can specify the test to "pass" or "fail" according to their utility's standard procedures.

The "PASS" or "FAIL" message is generated using the CT accuracy class (see Section 13.9.1) and the selected error limit from the User Preferences menu. If no CT nameplates are selected in

the Site Editor, the PowerMaster® estimates a nameplate according to the readings and a default accuracy class of 0.3. Once the measured ratio is displayed, the PowerMaster® calculates the error to see if it is within limits. For example, if the measured ratio is 201.86:5, the nameplate is 200:5, the accuracy class is 0.1, and the error limit is set to "2.0x Specification Accuracy," then the PowerMaster® will display a "FAIL" message. Here is how it is calculated:

[(201.86-200) / 200]*100 = 0.93% error

(Accuracy class = 0.1) * (Error limit = 2) = ±0.2%

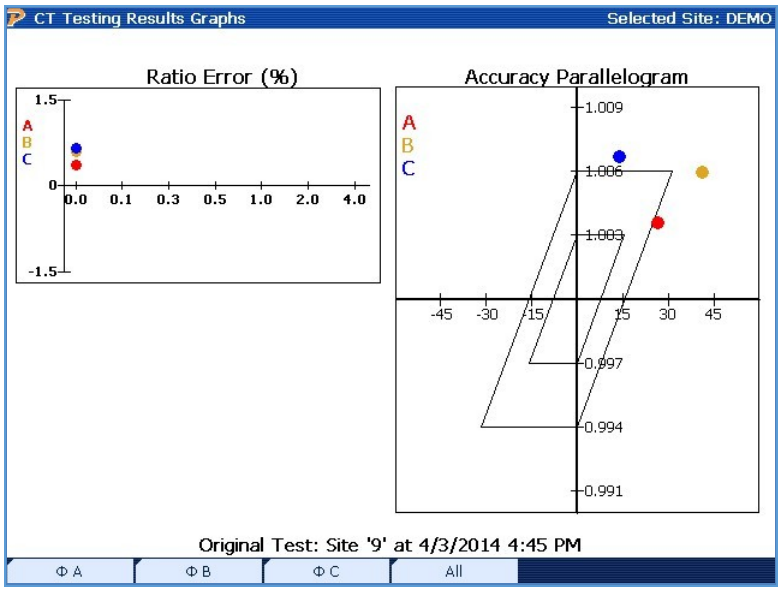
0.93% > 0.2% = FAIL

Errors that could cause a CT to fail could be improper labeling of the CT, overburdened, loose wires, or a damaged CT. In addition to physical problems such as those listed above, there are other reasons a CT could fail a test. A CT"s accuracy class is only valid if the CT is operating within its temperature, rating factor, burden, and current limits.

If a CT is overburdened, it can cause the secondary current to drop, and reduce the accuracy of the CT in the test results. For the above listed transformer, the 0.1% accuracy is only valid if the CT is fully loaded on the primary. The CT would then also only be 0.2% accurate from 10% of its rated load, to maximum load. Below 10% of the rated load, there is no guarantee of accuracy.

Because of these problems, using a CT with a higher rating factor will help with increased accuracy. The rating factor on a CT is a multiplier of the ratio which allows more operating range at its rated accuracy. If a CT has a rating factor of 2, a ratio of 20:5 and is rated at 0.3% accuracy, it will maintain that 0.3% accuracy from 20A to 40A, or Primary rated maximum current * rating factor.

11.1.3 CT Ratio Testing Results Graphs



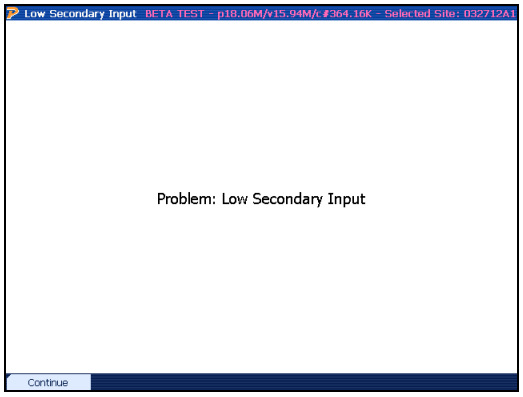
Functionality:

F1	Isolates graph for A phase only
F2	Isolates graph for B phase only
F3	Isolates graph for C phase only
F4	Views graphs for all phases (default)

11.1.3.1 CT Testing Error Messages

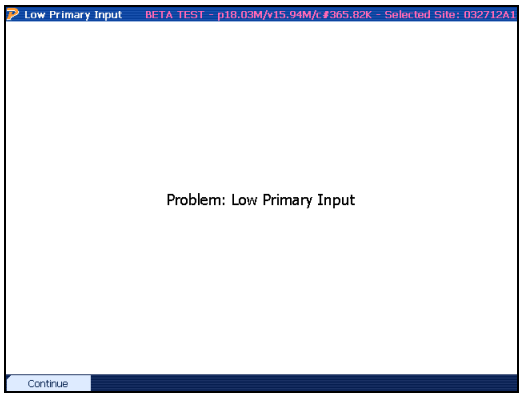
During the CT test, the PowerMaster® may display error messages if a problem occurs. If the user encounters one or more of these error codes, please check the setup again.

Examples:



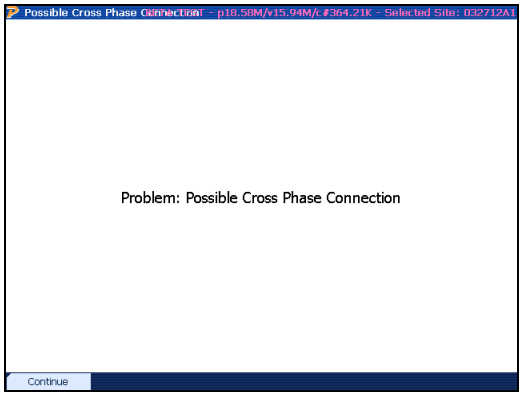
The PowerMaster® detect less than 0.1A secondary current on the probe used for the phase under test. Check the following:

1. Verify the CT does not have a shunted secondary
2. Verify the probe is inserted into the test switch or clamped on the secondary wire
3. Check for a wiring error from the secondary of the CT
4. Contact Technical Support for troubleshooting the probe and/or analyzer



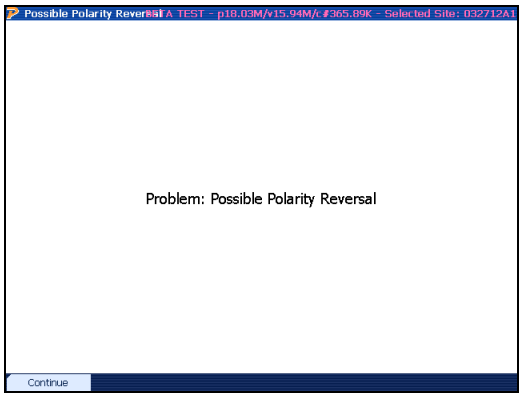
The PowerMaster® detect less than 0.1A primary current on the probe used for the phase under test. Check the following:

1. Verify the probe is connected to all primary conductors for the CT
2. If using the HV probe, verify the probe is turned on.
3. Check for a wiring error from the primary of the CT
4. Contact Technical Support for troubleshooting the probe and/or analyzer



The PowerMaster® detects a phase angle error greater than 100 degrees for the phase under test. Attempt the following:

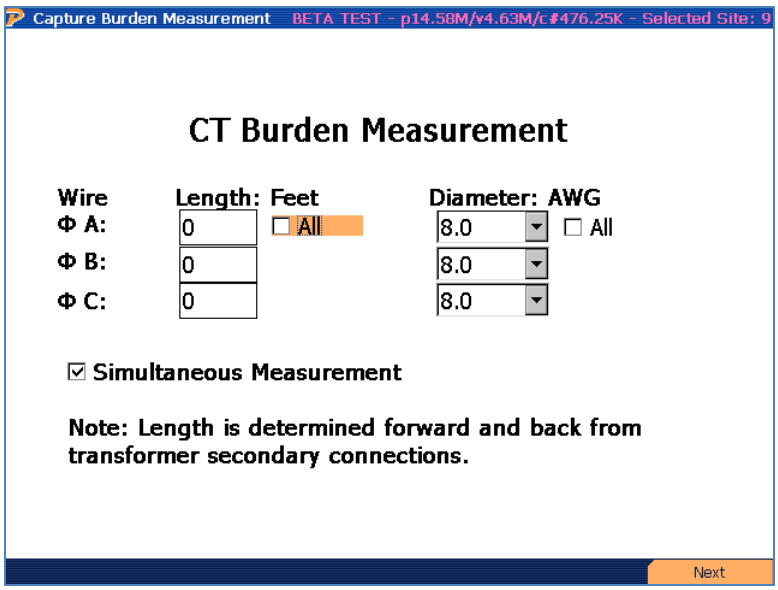
1. Verify the probe is connected to all primary conductors for the correct CT
2. Verify the probe is not connected to an incorrect phase
3. Check for a wiring error from the primary of the CT
4. Contact Technical Support for troubleshooting the probe and/or analyzer



The PowerMaster® detects a phase angle error between 190 and 170 degrees for the phase under test. Attempt the following:

1. Verify the polarity of the probe is correct (arrow towards load)
2. Check for a wiring error from the primary of the CT
3. Contact Technical Support for troubleshooting the probe and/or analyzer

11.2 CT Burden Measurement



Description:

This application allows the user to perform an in service burden measurement of the CT circuit. There are four different methods to measure the burden in the system using the PowerMaster®:

1. Direct Connections to CT with Common Neutral Phase
2. Direct Connections to CT with Separate Neutrals
3. Calculated Burden with Connections to Test Switch and Common Neutral Phase
4. Calculated Burden with Connections to Test Switch and Separate Neutrals

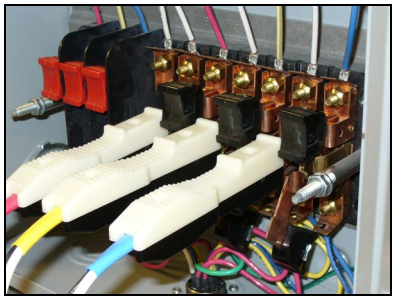
For each method, the PowerMaster® measures the entire resistance in the circuit for each CT. If a CT is selected in the Site Editor, the PowerMaster® will display a PASS or FAIL message on the screen based on burden rating (Ohms). If a FAIL message is displayed, this means that the measured resistance in the circuit exceeds the manufacturer's stated burden rating. If resistance increases enough to over burden the CT, less secondary current is produced. This scenario results in a billing error even though the meter is functioning correctly.

Once an error is detected by the PowerMaster®, the technician should follow methods on decreasing the actual burden. This normally consists of tightening down connections at the test switch and/or CT secondary terminals. If a problem remains, the technician may consider replacing the CT with a higher burden rating to validate resistance is within specification.

11.2.1 Direct Connections to CT with Common Neutral Phase

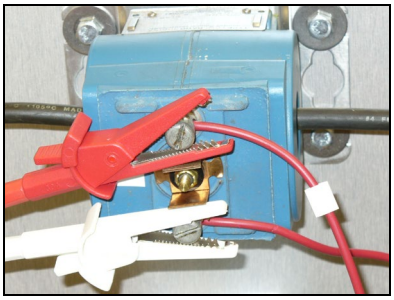
This set of instructions is applicable when all active CTs share a common neutral and/or ground.

STEP 1



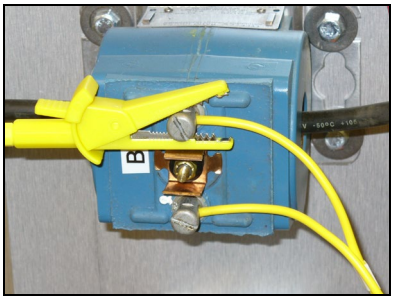
Insert direct current probes into test switch.

STEP 2



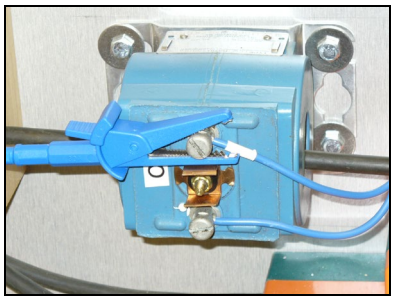
Connect the red (+) and white (-) voltage cable connections to the CT secondary for A phase

STEP 3



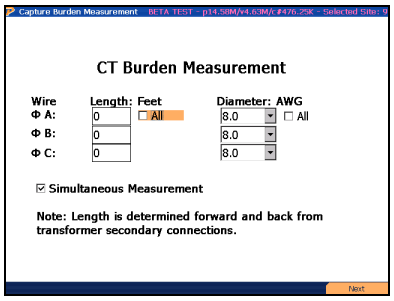
Connect the yellow (+) voltage cable connection to the CT secondary for B phase

STEP 4



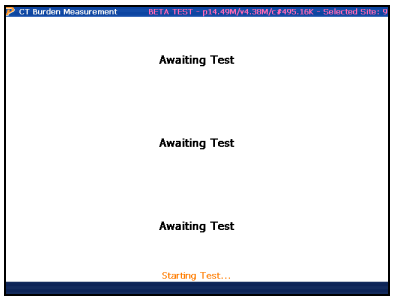
Connect the blue (+) voltage cable connection to the CT secondary for C phase

STEP 5



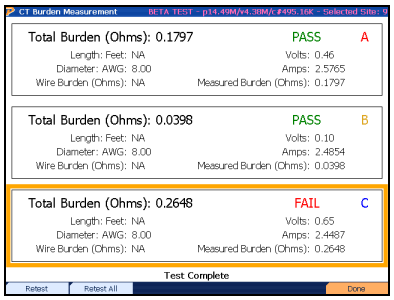
Verify Length is set to 0 and "Simultaneous Measurement" is selected. Press F6 to continue.

STEP 6



Test will begin automatically

STEP 7

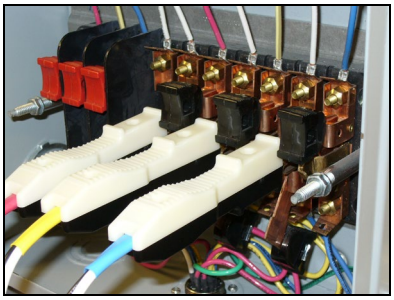


View results. Press F6 to save and complete.

11.2.2 Direct Connections to CT with Separate Neutrals

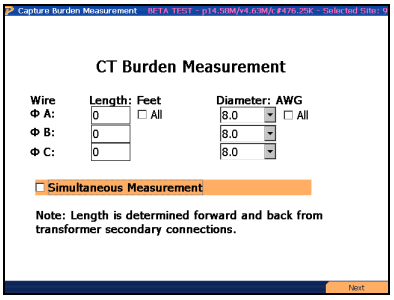
This set of instructions is applicable when all active CTs do not share a common neutral and/or ground.

STEP 1



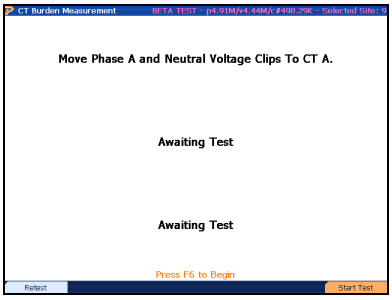
Insert direct current probes into test switch.

STEP 2



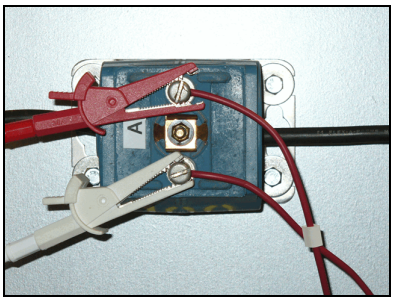
Verify Length is set to 0 and "Simultaneous Measurement" is NOT selected. Press F6 to continue.

STEP 3



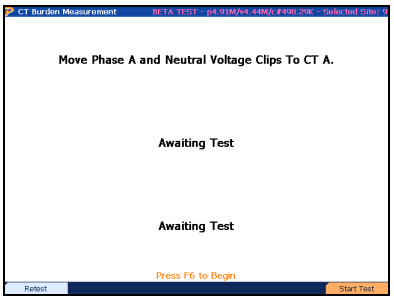
Test will pause waiting for user input

STEP 4



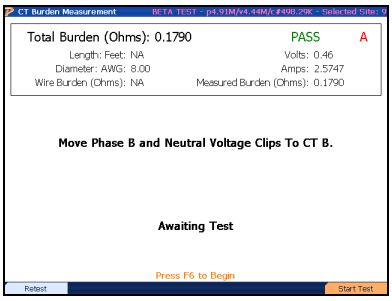
Connect the red (+) and white (-) voltage cable connections to the CT secondary for A phase

STEP 5



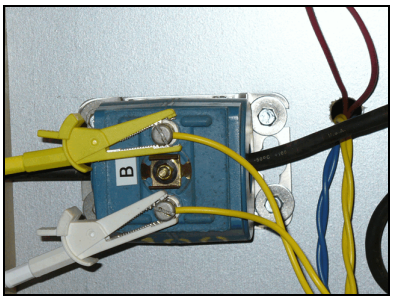
Press F6 to test A phase CT

STEP 6



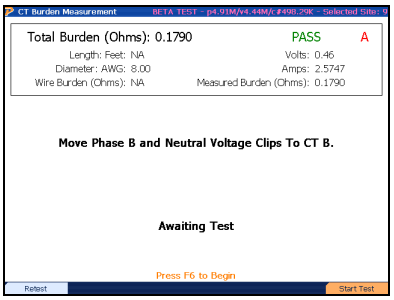
View results for A phase CT

STEP 7



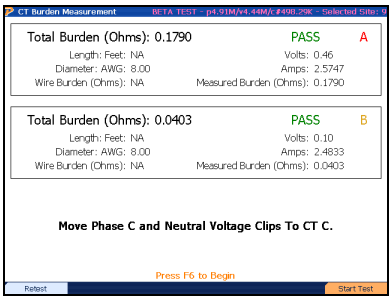
Connect the yellow (+) and move the white (-) voltage cable connections to the CT secondary for B phase

STEP 7



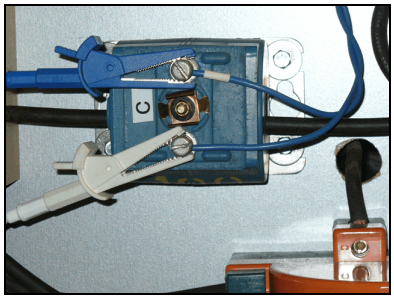
Press F6 to test B phase CT

STEP 8



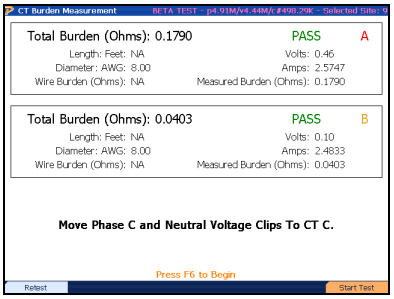
Press F6 to test B phase C

STEP 9



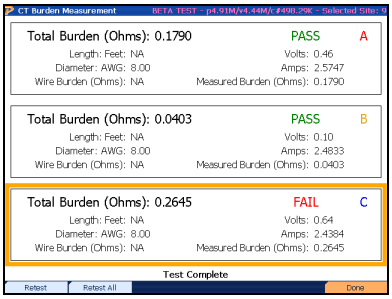
Connect the blue (+) and move the white (-) voltage cable connections to the CT secondary for C phase

STEP 10



Press F6 to test C phase CT

STEP 11

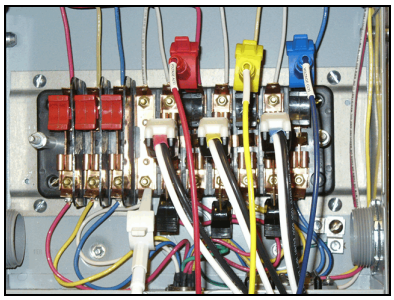


Press F6 to save and complete

11.2.3 Calculated Burden with Connections at Test Switch and Common Neutral Phase

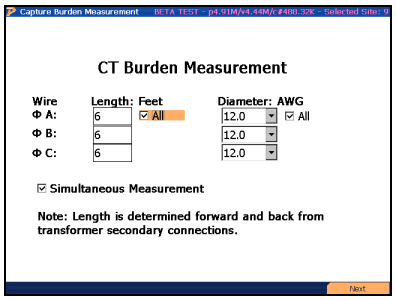
This set of instructions is for an application where the CT secondary connections cannot be accessed. All voltage and current measurements are made at the test switch. The total resistance (burden) is calculated by adding the wire burden and the measured burden. The wire burden is derived from the length and diameter (AWG) of the wire. Length is based on the distance from the CT secondary connection to the test switch and back. For example, if the distance from the meter to the CT is 3 feet, it is assumed the total length to and from the return of the CT is 6 feet. AWG can typically be determined by a notation imprinted on the insulation of the wire (ex. “12 AWG”).

STEP 1



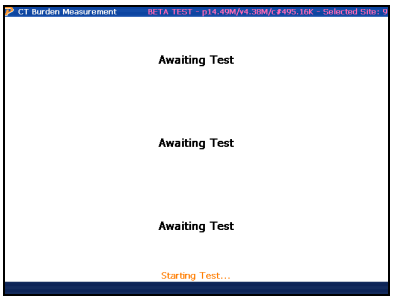
Insert direct current probes and move A, B, C voltage clips to top of currents. Connect white voltage clip to Neutral.

STEP 2



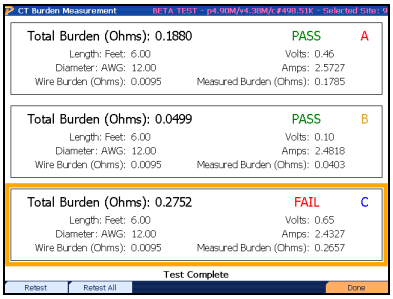
Input the total length and diameter (AWG). Verify “Simultaneous Measurement” is selected. Press F6 to continue.

STEP 3



Test will begin automatically

STEP 4

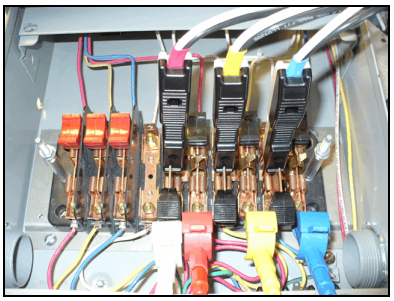


View results. Press F6 to save and complete.

11.2.4 Calculated Burden with Connections at Test Switch and Separate Neutrals

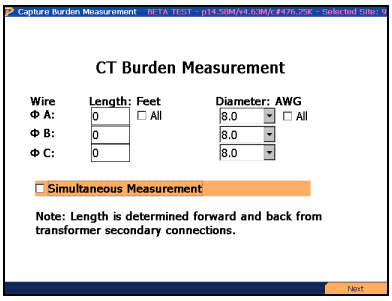
This set of instructions is similar to Section 11.2.3, but the user must move the white voltage clip to the Neutral phase associated with the CT under test.

STEP 1



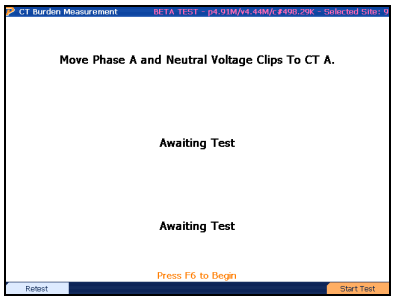
Insert direct current probes into test switch. Move the voltage leads to the bottom of the currents. Connect the white lead (Neutral) to the bottom of A phase current.

STEP 2



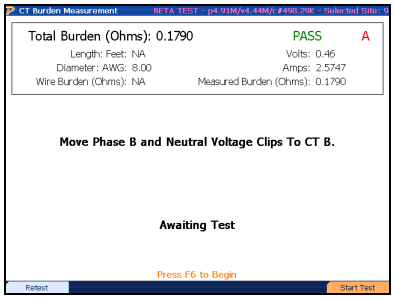
Input the total length and diameter (AWG). Verify "Simultaneous Measurement" is NOT selected. Press F6 to continue.

STEP 3



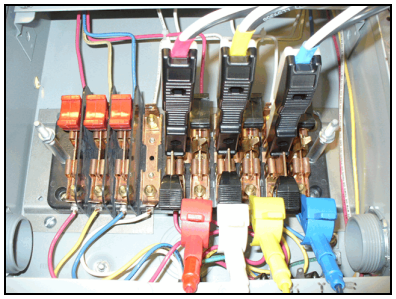
Press F6 to test A phase CT

STEP 4



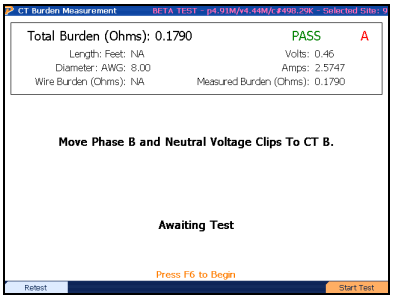
View results for A phase CT

STEP 5



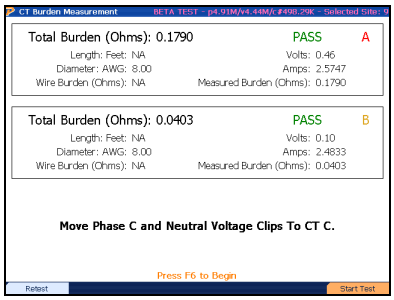
Move the white lead (Neutral) to the bottom of B phase current.

STEP 6



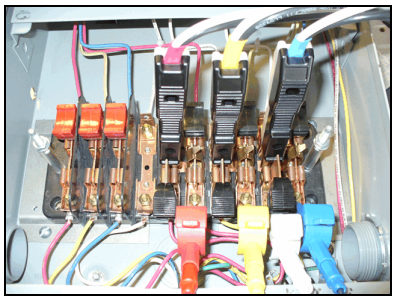
Press F6 to test B phase CT

STEP 7



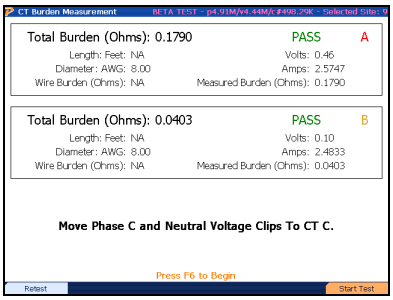
View results for B phase CT

STEP 8



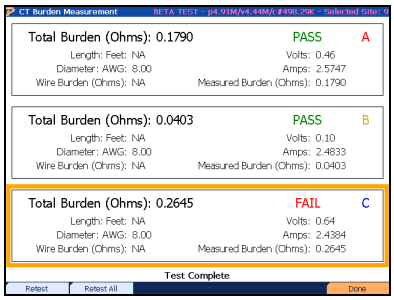
Move the white lead (Neutral) to the bottom of C phase current.

STEP 9



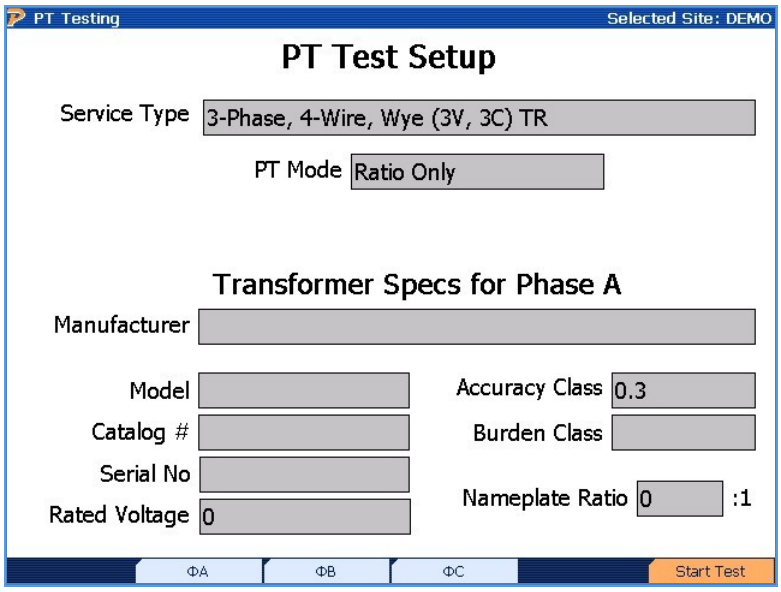
Press F6 to test C phase CT

STEP 10



View results for C phase CT.
Press F6 to save and complete

11.3 PT Testing



Functionality:

F2	Views the database information for PT phase A (default)
F3	Views the database information for PT phase B
F4	Views the database information for PT phase C
F6	Starts the test

Description:

This screen allows the user to perform a voltage transformer (PT) test using the customer's load. The test performed is a ratio test and it checks only the PT ratio (and angle) as measured from the actual PT primary and secondary voltages

The values for "PT Mode" are populated using the settings in the Test Editor that is associated with the site installation. The "Transformer Specs" for each individual phase are populated using the information from the Site Editor. These fields cannot be edited in this screen, but must be edited in the Site Editor screen.

When results are displayed, A phase is always located at the top graph, then the other two graphs correspond to B phase and C phase respectively. If the user is testing a service type with only 1 or 2 PT's present, the PowerMaster® will only test the PT's that are active for the particular service type.

The measured PT ratio value is displayed as "Measured Ratio." This value is calculated from the voltage readings from the secondary probe(s) and primary probe(s). Phase angle information is also displayed as an angle or in minutes. Generally, the user desires the measured PT ratio value to be as close as possible to the PT nameplate value. Once this is determined, the user can specify the test to "pass" or "fail" according to their utility's standard procedures.

The “PASS” or “FAIL” message is generated using the PT accuracy class (see Section 13.9.1) and the selected error limit from the User Preferences menu. If no PT nameplates are selected in the Site Editor, the PowerMaster® estimates a nameplate according to the readings and a default accuracy class of 0.3. Once the measured ratio is displayed, the PowerMaster® calculates the error to see if it is within limits. For example, if the measured ratio is 3.76:1, the nameplate is 4:1, the accuracy class is 0.1, and the error limit is set to “2.0x Specification Accuracy,” then the PowerMaster® will display a “FAIL” message. Here is how it is calculated:

[(3.76-4) / 4]*100 = -6.0% error

(Accuracy class = 0.1) * (Error limit = 2) = ±0.2%

6.0% > 0.2% = FAIL

Testing Tips:

1. Verify the probe is rated for the voltage being tested. Only use probes meeting the manufacturer’s specifications. Using probes that do not meet the manufacturer’s specifications may lead to a safety hazard.
2. Never connect a voltage probe around a conductor before terminating it to its cable and to the PowerMaster®.
3. For Litewire probes, verify the optic cable is clean to prevent surface arcing.
4. Position the probe as far as practical from other voltage carrying conductors.
5. IN GENERAL, if a PT Ratio test has an erroneous ratio result or a phase angle greater than ±1°, check the installation of the voltage probe before suspecting a PT problem.

Using the Volt Litewire Probe

PowerMaster® Connections:

1. Connect the 3-Phase Probe Adapter Cable to either SET 1 or SET 2.
2. Connect the HV Signal Cable (stamped with the Volt Litewire serial number) to the red connector on the 3-Phase Probe Adapter Cable.

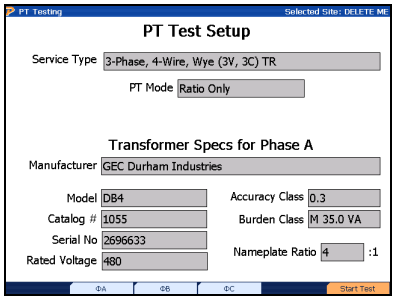
Connection to the Service:

Refer to the Volt LiteWire manual provided on page 7 (“Making Phase to Ground Measurements”). Please note that when doing phase to ground measurements, using a “hot tap clamp” is simply referring to any clamp device (i.e. vice grips) to tie the Phasing Electrode to earth ground (refer to page 14 of the Volt Litewire manual for a picture of the Phasing Electrode).

The user also has the option to view phase to phase measurements (see page 9 for “Making Phase to Phase Measurements With two Hot Sticks”). These measurements can be viewed and saved in any hot screen. However, performing a PT Ratio Test can only be done with phase to ground measurements.

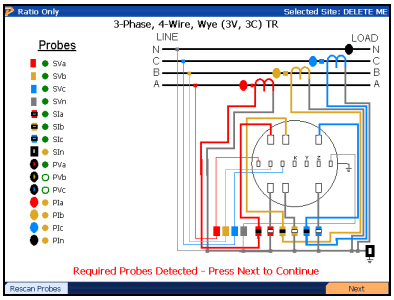
Volt Litewire Application Procedure:

STEP 1



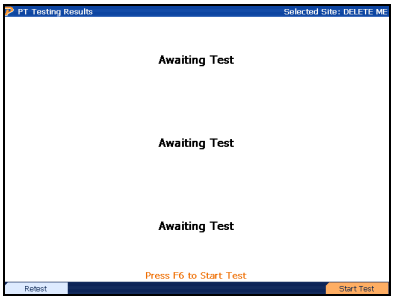
Press F6 to continue

STEP 2



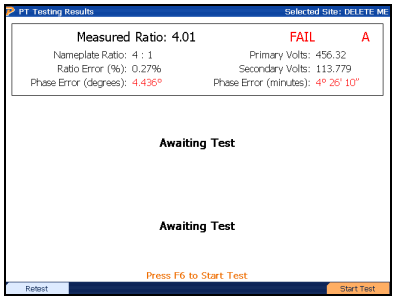
Confirm the probes are connected, F6 to continue

STEP 3



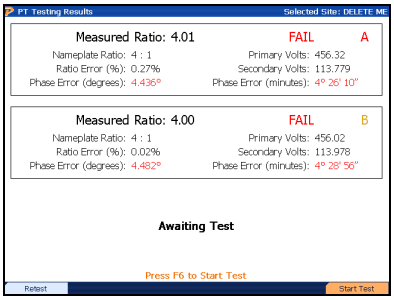
Press F6 to continue

STEP 4



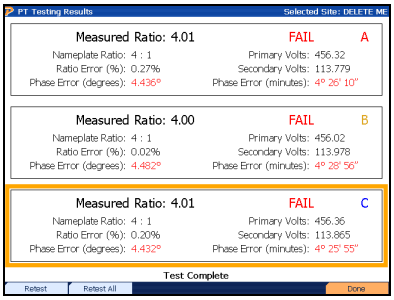
View results. Move probe to B phase, F6 to continue.

STEP 5



View results. Move probe to C phase, F6 to continue.

STEP 6



View results. Press F6 to save.

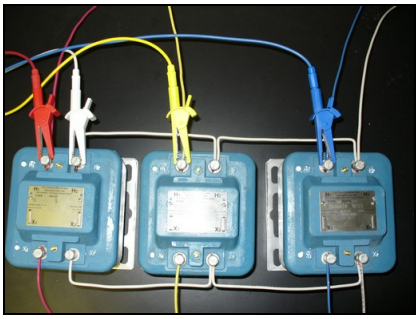
Using the VP600 Voltage Probe

PowerMaster® Connections:

1. Connect the cable to either SET 1 or SET 2.

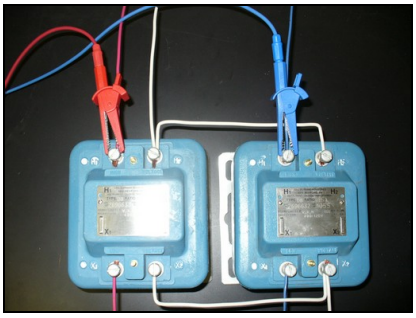
Connection to a 4-wire Service (600V Max):

1. Connect the Voltage Cable from the PowerMaster® to the secondary voltages as normal.
2. From the VP600 probe, connect the colored alligator clips to the primary side (H1) of all respective active phases.
3. Connect the white alligator clip to a neutral phase (H2)
4. Proceed with testing.



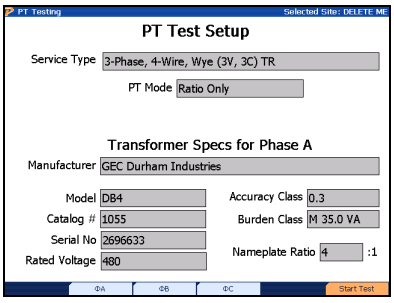
Connection to a 3-wire Service (600V Max):

1. Connect the Voltage Cable from the PowerMaster® to the secondary voltages as normal.
2. From the VP600 probe, connect the colored alligator clips to the primary side (H1) of all respective active phases.
3. Connect the white and yellow alligator clip to an earth ground
4. Proceed with testing.



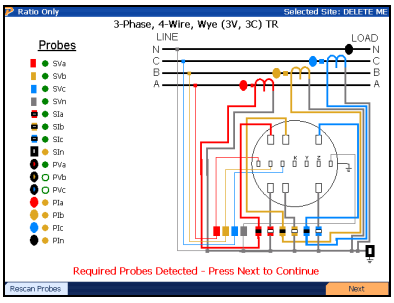
VP600 Voltage Probe Application Procedure:

STEP 1



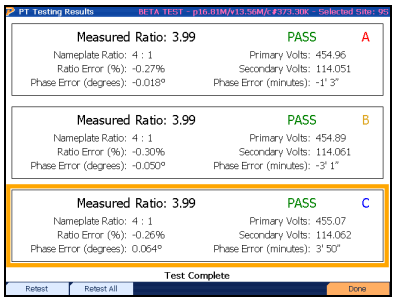
Press F6 to continue

STEP 2



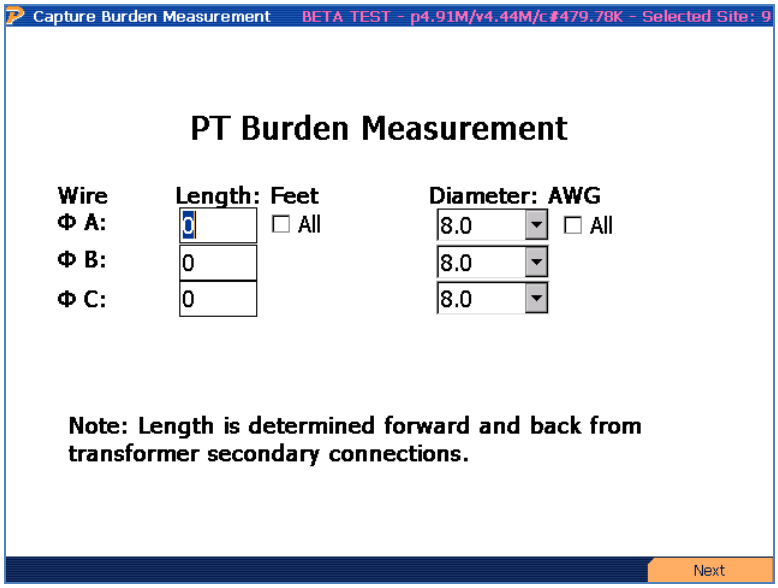
Confirm the probes are connected, F6 to continue

STEP 3



View results. Press F6 to save.

11.4 PT Burden Measurement



Description:

This application allows the user to perform an in service burden measurement of the PT circuit. There are two different methods to measure the burden in the system using the PowerMaster®:

1. Burden Measure with Connections at Test Switch
2. Calculated Burden with Connections to Test Switch

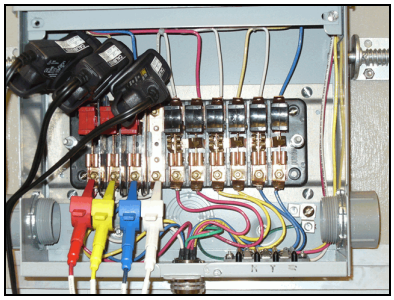
For each method, the PowerMaster® measures the entire resistance in the circuit for each PT. If a PT is selected in the Site Editor, the PowerMaster® will display a PASS or FAIL message on the screen based on burden rating (VA). If a FAIL message is displayed, this means that the measured resistance in the circuit exceeds the manufacturer's stated burden rating. As resistance increases, less secondary voltage is measured by the meter. If the meter does not measure all available voltage, the likelihood of a billing error will occur.

Once an error is detected by the PowerMaster®, the technician should follow methods on decreasing the actual burden. This normally consists of tightening down connections at the test switch and/or PT secondary terminals. If a problem remains, the technician may consider replacing the PT with a higher VA rating to validate resistance is within specification.

11.4.1 Burden Measure with Connections at Test Switch

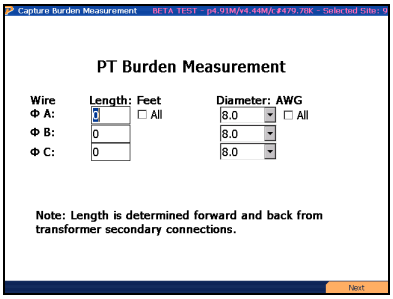
This set of instructions is for when current connections are made at the PT while the voltage connections are made at the test switch. The use of clamp-on probes (MN375 or MN353) is required for measuring secondary current.

STEP 1



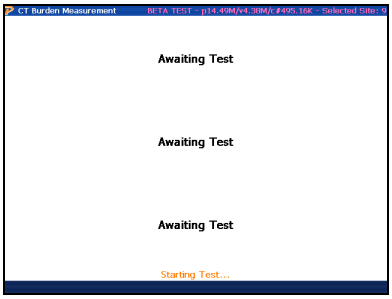
Clamp current probes around voltage wires at test switch. Connect voltage leads as normal.

STEP 2



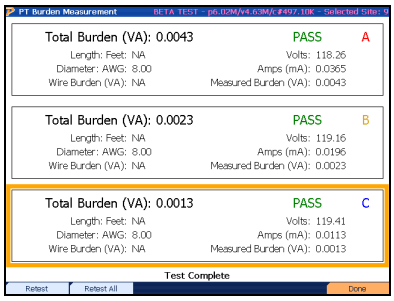
Verify Length is set to 0. Press F6 to continue.

STEP 3



Test will begin automatically

STEP 4

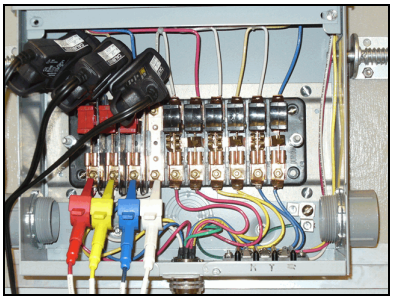


View results. Press F6 to save and complete.

11.4.2 Calculated Burden with Connections at Test Switch

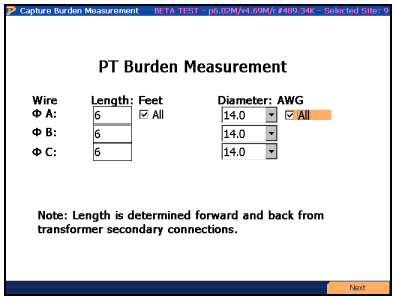
This set of instructions is for an application where the PT secondary connections cannot be accessed. All voltage and current measurements are made at the test switch and resistance (VA) is calculated based on the wire length and diameter (AWG) connected to the current terminals. Length is based on the distance from the PT secondary connection to the test switch. AWG can typically be determined by a notation imprinted on the insulation of the wire (ex. “12 AWG”).

STEP 1



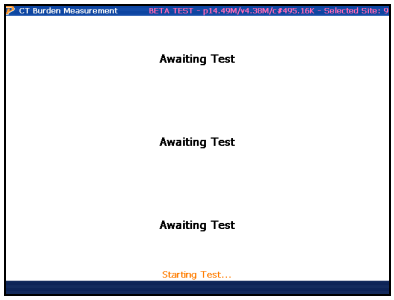
Clamp current probes around voltage wires at test switch. Connect voltage leads as normal.

STEP 2



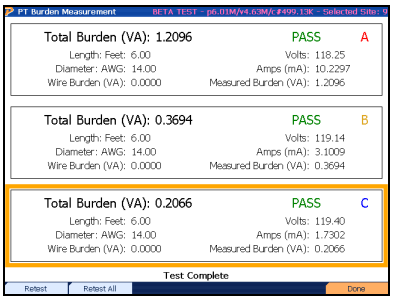
Input the total length and diameter (AWG). Press F6 to continue.

STEP 3



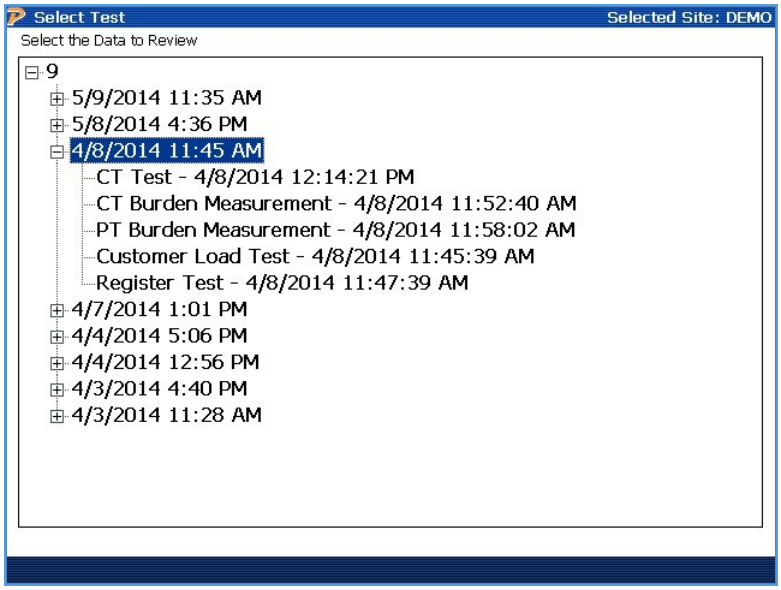
Test will begin automatically

STEP 4



View results. Press F6 to save and complete.

12 Recall Data



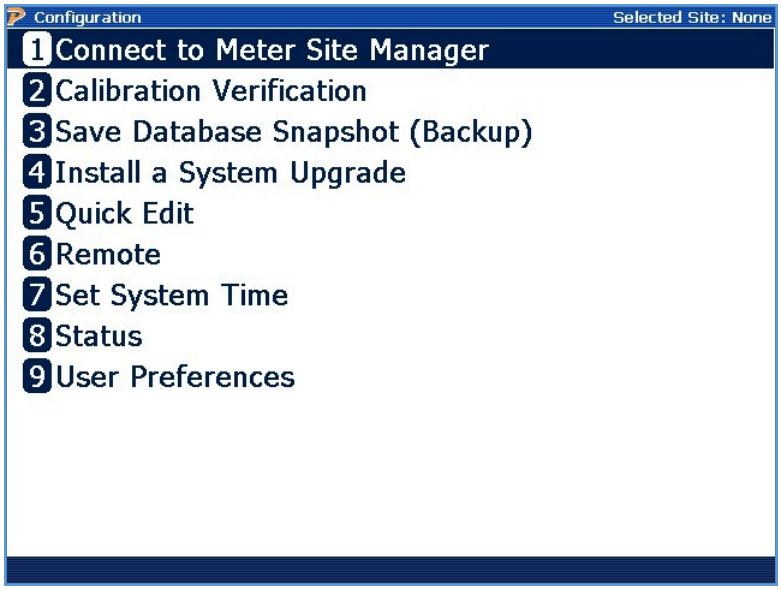
Functionality:

	Expands boxes
F6	Expands boxes or Selects data to view

Description:

This screen allows the user to view saved data for each site installation in the database. After the user “expands” the data, the user presses F6 to view the stored information.

13 Utilities



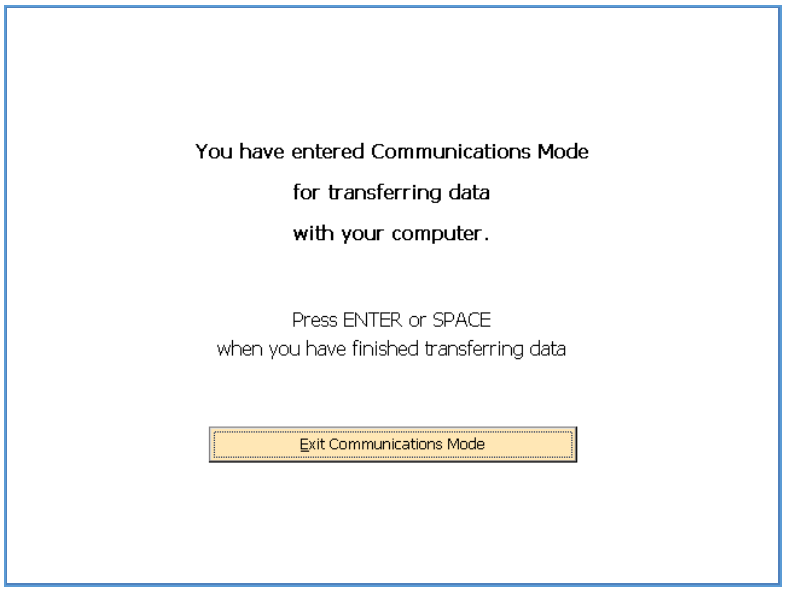
Functionality:

▲ ▼	Moves cursor up and down to a menu selection
ENTER	Accepts and enters menu selection

Description:

The menu allows the user to change the PowerMaster® settings and other various tasks and applications.

13.1 Connect to Meter Site Manager

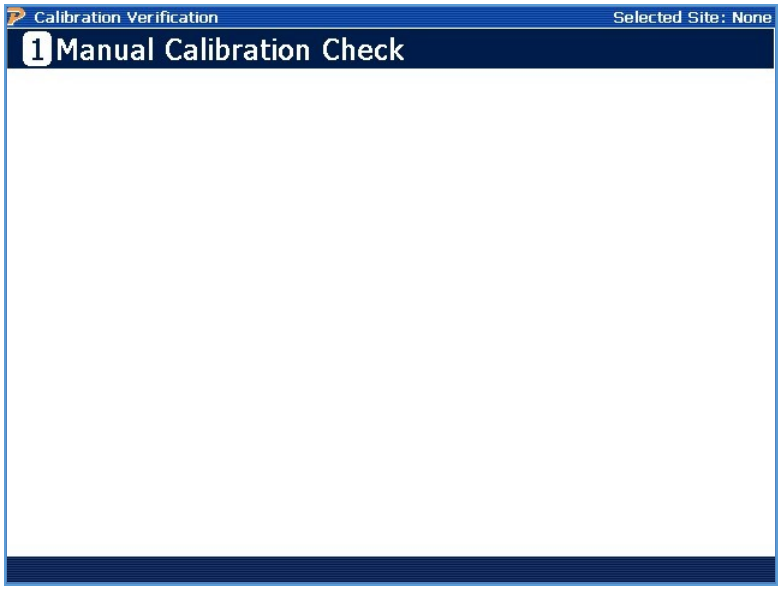


Description:

This screen allows the user to communicate with Meter Site Manager 2. After communications are complete, press Enter or Space to reboot the PowerMaster®. To avoid potential problems, follow the below steps when performing data transfer to the PC from the PowerMaster®:

1. Turn on the PowerMaster®, verify the unit is on AC power.
2. Launch Meter Site Manager on the PC
3. Connect the USB data transfer cable to the PC
4. On the PowerMaster®, enter the utilities menu, then select Option 1 Connect to Meter Site Manager
5. Connect the USB Data transfer cable to the PowerMaster® via the USB to Host connection
6. Wait for the PowerMaster® to chirp
7. In Meter Site Manager, Select Communications, Transfer Data from PowerMaster®
8. Select sites to download to the PowerMaster®, Select Communications, Create Route and send to PowerMaster® Analyzer
9. Once data transfer is complete, press “Enter” on the PowerMaster® to exit communication mode.
10. Disconnect the USB Cable

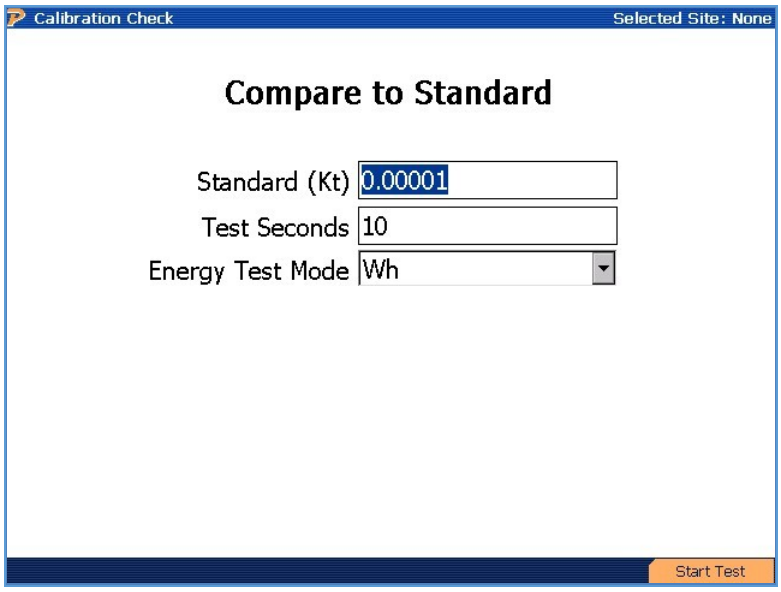
13.2 Calibration Verification



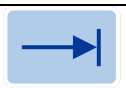
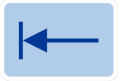
Functionality:

ENTER	Enter Calibration Check

13.2.1 Calibration Verification Setup



Functionality:

	Moves to next field
	Moves to previous field
	Enters drop down box and views test mode selections; checks/unchecks check boxes
	Moves cursor up and down for selecting a test mode in the drop down box
F6	Continues

Description:

This feature can perform a cross-check against the user's shop standard to verify the accuracy. Enter the Kh value of the shop standard into the field for "Standard (Kt)". Remember if the standard is single phase and you have the system hooked up series-parallel then you need to multiply the standard Kt by three (3). The user can also enter the desired test time and energy test mode (Wh, VAh, and VARh). When selecting the Energy Test Mode, verify the shop standard is correctly matched to the PowerMaster®'s energy test mode.

Using Standard Voltage and Current Cables with the PowerMaster®

What Do I Need?

1. PowerMaster® unit
2. Standard current and voltage leads
3. PowerMaster® External Digital Cable (separate accessory)

4. External power supply (current and voltage source)
5. Whr/VAhr/VARhr standard
6. AC adapter with a “pigtail” termination (line & neutral bare wires)
7. 10-terminal test switch
8. 18+ AWG wire for voltage and 12+ AWG wire for current

Hookup Instructions:

1. From the external power supply, connect the voltage output to the A phase potential on the test switch
2. From the external power supply, connect the voltage output return to the N phase potential on the test switch.
3. From the test switch, connect the N phase potential to a known earth ground.
4. From the test switch, connect a jumper wire from A potential to B potential. Connect another jumper wire from B potential to C potential. This creates a parallel circuit for the voltage.
5. From the W-hr/Var-hr standard, connect the line voltage to the A phase potential on the test switch.
6. From the W-hr/Var-hr standard, connect the neutral voltage to the N phase potential on the test switch.
7. From the external power supply, connect the current output to the bottom of the A phase current on the test switch.
8. From the external power supply, connect the current output return to the “current out” of the W-hr/Var-hr standard.
9. From the W-hr/Var-hr standard, connect the “current in” of the W-hr/Var-hr standard to the C phase current return on the test switch.
10. From the test switch, a) connect a jumper wire from the top of the A phase current to the top of the A phase current return. From the bottom of the A phase current return, b) connect a jumper wire to the bottom of B phase current. From the top of B phase current, c) connect a jumper wire to the top of B phase current return. From the bottom of B phase current return, d) connect a jumper wire to the bottom of C phase current. From the top of C phase current, e) connect a jumper wire to the top of C phase current return. This creates a series circuit for the current.
11. From the PowerMaster®, connect the VOLTAGE leads to the voltage potentials on the test switch (A=red, B=yellow, C=blue, N=white).
12. From the PowerMaster®, insert the CURRENT leads into the current return phases on the test switch (A=red, B=yellow, C=blue).
13. From the PowerMaster® DIGITAL input, connect the External Digital Cable (STD IN) to the pulse output on the W-hr/Var-hr standard.
14. From the W-hr/Var-hr standard, use the AC adapter to connect the auxiliary power from the standard.

Procedure:

1. Verify all connections according to the hookup instructions and wiring diagram.
2. Using the external power supply, select the desired voltage, current, and power factor for the test. This will be a series-parallel load.
3. At the Calibration Check screen, select the correct energy test mode (Whr, VARhr, or VAhr) and enter the desired time and Kh value of the standard. When using a series parallel load, the Kh value should be multiplied by 3 (ex. 0.00001 * 3 = 0.00003)
4. Press F6 (Start Test) to begin the test.
5. View and record results.
6. Press PREV to return to the Calibration Verification menu.

Using the Calibration Cable Set with the PowerMaster®

What Do I Need?

1. PowerMaster® unit
2. PowerMaster® Calibration Cables Kit
3. PowerMaster® External Digital Cable (separate accessory)
4. External power supply (current and voltage source)
5. W-hr/Var-hr standard
6. AC adapter with a “pigtail” termination (line & neutral bare wires)
7. 18+ AWG wire for voltage and 12+ AWG wire for current

Hookup Instructions:

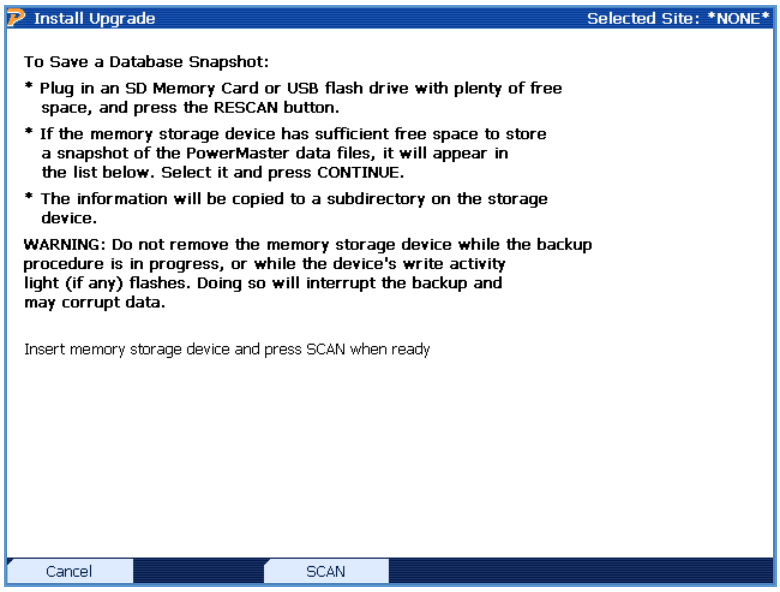
1. From the PowerMaster®, connect the one end of the Voltage calibration cable to line (red) and neutral (black) of the W-hr/Var-hr standard.
2. From the PowerMaster®, connect the other end of the Voltage calibration cable to the external power supply (red = V out HI, white = V out LO, yellow = V sense HI, blue = V sense LO). Connect the ground (green) to a known earth ground.
3. From the PowerMaster®, connect the Current calibration cable for line (red) to the W-hr/Var-hr standard’s current return. Then, connect the neutral (black) to the external power supply’s current output neutral (LO).
4. From the external power supply, connect the current output (HI) to the W-hr/Var-hr standard’s current.
5. From the PowerMaster® DIGITAL input, connect the External Digital Cable (STD IN) to the pulse output on the W-hr/Var-hr standard.
6. From the W-hr/Var-hr standard, use the AC adapter to connect the auxiliary power from the standard.

Procedure:

1. Verify all connections according to the hookup instructions and wiring diagram.
2. Using the external power supply, select the desired voltage, current, and power factor for the test. This will be a series-parallel load.

3. At the Calibration Check screen, select the correct energy test mode (W-hr, Var-hr, or Va-hr) and enter the desired time and Kh value of the standard. When using a series parallel load, the Kh value should be multiplied by 3 (ex. 0.00001 * 3 = 0.00003)
4. Press F6 (Start Test) to begin the test.
5. View and record results.
6. Press PREV to return to the Calibration Verification menu.

13.3 Save a Database Backup



Functionality:

F1	Cancels and returns to Configuration Menu
F3	Scans flash drive for free space

Description:

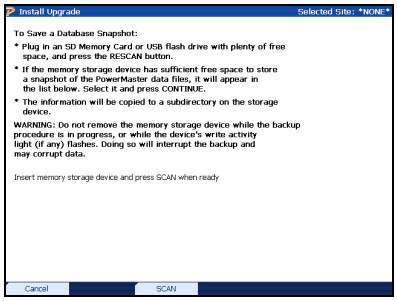
When the user may want to backup the PowerMaster® database for security purposes, place a USB flash drive into one of the PowerMaster®'s USB peripheral ports. Next, press F3 to scan the USB flash drive to verify enough space is required to save the database.

As an alternative, the user can run this process instead of downloading the database using Meter Site Manager 2. Refer to the Meter Site Manager 2 Instruction Manual for further details.

NOTE: The USB Flash drive must be 2GB or smaller for the PowerMaster® to recognize the device.

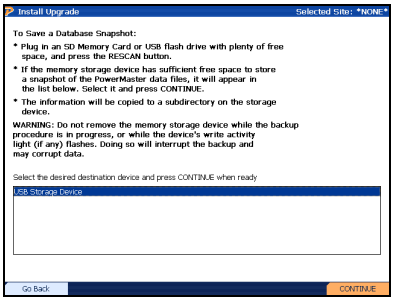
The following steps show the user how to backup the PowerMaster® in the field:

STEP 1



Insert USB Flash drive into a USB peripheral and press F3 to scan

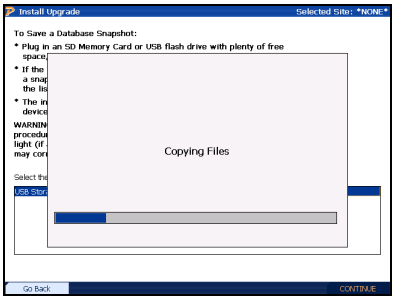
STEP 2



After free space is confirmed, press F6 to begin backup

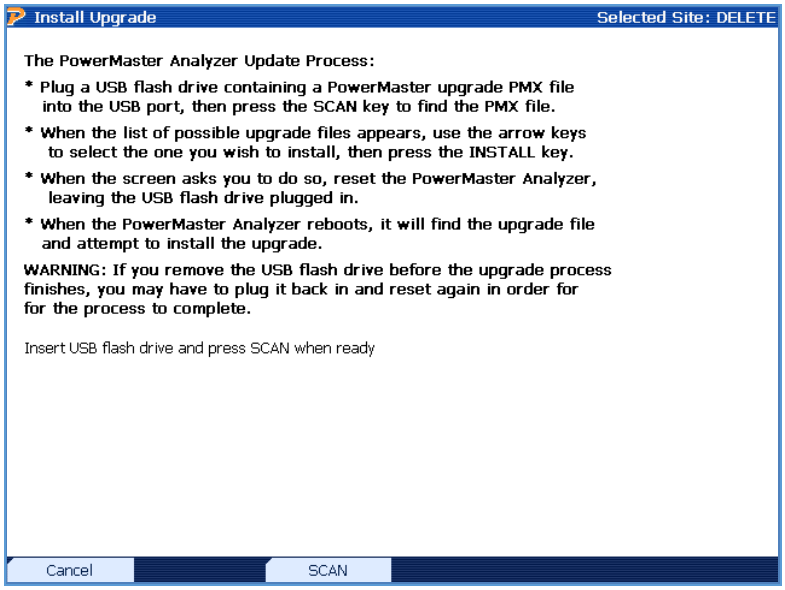
DO NOT REMOVE USB FLASH DRIVE!

STEP 3



Copy of the database will save to USB flash drive

13.4 Install a System Upgrade



Functionality:

F1	Cancels and returns to Configuration Menu
F3	Scans flash drive for PowerMaster® upgrade file (.PMX)

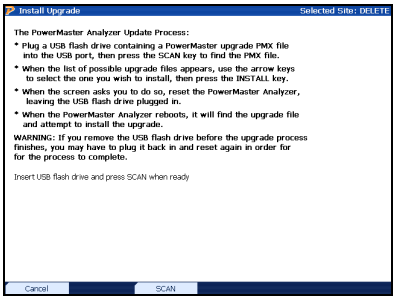
Description:

When new software updates are available, Powermetrix will contact the user of its availability. The upgrade file package (.PMX extension) must be moved to a USB flash drive. Once the file package is on the USB flash drive, the user will connect it to one of the PowerMaster®'s USB peripheral ports. The following steps show the user how to update the PowerMaster® in the field:

NOTE: The USB Flash drive must be 2GB or smaller for the PowerMaster® to recognize the device.

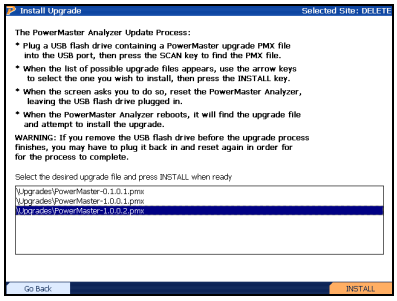
The following steps show the user how to update the PowerMaster® in the field:

STEP 1



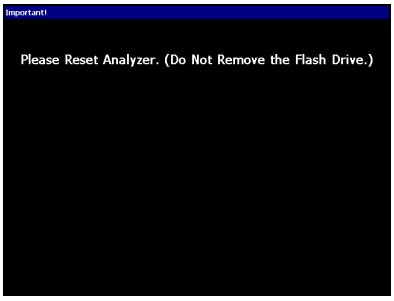
Insert USB Flash drive into a USB peripheral and press F3 to scan. Verify unit is plugged into AC Power.

STEP 2



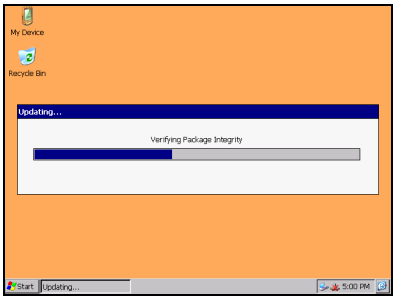
Select the .PMX upgrade file and press F6 to install

STEP 3



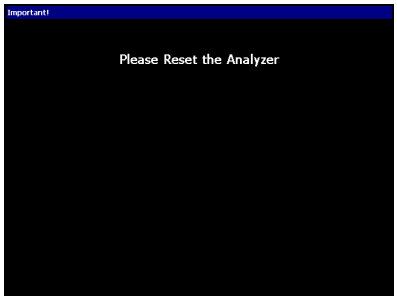
After recognition, reset the PowerMaster® by turning off then turning back on

STEP 4



After power up, the PowerMaster® will run the update application automatically (this may take several minutes)

STEP 5



After installation, reset the PowerMaster® by turning off then turning back on

13.5 Quick Edit

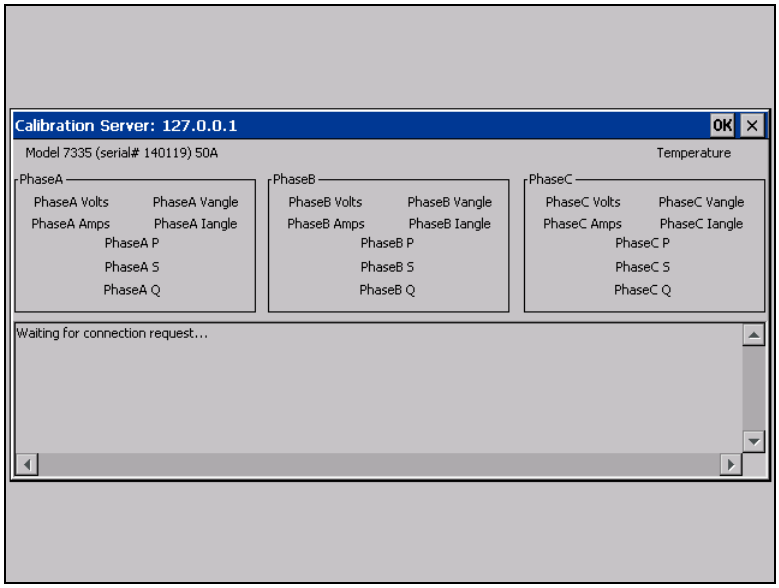
Functionality:

▲ ▼	Moves cursor up and down for selecting an entry

Description:

This menu allows the user to quickly enter a form for the purposes of editing or deleting. New components and setups can be created here as well. This is meant as an alternative method for editing as opposed to using the Site Editor exclusively (see Section 7.4.1).

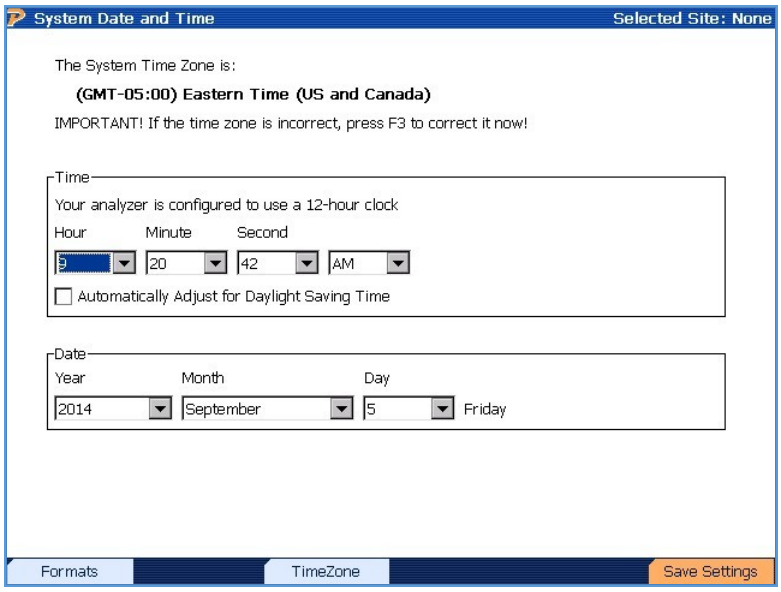
13.6 Remote



Description:

This screen allows the user to communicate with the PowerMaster® 8900 Series Lab Calibration System. After communications are complete, press Enter or Space to reboot the PowerMaster®.

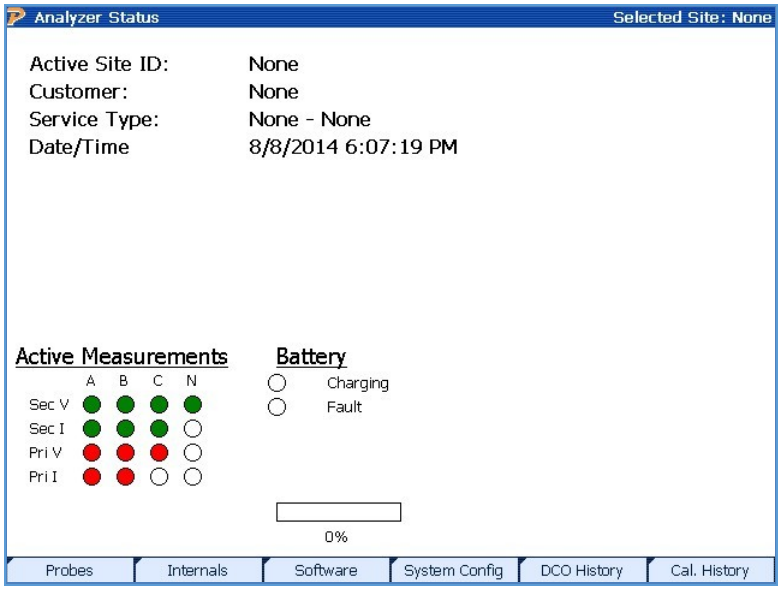
13.7 Set System Time



Functionality:

→	Moves to next field
←	Moves to previous field
▼	Enters drop down box and views selections; checks/unchecks check boxes
▲ ▼	Moves cursor up and down for selecting a value in the drop down box
F1	Changes the time format for domestic and international time zones
F3	Changes the time zone
F6	Saves changes and exits

13.8 Status



Functionality:

F1	Runs "Probe Scan" to detect all active probes that are connected (see Section 13.8.2)
F2	Displays internal voltages and temperatures
F3	Displays all current PowerMaster® software revisions
F4	Displays all configured options in the user's unit
F5	Displays all engineering changes made in the history of the user's unit
F6	Displays all calibrations that have been performed in the history of the user's unit

Description:

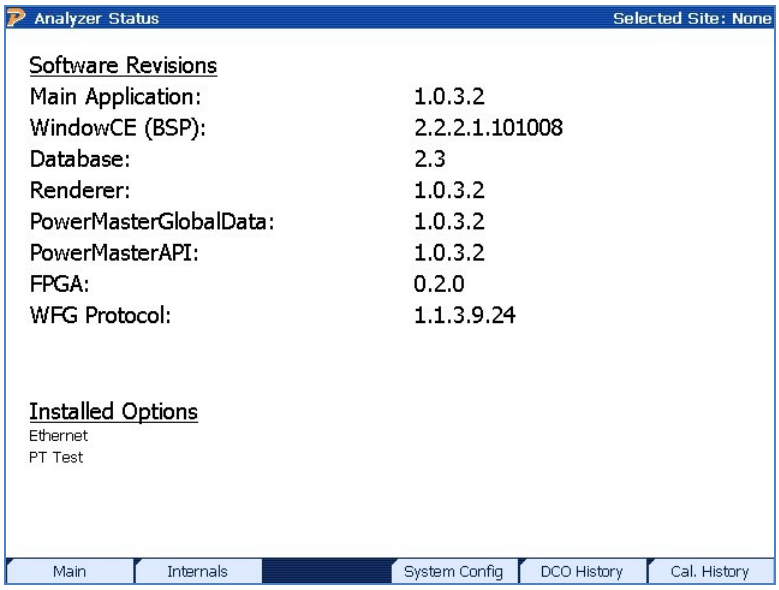
This gives the user a quick verification of the analyzer's condition. Different function keys are displayed to access further detail or perform a probe scan (see Section 13.8.2).

The "Active Measurements" show the user what currents and voltages are detected by the attached probes and lead sets.

The "Battery" display shows the user the current battery status (based off the internal battery voltage reading).

Charging	When green, the battery is actively charging
Fault	When red, the battery is detected to have an error

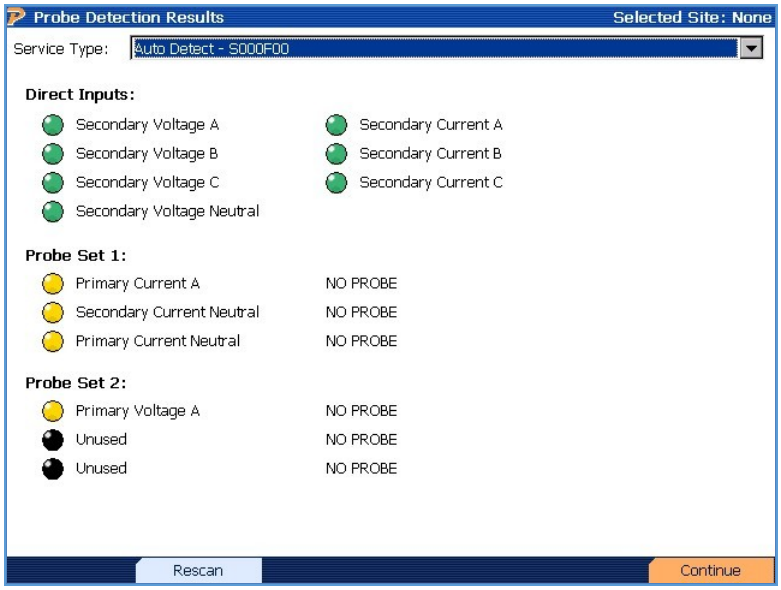
13.8.1 Software Revisions



Description:

This screen is to allow the user to view the version of software that is presently in the PowerMaster®. The installed options can also be seen in this screen.

13.8.2 Probe Scan



Functionality:

	Enters drop down box and views service type selections (available when no site is selected)
	Moves cursor up and down for selecting a service type in the drop down box
	Rescans the probes after connection is made
	Continues

Description:

This screen is to allow the user to view and change what probes are required according to the service type. If the required probes are not detected, the Probe Scan will display a red light next to the required probe(s). Once the user connects the required probe, press Rescan (F2) to scan for the probe. If the probe is successfully detected, the light is displayed green.

Direct Inputs

The direct inputs are the voltage and current (“duckbills”) lead sets that are accessories to the PowerMaster®. On the connector panel, they are labeled DIRECT VOLTAGE and DIRECT CURRENT respectively. Direct inputs do not include any type of clamp-on probe, flexible probe, or high voltage probe.

Service Type

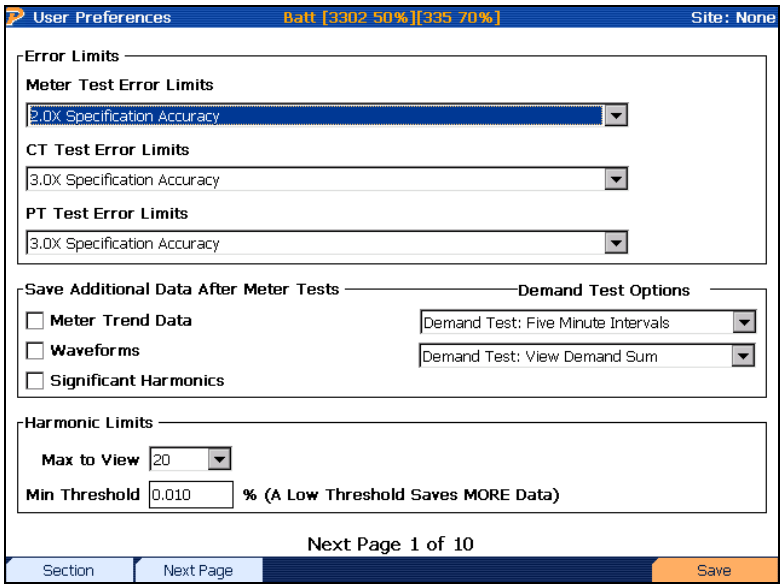
The user can change the service type at this screen. Once the service type is selected, the Probe Scan will automatically run and display to the user the required probes.

Color Key

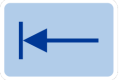
GREEN	Probe is required and is successfully connected
RED	Probe is required and is not connected. Connect required probe and press Rescan to confirm
YELLOW	Probe is optional for use, but is not required
BLACK	Probe is not used for this service type

13.9 User Preferences

13.9.1 Error Limits and Data Save Options



Functionality:

	Moves to next field
	Moves to previous field
	Enters drop down box and views test mode selections; checks/unchecks check boxes
	Moves cursor up and down for selecting a test mode in the drop down box
F1	Moves to the next important section of the screen
F2	Moves to the next set of user preferences
F6	Saves changes and exits

Description:

This screen allows the user to set the error limits for testing and how much (or little) data is saved.

Error Limits
The three error limits are based on the accuracy class of the component. For example, if the meter has an accuracy class of 0.2% and an error limit set to "2.0x Specification Accuracy," the PowerMaster® will only display an error if the registration is outside of 99.60% and 100.40%.

Accuracy class = 0.2%

Error Limit = 2.0x Specification Accuracy

0.2 * 2 = ±0.4%

Optionally, the user selects "User Defined Accuracy" to set a custom error limit

Save Additional Data After Meter Tests
The user has the option to save additional information:

Meter Trend Data: This option saves the trending graphs to the database.

Waveforms: This option allows the user to auto save during a Meter Test and manually save the waveform diagrams.

Significant Harmonics: This option allows the user to auto save during a Meter Test and manually save the harmonic information.

Demand Test Options

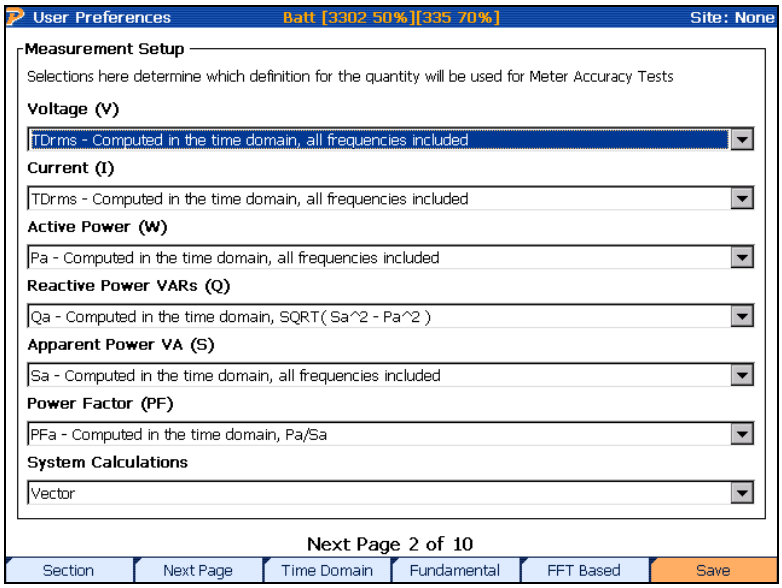
This allows the user to choose the timed intervals for a demand test. Choices available are 5 minute or 3 minute intervals. The user also has the ability to change the display from energy (Whr) or demand (W) accumulation. The user can also select how the results will be displayed: Demand Sum (Whr/hr, sum of all intervals), Demand Average (Whr/hr, average of all intervals), or Energy (Whr, average of all intervals).

Harmonic Limits
This option is displayed when "Significant Harmonics" is selected. This narrows down the number of harmonics the user feels significant and wishes to save to the database.

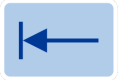
Max to view: This allows the user to select how many harmonics are displayed on the screen

Min Threshold: This option sets the minimum harmonic distortion percentage to be saved. For example, if the user sets the minimum to 1%, all harmonics that are 0.9% and below will not be saved. This prevents the user from saving too much unnecessary data to the database.

13.9.2 Measurement Calculations



Functionality:

	Moves to next field
	Moves to previous field
	Enters drop down box and views test mode selections
	Moves cursor up and down for selecting a test mode in the drop down box
F1	Moves to the next important section of the screen
F2	Moves to the next set of user preferences
F3	Changes all calculations using the time domain
F4	Changes all calculations using the fundamental only (no harmonics)
F5	Changes all calculation using frequency (default)
F6	Saves changes and exits

Description:

The following describes how the PowerMaster® specifically calculates power according to the user's selections above:

TIME DOMAIN[1]

In Time Domain, data is processed on a point by point basis and the results integrated over precisely one cycle of the incoming signal. The quantities calculated are:

Calculations

$V_{rms} = \sqrt{\frac{1}{N}\sum_n V_n^2}$	V(TDRMS) - The processing properly accounts for the exact number of samples in a cycle including fractional data points
$I_{rms} = \sqrt{\frac{1}{N}\sum_n I_n^2}$	I(TDRMS)
$Pa = \frac{1}{N}\sum_n V_i I_i$	Active Power (Pa) – Calculation includes any DC component as well as all frequencies in the signal up to the cutoff frequency of 32 kHz.
$Sa = VA = V_{rms} I_{rms} = \sqrt{\frac{1}{N}\sum_{i=0}^{i=N-1} V_i^2 \bullet \frac{1}{N}\sum_{i=0}^{i=N-1} I_i^2}$	Apparent Power (Sa) - Calculation includes any DC component as well as all frequencies in the signal up to the cutoff frequency of 32 kHz.
$Qa = \sqrt{S^2 - P^2}$	Reactive Power (Qa) – There is not a good formulation in the time domain for directly computing Q. We have adopted the approach of computing it from the "Power Triangle" assumption.
$PFa = \frac{Pa}{Sa}$	Power Factor (PFa)

FREQUENCY DOMAIN[2]

In Frequency Domain (FFT), every 2048 data points a complete Fourier analysis is performed. The user has control over the maximum number of harmonics to be included in the analysis as well as the ability to set a threshold which can exclude harmonics whose amplitude is below the user set threshold (see Section 13.9.1). While time domain calculations of power quantities yield energy directly because they are integrals, Fourier calculations deliver average rates over the time interval of the analysis.

According to Fourier's Theorem any ***periodic*** signal can be represented in the following manner:

$$V(t) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left(a_n Cos(n\omega_0 t) + b_n Sin(n\omega_0 t)\right)$$

The PowerMaster® calculates a_n, b_n and ω_0 for n = 0 to 100. Given these parameters we can calculate any of the quantities of interest as follows:

Calculations:

$V_{rms} = \frac{1}{(2)^{1/2}}\left[\sum_n (a_{vn}^2 + b_{vn}^2)\right]^{1/2}$	Vt(FDRMS) – RMS voltage computed using all harmonics which pass the user definable filter.[1]
$I_{rms} = \frac{1}{(2)^{1/2}}\left[\sum_n (a_{in}^2 + b_{in}^2)\right]^{1/2}$	It(FDRMS) – RMS current computed using all harmonics which pass the user definable filter.[1]

$Pt = \sum_n \left\| \hat{V}_n \bullet \hat{I}_n \right\| = \sum_n (a_{vn}a_{in} + b_{in}b_{vn})$ $= \sum_n V_n I_n \cos(\theta_n)$	Pt(FD) – Active power computed by summing the vector dot products of each of the harmonics[1]
$Qt = \sum_n \left\| \hat{V}_n \times \hat{I}_n \right\| = \sum_n (a_{vn}b_{in} - a_{in}b_{vn})$ $= \sum_n V_n I_n \sin(\theta_n)$	Qt(FD) – Reactive power computed by summing the vector dot products of each of the harmonics[1]
$St = \frac{1}{2}\left[\sum_n (a_{vn}^2 + b_{vn}^2)(a_{in}^2 + b_{in}^2) \right]^{1/2}$	St(FD) – Apparent power computed by summing the Vrms times Irms for each harmonic.
$PFt = \frac{Pt}{St}$	Power Factor (PFt)

Note:

[1] The a_0 component is not included in numbers reported by the PowerMaster®.

[2] Normalization constants have been omitted for simplicity

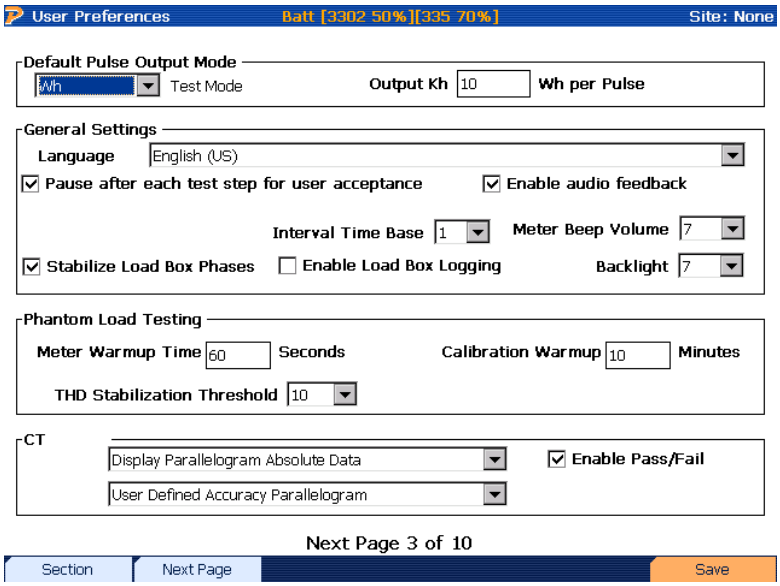
FUNDAMENTAL ONLY

For Fundamental Only, the PowerMaster® uses a subset calculation from the Frequency Domain. In this case, harmonics are *not* included in the analysis.

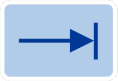
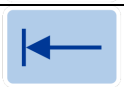
Calculations:

$V1 = \frac{1}{(2)^{1/2}}\left[a_{v1}^2 + b_{v1}^2\right]^{1/2}$	V1(FDRMS) – RMS voltage for the fundamental frequency only.
$I1 = \frac{1}{(2)^{1/2}}\left[a_{i1}^2 + b_{i1}^2\right]^{1/2}$	I1(FDRMS) – RMS current for the fundamental frequency only.
$P1 = \left\| \hat{V}_1 \bullet \hat{I}_1 \right\| = a_{v1}a_{i1} + b_{v1}b_{i1} = V_1 I_1 \cos(\theta_1)$	P1(FD) - Active power for the fundamental only
$Q1 = \left\| \hat{V}_1 \times \hat{I}_1 \right\| = a_{v1}b_{i1} - a_{i1}b_{v1} = V_1 I_1 \sin(\theta_1)$	P1(FD) - Reactive power for the fundamental only
$S1 = \frac{1}{2}(a_{v1}^2 + b_{v1}^2)^{1/2}(a_{i1}^2 + b_{i1}^2)^{1/2}$	S1t(FD) – Apparent power computed as Irms times Vrms for the fundamental only.
$PF1 = \frac{P1}{S1}$	Power Factor (PF1)

13.9.3 General Settings



Functionality:

	Moves to next field
	Moves to previous field
	Checks all checkboxes
	Moves cursor up and down for selecting a test mode in the drop down box
F1	Moves to the next important section of the screen
F2	Moves to the next set of user preferences
F6	Saves changes and exits

Description:

This screen allows the user to set general settings in the PowerMaster®.

Default Pulse Output Mode
These options allow the user to customize the pulse output for the PowerMaster®. Energy selections are Wh, VARh, and VAh. The user will enter the Kh value in measurements of µWh (micro Watt-hours) per pulse.

Pause after each test for user acceptance
This selection is used for Integrated Site Testing. By default, after each component test (meter, CT, PT, etc.) results are displayed, the PowerMaster® will wait for customer input. This allows the user to retest or cancel the test altogether. If this selection is unchecked, the PowerMaster® will verify the results meet the required specifications (see Section 13.9.1 for Error Limits) and move

forward to the next test. If the results do not meet the required specifications, the PowerMaster® will stop and wait for customer input.

Enable Audio Feedback & Language
This selection allows the user to turn the audio off (unchecked) and on (checked). The volume can be increased or decreased for both the general audio and the meter pulse. "Language" allows the user to select the language preference for text displayed.

Interval Time Base

When using the Power Meter and measurement mode is set to "Interval", the user can set the time base here from 1 to 100 seconds before the next data set is displayed on screen.

Meter Beep Volume

This setting is to adjust the volume for the audible feedback when a pulse is detected during a Customer Load Meter Test, Phantom Load Meter Test, or Overall Meter Test. The range is from 0 (mute) to 7 (loudest).

Stabilize Load Box Phases

If this selection is checked, the PowerMaster® will use a correction to accurately stabilize the phase angles when performing a phantom load test. If this selection is un-checked it will ignore the correction.

Enable Load Box Logging

This selection is enabled for a diagnostic mode used by Product Support. By default, this function is disabled.

Backlight

Sets how long the backlight will stay on.

CT

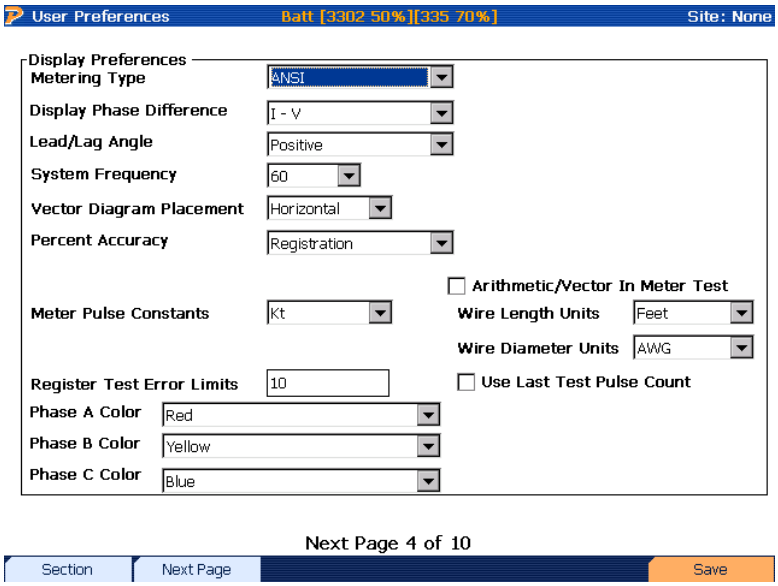
There are two options for how to display the parallelogram: Absolute Data, Relative to Zero Burden. Below that are the options that determine which parallelogram is used:

1. IEEE: 2 Parallelograms at the CT rated accuracy levels (default is 0.3% and 0.6%)
2. User Defined: Takes into account the error limits the user defined on Page 1. Example, 3x error limit will draw a parallelogram at 0.9% and 1.8%
3. Both: Will draw a total of 4 parallelograms based on IEEE and User Defined.

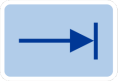
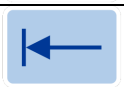
Enable Pass/Fail

Unchecking this box turns off the pass/fail indicator and just returns data as it.

13.9.4 Display Preferences



Functionality:

	Moves to next field
	Moves to previous field
F1	Moves to the next important section of the screen
F2	Moves to the next set of user preferences
F6	Saves changes and exits

Description:

This screen allows the user to change viewing preferences, primarily to switch between ANSI and IEC modes of viewing.

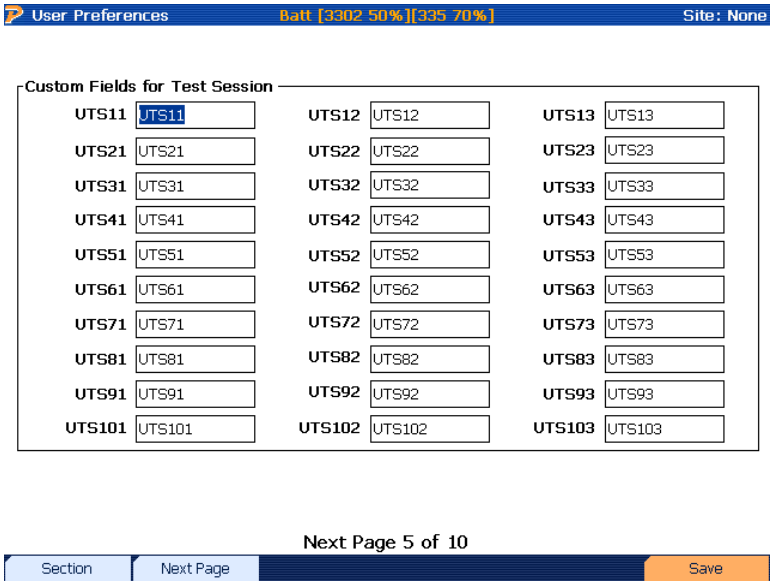
Lead/Lag Angle

When using the Vector Diagram and Power Meter, and option is available for the phase angle to display either 0/360 or -180/180. “Positive” (0/360) is the default value. Used for reference only.

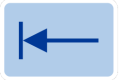
Arithmetic/Vector in Meter Test

This selection enables a soft key after a Customer Load Meter test is complete that allows the user to toggle Power Factor calculations of Vector (W/VA) or Arithmetic (cos(theta)). Used for reference only.

13.9.5 Custom Fields for Test Session



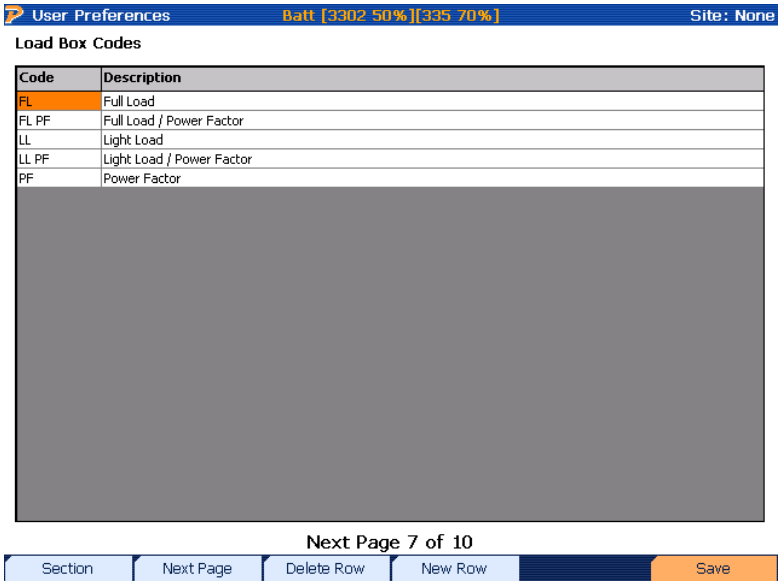
Functionality:

	Moves to next field
	Moves to previous field
	Allows edits to be made for the active field
F1	Moves to the next important section of the screen
F2	Moves to the next set of user preferences
F6	Saves changes and exits

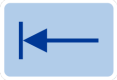
Description:

These screens (pages 5-6) allow the user to change the labels for custom fields in the PowerMaster®. The Custom Fields for Test Session are directly input into the MasterTestRecord table in the database. They can be exported from the database, but cannot be directly viewed from Meter Site Manager 2.

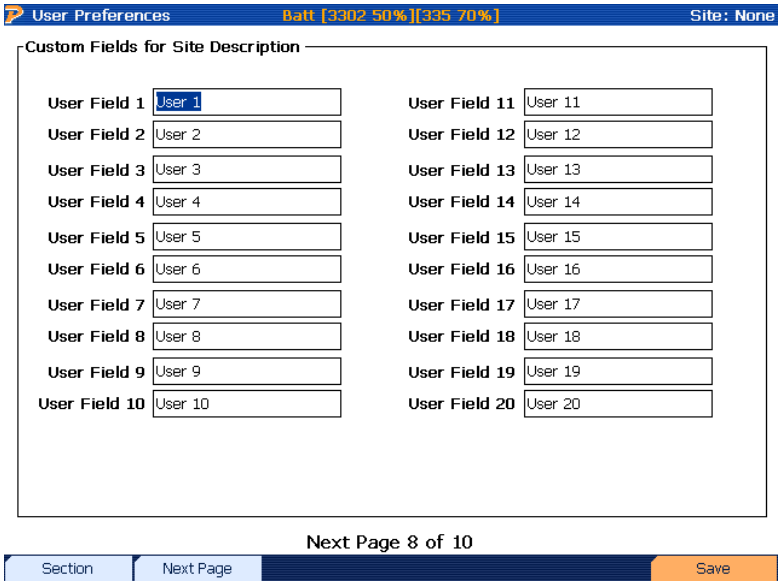
13.9.6 Load Box Labels



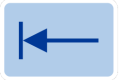
Functionality:

	Moves to next field
	Moves to previous field
	Allows edits to be made for the active field
F1	Moves to the next important section of the screen
F2	Moves to the next set of user preferences
F3	Deletes a row
F4	Creates a new row for more entries
F6	Saves changes and exits

13.9.7 User Defined Fields for the Site



Functionality:

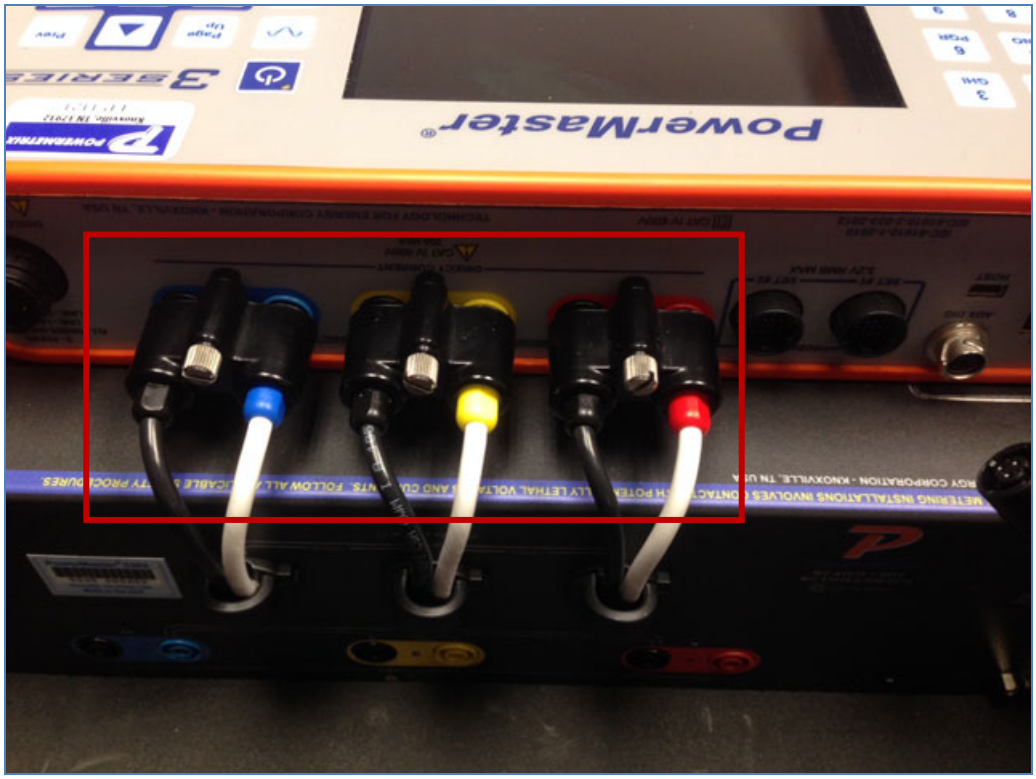
	Moves to next field
	Moves to previous field
F1	Moves to the next important section of the screen
F2	Moves to the next set of user preferences
F6	Saves changes and exits

Description:

These screens (pages 8-10) allow the user to change the labels for custom fields in the PowerMaster®. The Custom Fields for the Site are directly input into the SiteDescription table in the database. They can be exported from the database, and can be directly viewed from Meter Site Manager 2 in the Site Report.

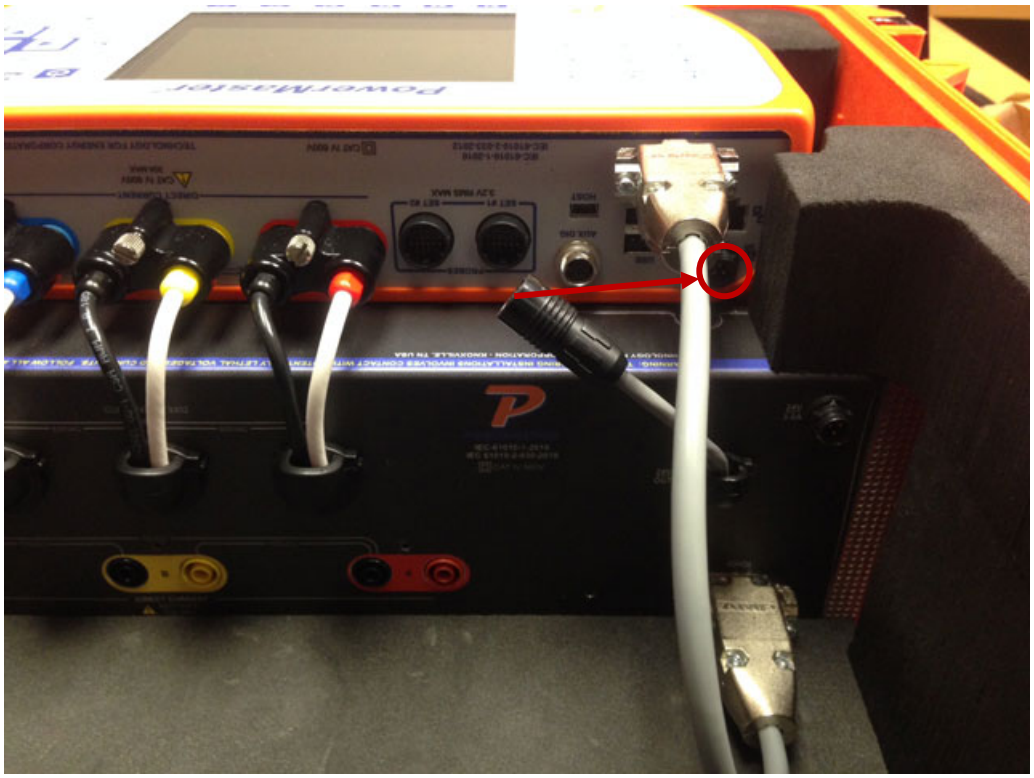
14 Connections to the Models 303, 305, & 335

1. Connect the current jumpers as shown below. Verify that the colors on the banana jacks match, and that the safety screw is firmly tightened.



2. Next, connect the communication cable from the 303/305/335 to the 3 series.

3. Finally, connect the battery jumper from the 335 to the 3 series.



4. Before testing, connect the duckbills to the 303/305/335 and connect the voltage probe to the 3 Series.

15 ANSI Specifications[1] (Model 3302)

AC Current Direct Channels

Channels	3 inputs, 0 to 20A		
Accuracy	**Range**	**Accuracy**	**Phase Error**
	1mA-10mA	0.1% +200µV noise	n/a
	10mA-100mA	0.1%	n/a
	100mA-20A	0.05%	±6mDeg[2]
			±30mDeg[3]
Resolution	0.000001A		

AC Voltage Channels

Channels	3 inputs with Neutral reference; 10 to 600 Vrms		
Accuracy	**Range**	**Accuracy**	**Phase Error**
	20mV-500mV	0.5% +2mV noise	±10mDeg[2]
	500mV-5V	0.5%	±10mDeg[2]
	5V-46V	0.3%	±3mDeg[2]
	46V-600V	0.05%	±3mDeg[2]
Resolution	0.000001V		

AC Current Probe Channels

Channels	6 inputs for probes		
Input Range	50mV to 3.2V		
Accuracy	0.1% with ±3mDeg + E_{probe}^2		
Probes Accepted	0.1mV/A to 100 mV/A, 0.00001mV/V to 1mV/V Voltage output clamp-on current probes, flex probes, high voltage current probes, primary voltage probes; power provided to probes from system, calibration information stored in probe. Only use probes meeting the manufacturer's specifications. Using probes that do not meet the manufacturer's specifications may lead to a safety hazard.		
Calibrated Probe Range	**Probe Model**	**Min**	**Max**
	MN375	0.5A	10A
	MN353	5A	150
	SR752	50A	1000A
	FLEX	50A	1000A
	Amp Litewire	50A	1000A
Resolution	Display determined by probe type		

Measurements

Calibrated Range	15W to 36kW	
Power Quantities	Watts, VA, VAR, PF (multiple user selectable calculations) Note: There is no US standard definition for VARs. We certify that our measurements of VARs match the definitions in our documentation to the specified accuracy.	
Watts Accuracy (Direct)	± 0.05%[2]	
Watts Accuracy (Probes)	± 0.1% + E_{probe}[2]	
Energy Quantities	Whr, VAhr, VARhr (multiple user selectable calculations)	
Whr Accuracy (Direct)	± 0.05%[2]	
Whr Accuracy (Probes)	± 0.1% + E_{probe}[2]	
Power Factor	-1.00 to 1.00	
Harmonics	Up to 50th harmonic, user selectable	
CT Ratio	0.3% with 0.3° phase error + E_{probe}	
CT Burden	**Range**	**Accuracy**
	20mV-500mV 500mV-5V	0.5% + 2mV noise 0.5%
PT Ratio	0.2% (no phase error specified) + E_{probe}	
PT Burden	**Range**	**Accuracy**
	1mA-10mA 10mA-20A	0.1%+ 200µA noise 0.1%
Definitions	System can calculate each quantity using a variety of user selectable definitions. Either full spectrum or fundamental only calculations are available.	

Current Source (with Models 305, 335)

Current Output	3 outputs, 0.1 to 5 amps per phase
Current Output Resolution	I < 5.0A, 1% of value I > 5.0A, 0.2% of value
Phase adjustability	0 to 359.9° in 0.1° steps each phase
Total Harmonic Distortion	< 1.0%, fundamental only
Current Accuracy	±0.2%, fundamental only
Operating Mode	Passive: Current source is phase locked and synchronizer to user voltage
Harmonics Sourcing	Through the 50th order, pre-defined selection in accordance with ANSI C12.20
Internal Battery	Lithium Ion PTO1661 10.8V 3.07AHr battery pack. Unit has internal rapid charger which operates when “24V/3A” is connected.

Environmental

Temperature (Operating)	-20°C to +50°C (-4°F to 122°F)
Humidity	0% to 95% at 23°C, non-condensing

Communication

Meter Pulse Input	1 input; <12V
Standard Pulse Input	1 input; max 1MHz, <12V
Calibration Pulse Output	1 input; 1MHz max, 5V TTL
USB to PC Port	1 (for connectivity to PC/Laptop)
USB Ports for Peripherals	2 (for keyboard, mouse, barcode reader, memory devices, etc.)
Ethernet Port	1 (for high speed connectivity)
RS232 Port	1 (for legacy devices)

Safety

Safety Certification	IEC 61010-1:2010
Measurement Category	600V CATIV
Degree of Protection	IP-40[4]

Physical

Display Resolution	Full color transmissive VGA (640 x 480)
Display Size	5.7 inch
Dimensions (W x H x D)	11.58” x 6.16” x 2.25”
Weight	3.5 lbs. (not including cables & accessories)
Case	Custom ABS plastic

Power

Auxiliary Power Voltage Input	100 to 240 VAC, 50/60Hz; charging at 0° to 45°C
Internal Battery	Lithium Ion PTO1661 10.8V 3.07AHr battery pack. Unit has internal rapid charger which operates when “24V/3A” is connected.

[1] Specifications were derived from testing of multiple Model 3302 units using the Powermaster 8900 calibration system. All information subject to change.

[2] When data displayed in “Time Interval” (with 5 second time base selected) or “Test Period” mode

[3] When data displayed in “Instantaneous” mode

[4] Unit must have Direct Current, Voltage, and Probe Set #1 & Set #2 connected

16 Appendix

Precision Pulse Output Description

Introduction

The PowerMaster® incorporates a high accuracy pulse output which can be driven by any of the following quantities:

Active Power (P):	Pa:	active power computed in the time domain (once per cycle). Includes DC and all frequency components up to 3 kHz.
	P1:	active power computed in the frequency domain (once every four cycles). Includes only the fundamental frequency component.
	Pt:	active power computed in the frequency domain (once every four cycles). Can include up to the 50th harmonic. The maximum number of harmonics to include are user selectable. A threshold (as a percent of the fundamental) can also be set to exclude harmonics with very low amplitudes.
Reactive Power (P):	Qa:	reactive power computed in the time domain (once per cycle). Includes DC and all frequency components up to 3 kHz.
	Q1:	reactive power computed in the frequency domain (once every four cycles). Includes only the fundamental frequency component.
	Qt:	reactive power computed in the frequency domain (once every four cycles). Can include up to the 50th harmonic. The maximum number of harmonics to include are user selectable. A threshold (as a percent of the fundamental) can also be set to exclude harmonics with very low amplitudes.
Apparent Power (P):	Sa:	reactive power computed in the time domain (once per cycle). Includes DC and all frequency components up to 3 kHz.
	S1:	reactive power computed in the frequency domain (once every four cycles). Includes only the fundamental frequency component.
	St:	reactive power computed in the frequency domain (once every four cycles). Can include up to the 50th harmonic. The maximum number of harmonics to include are user selectable. A threshold (as a percent of the fundamental) can also be set to exclude harmonics with very low amplitudes.

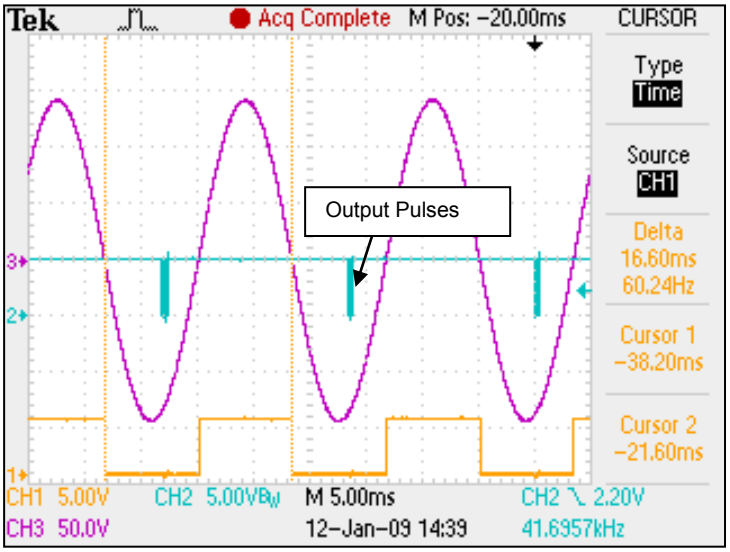
User Setup

The system defaults to Active Power as the output mode. The selection between Pa, P1, and Pt is determined by the user setting on page 2 of the User Preferences menu.

The default Kh of the system is 10 micro-units per pulse. Hence the default output is 10 µWh per pulse. The Kh can be changed on page 3 of the User Preferences dialog. The range of possible Kh values is 5 micro-units to 65535 micro-units. Using 10 micro-units per pulse gives the same Kh as most commonly available standards.

Pulse Generation

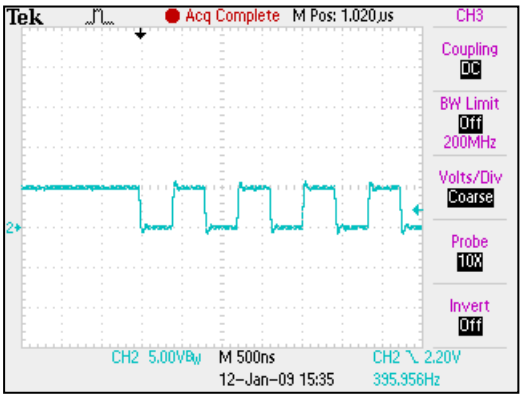
Power quantities are defined over a single cycle of the measured cycle. While instantaneous power may vary from positive to negative over a cycle, the pulse output is designed to be proportional to the net power over a cycle. To analyze the net power over a cycle we cannot know the result until the cycle is completed.



Trace Description

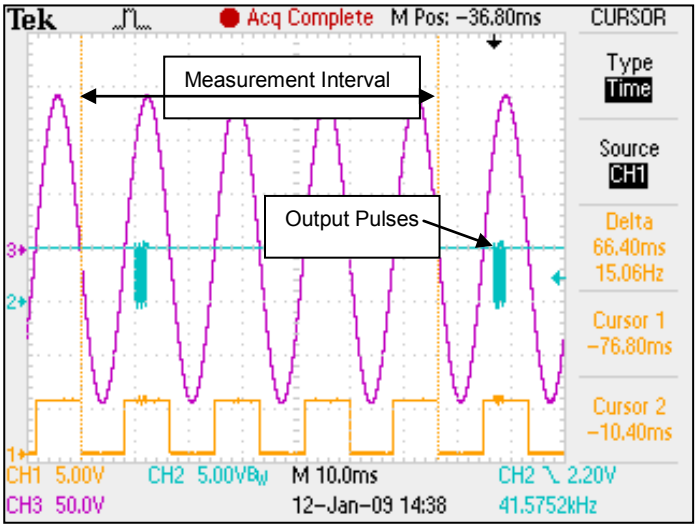
Magenta	Phase A
Yellow	Zero Crossing Signal
Blue	Output Pulses

When operating in Time Domain measurement mode (a power computation every cycle), the PowerMaster® computes the result for one cycle (for example the cycle designated by the vertical cursors above) and outputs the associated pulses starting approximately 5 ms later. The pulses have a constant frequency of 1.2288 MHz. The number of pulses in the burst is equal to the measured value for the previous cycle divided by Kh. Any fractional remainder is carried over to the next cycle.



Start of pulse burst.

When operating in Frequency Domain measurement mode (a power computation every 4 cycles), the PowerMaster® computes the result for a four cycle interval (for example the cycles designated by the vertical cursors above) and outputs the associated pulses starting approximately 10 ms later. The pulses have a constant frequency of 1.2288 MHz. The number of pulses in the burst is equal to the measured value for the previous four cycles divided by Kh. Any fractional remainder is carried over to the next measurement period.



Using the PowerMaster Pulse Output Accurately

To get the highest possible accuracy when using the PowerMaster® pulse output the pulses should be counted for precisely an integral number of seconds. This will insure that the number of pulses counted is accurate provided that the load is stable for at least four cycles prior to the beginning of counting and eight cycles prior to the end of counting.