E650 S4x

Family of Commercial and Industria
Meters Instruction/Technical Manua

Landis+Gyr
manage energy better

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Document History

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Table of contents

List of Tables

List of Figures

Safety Warnings
The following safety precautions must be observed during all phases of operation, service, and repair of this device. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and the intended use of the metering instrument. Landis+Gyr Inc assumes no liability for the customer's failure to comply with these requirements.

- **Warning:** Any work on, or near, energized meters, meter sockets, or other metering equipment can present a danger of electrical shock. All work on this product should be performed only by qualified electricians and metering specialists in accordance with local utility safety practices, utility requirements and procedures outlined in Chapter 14 of The Handbook for Electricity Metering (10th edition). The information contained within this manual is intended to be an aid to qualified metering personnel. It is not intended to replace the extensive training necessary to handle metering equipment in a safe manner.
  - Use care when servicing with the power on.
  - Be aware that dangerous voltages exist at several points within the meter when this product is installed on a meter base.
  - Disconnect power before meter disassembly, soldering, or replacing components.

The E650 S4x meter is connected directly to line potential. Due to the possibility of the potential lines being reversed, points accessible with the cover off may be at line voltage.

LINE POTENTIAL IS PRESENT ON THE INCOMING CONNECTORS ON THE MEASUREMENT BOARD INCLUDING THE BATTERY CONNECTOR.

The option board is connected directly to the main board and may also be at a high potential. The meter's inner housing prevents touching the option board. Removing the inner housing exposes line voltage. This warning label is affixed to the meter frame and identifies hazards in the meter.

Any option or I/O cables connecting to the meter from the mounting device must use sufficient insulation for the service voltage employed. As a general rule insulation should be designed for a 480 volt AC_{rms} service voltage since service voltage is not always known at the time of meter manufacture.

Warning
All applicable electrical codes and standards must be followed. Failure to use sufficient insulation on option or I/O cables connecting to the meter through the mounting device could cause serious personal injury, property damage, and/or death.

1 Three phase power supply restrictions: **(NOTE: THIS INFORMATION NEEDS TO BE INCLUDED IN THE S4x K-Base Documentation.)**

2 For any S4x K-Base meter equipped with 3-phase power supply, it cannot be used with bottom feed option.

3 I.E. Any S4x K-Base meter being used for bottom feed cannot be equipped with a 3-phase power supply.

4 Standard K-Base Power Supply used for bottom feed meter configurations.

5 K-Base Bottom Feed issues - Marketing (Ken Croy) to call meeting to review K-Base AMR connections and bottom feed applications. (Presently only A-phase available to bottom feed K-Base meters)

6 What kind of problems does this present to PLC's that normally connect to C-Phase?

7 Invite: Anibal Ramirez, John V, Bob Rapsinski, Andy Guymon, Mimi Lynde?, Andrea Amato, Ron Tate.

8 Review and compile listing of AMR's power connections for K-Base meters, specifically bottom feed connected meter installations. (Reference Steve Schamber's AMR power connection listing for meter forms.)

9

1 The E650 S4x

The E650 S4x solid-state meter provides a single solution for nearly all metering applications. The E650 S4x combines the time-proven technology of Landis + Gyr's legacy solid-state meters with some of the latest technological innovations. Key E650 S4x enhancements over the S4e are:

- Field or AMI (over the air) Flash Upgradable Firmware and Meter Programming
- Firmware Can Be flashed Without Losing Energy Data
- Ethernet Connectivity (optional, under development)
- Designed to facilitate AMI integration…uses the same form and fit as FOCUS
- High Speed Optical Communications…up to 38.4K baud
- Standard, On board 256K Load Profile. Optional 1Meg or Dual Recorder load profile
- Extensive Event Flagging
- Reduced Physical Profile
- "Power from any Phase" metrology power supply (optional)
- The E650 S4x is a true 4 Quadrant meter
- Forward and Reverse Demand Metrics
- Reactive, TOU, and Load Profile is Standard on Every Meter
- Voltage Log is Standard
- Robust Tamper Detection
- Display from Battery Power during Power Outages

Figure 1.1 E650 S4x Meter

The E650 S4x provides more than just reliability and accurate billing data. The E650 S4x is designed to be the foundation for a complete metering infrastructure. See section 1.7 for communication options and section 1.5 for upgradeability. Combining the E650 with the 1132 Suite software or an AMI system, can yield a complete package for accessing real-time voltage, current, and load data monitoring, extensive user-defined event and Tamper alerts, data and graphical load analysis capability, and vector diagrams.

1.1 The E650 S4x Universal Meter

All E650 S4x meters include wide-dynamic voltage application capability, forms reduction, ServiceScan automatic service recognition, and GyrBox installation diagnostics and monitoring. A single register type is all that is needed. The following chart details the various capabilities available in the basic E650 S4x meter:

RXR	Active and Reactive Energy, Demand or TO format, 256K Load Profile Onboard	Standard Configuration
AXR	ACTIVE ENERGY METERING ONLY: Even thou reactive metrics are always available, the me can be programmed for Active Energy Meter Only	Requires programming via 1132P

1.2 ServiceScan Automatic Meter Service Type Recognition

Wide-dynamic voltage ranging and form consolidation techniques allow each E650 S4x to be used in a wide variety of metering installations. There is no need, however, to identify the service in advance. You can simply install the E650 S4x, and it will automatically detect the service type and voltage, displaying the information on the LCD and properly configuring the GyrBox for a complete diagnostic check of the installation. An E650 S4x can be re-installed at an installation of a different wiring type, same base type required, without the need for re-programming. For use in a non-ANSI standard service, a total of five user defined service types can be downloaded to the E650 S4x (see section 3.2.3).

1.3 GyrBox Installation Diagnostics

The E650 S4x GyrBox continually performs a complete diagnostic analysis on the metering installation equipment, the service wiring, and the load characteristics. See section 5.2 for instructions on activating GyrBox mode. The E650 S4x continually monitors the service and load for equipment failures, improper installation wiring, poor load conditions, power quality conditions, and tampering. GyrBox monitors the installation for phase polarity, inactive phases, phase angle displacement, phase imbalance, and energy flow polarity while reporting in real-time the phase angles, phase voltages, phase currents, and diagnostic error counters.

1.4 Software and Software Upgrades

The E650 S4x meter offers flexible functionality options to support today's rapidly advancing utility environment. 1132 Suite software is used to upgrade meters to TLC (*under development, not yet available*), 1Meg load profile, and Dual Recorder (2nd Load Profile). Upgrading Load Profile to 1Meg and/or Dual Recorder, or upgrading to TLC requires a connection to the meter and a Hardlock Key (USB type available). The meter programming utilities are 1132Com for reading, programming, upgrading, and flashing new firmware, 1132Prog for developing programs, and 1132Gyr for preparing reports. Windows XP or Windows 7 is needed for 1132Com/1132Prog/1132Gyr.

1.5 Inputs / Outputs

An optional input/output board provides up to four, form C, solid-state relays and up to two external inputs for recording pulses from a remote source. See section 8 for more information. The board can be easily added in the field without the need for special tools.

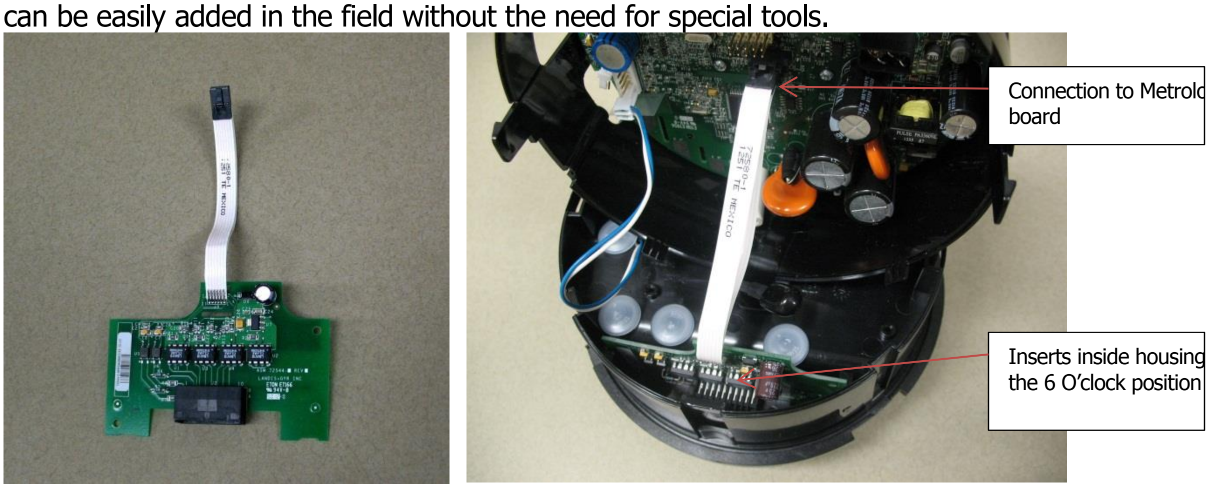


Figure 1.6 2 input, 4 output Option Board

1.6 Communications

The modular E650 S4x meter package is designed to allow for flexibility to add functionality in the future, leaving space for communications boards as well as advanced function processing boards along with an input/output relay board. Communications boards, such as RS485, RS232, and Ethernet boards can be supplied with the meter from the factory or added to a meter in the field. In addition, many AMI third party vendors offer various automated meter reading options.

1.7 Provisions for AMI Integration:

The E650 S4x meter features 0.110 inch voltage fast-on connectors for connecting AMI modules that require service voltage. The E650 S4x offers the same 10-pin header as FOCUS for easy AMI installation. All meter data has the capability to be transmitted over the optical port or 10 pin AMI communication header.

1.8 Advanced Feature Sets

1.8.1 Expanded Load Profile of 1Meg Bytes

Using the basic E650 S4x, a utility has the capability of recording up to 16 channels of load profile information with 256K. With the optional 1Meg bytes of memory, extended power quality load surveys are possible. The load profile capability in conjunction with Landis+Gyr Data Analysis Software (1132Gyr) provides utilities and their customers with statistical and graphic representations of load conditions for continuous monitoring of the power system. See section 7.10 for a full discussion on load profile capabilities.

1.8.2 Dual Recorder Option

The E650 S4x also offers, as an option, Dual Recorder function. This "2nd Load Profile" can be configured for an additional 16 channels and have different interval lengths than the 1st Recorder. This 2nd recorder can be used with the standard 256K or the optional 1Meg load profile memory capacity.

2 Application Information

2.1 Available Meter Forms by Base and Class

Base	Transformer Rate Class 20	Class 12(	Class 20(	Class 320**	Class 480
S-Base	3, 9/8, 45(5)*, 36(6)*,		1,2, 12, 25 16/15/14	2, 12, 16/15/1	
A-Base	10/8, 45(5)*, 36(6)	16/15/14			
K-Base					12, 16/15/14, a 27

*36S/36A replaces the traditional 6S/6A, 45S/45A replaces the traditional 5S/5A
**Class 320 Meters are referred to as SE base

Figure 2.1 Wiring Diagrams for 36S (6S), 45S (5S)

2.2 Installation Procedures

For installation instructions refer to local utility practices, regulations and/or the Handbook for Electricity Metering.

2.3 Battery Installation (for TOU and Load Profile applications)

Warning: LINE POTENTIAL IS PRESENT ON THE INCOMING CONNECTORS ON THE MEASUREMENT BOARD INCLUDING THE BATTERY CONNECTOR. BE SURE TO INSTALL THE BATTERY WITH THE METER DE-ENERGIZED.

1) Remove the meter cover
2) Place the battery's two-pin connector into the matching two-pin slot, which is located in the 10 o'clock position on the register assembly housing, see figure 2.3 below.
3) Put the battery in the round cavity located directly below the two-pin connector on the meter frame
4) Position the battery wires into the slot to prevent them from interfering with cover installation or meter functions
5) Replace meter cover

Figure 3.3 Battery Installation Procedures

2.3.1 Battery Carryover Time

Battery carryover time is measured to log the cumulative time the battery has been in use. Time on carryover is displayed in minutes, and is reset to zero when a new battery is installed and the change battery function is performed in 1132Com. Minimum expected carryover time for the E650 S4x meter with supplied battery is 2 years. The shelf life of the battery is 10 years.

3 Operating Instructions

3.1 Overview of Electronic Hardware

3.1.1 LCD Display

A full listing of the available Register Displays can be found in the 1132 Prog software, version 5.0 or newer. The blue arrows indicate direction of positive energy flow.

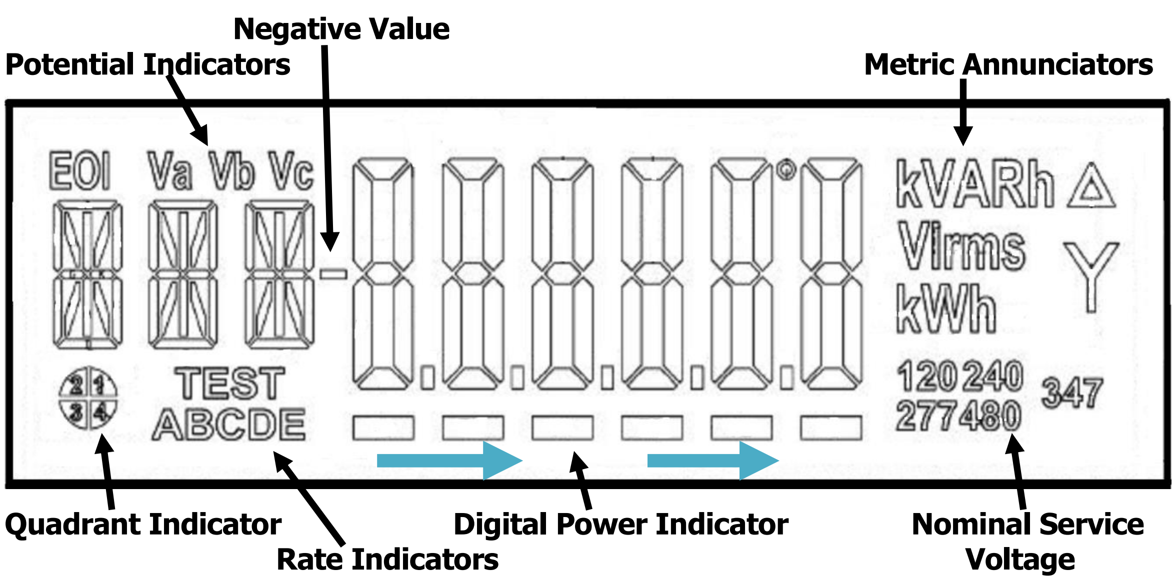


Figure 3.1 LCD Display

The potential indicators on the LCD (Va, Vb, Vc) appear only if the service is polyphase and only then if potential is applied to the respective phase. The annunciators, kVARh, Vrms, kW, etc. are programmed for display using 1132Prog/1132Com. They can be enabled or disabled; this feature does not affect the other indicators/identifiers on the LCD. The nominal service voltage indicators (120, 240, 277, 347, 480) signal which service voltage is being applied to the meter. Review of the power quadrant indicator indicates the quadrant in which power is presently applied by flashing that particular quadrant. The delta/wye symbols light according to the service type of the meter. The digital power indicator scrolls across the bottom of the display (left to right) to indicate positive or (right to left) to indicate negative energy flow.

3.1.2 Special Display Identifiers

The E650 meter indicates certain modes of operation on the display by flashing back and forth between the normal 3 character display ID and a special display ID (the 3 smaller digits at the left end of the LCD). The following table lists the special display ID's and their meaning.

Special Display I	Meaning	Firmware Versi Available	Description
C/U	Catch-Up		The meter is in catch-up.
P/T	Pass-Through		The meter is in pass-through communicatior mode.
R/C	Remote Communication		The meter is in a communication session through the AMR port.
P/R	Programmer/Read		The meter is in a communication session through the optical port.
Z/F	Zero Fill		The meter is zero filling load profile.
S/B	Stand-By		The meter is in stand-by mode.
U/L	Un-Lock		The meter has un-lock active.

Table 3.1.1 Special Display Identifiers

3.2 Switches

There are four user interactive switches on the E650 S4x. They are the Demand Reset, Cover Removal Detect, Test Mode and GyrBox Magnetic Reed switches. The Demand Reset switch is accessible through the covers having the Demand Reset feature. The GyrBox Magnetic Reed switch is actuated by holding a magnet over the designated area, with or without the meter cover present. To activate the Test Mode switch the cover must be removed. Removing the cover actuates the Cover Removal Detect switch. Unlike the S4e, the E650 S4x is not equipped with a scroll switch but rather the display sequences will be accessible with a series of procedures that employ the GyrBox Magnetic Reed, Demand Reset, and Test Mode switches.

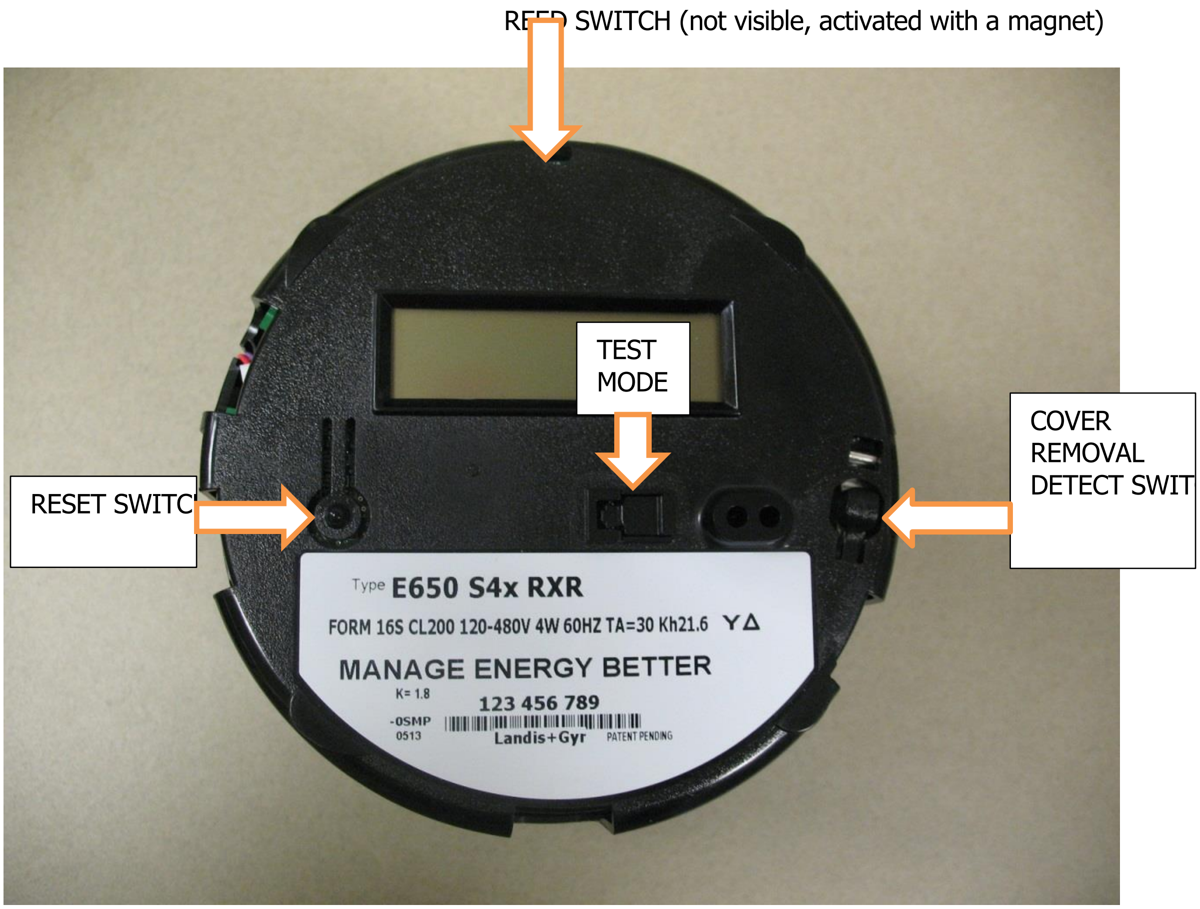


Figure 3.1.3 Accessible E650 S4x Switches

3.2.1 User Interface Switches

3.2.1.1 Reset Switch

The reset switch is used to manually reset the demand metrics to zero. The meter can be configured a number of ways to include additional actions upon manual reset of demand.

3.2.1.2 Test Mode Switch

The test mode switch, when placed in the vertical, upright position, places the meter in test mode so that the meter's accuracy may be checked without adding test accumulation to any of the meter's normal register. As soon as the test mode switch is returned to its horizontal (flush with the face of the meter) position, all accumulation that occurred while the meter was in test mode is deleted.

3.2.1.3 Cover Removal Detect Switch

The cover removed (and returned) switch triggers an event in the event log when the meter cover is removed and another event if/ when it is subsequently re-installed on the meter. Both of the events are Date/Time stamped. When equipped with a battery, the switch also posts an event if the meter is powered down, the cover then removed, and then the meter powered up. In other words, the meter knows if it is powered up with the cover off after being powered down with the cover on. It can also detect if the meter is powered up without a cover and then the cover placed on the meter, and then the meter powered down. There are events for each of these conditions.

3.2.1.4 Reed Switch

A reed switch, which is activated by placing a magnet at the twelve o'clock position (on top of the meter), can be used for advancing the normal mode display sequence with a swipe, activating the ALT display mode by holding the magnet at the top for approximately 3 seconds, and GyrBox diagnostic displays, by holding the magnet at this position for approximately 6 seconds. In each case, swiping the magnet will then advance the display OR the display will advance automatically after a few seconds if no action is taken.

3.2.2 Internal Switch & Sensor

3.2.2.1 Tilt Switch

The internal tilt switch is a level detector and can sense when the meter is shifting position from its normal orientation and post an event in the event history log. (Does this detect vibration?)

3.2.2.2 Magnetic Field Sensor

The E650 S4x is equipped with a Hall Effect switch to detect the presence of a foreign magnetic field being introduced. The metrology will post an event in the event log if a field is detected. (Does this sensor differentiate between reed sw. actuation and attempts to influence the meter accuracy?)

3.3 Optical Port/ Calibration LED

An optical port is provided for programming and recording meter data. The port is an ANSI Type II. The optical port and calibration output share the same LED. Whenever the meter is not communicating, the optical port LED will output a calibration pulse at a rate proportional to the watt-hours flowing through the meter. This calibration pulse automatically stops when the meter clock transits midnight. Other programmed metrics can be tested by entering test mode, manually scrolling to the appropriate metric calibration pulse display (causing the LED to pulse proportional to that metric), and checking calibration while in test mode. The Calibration LED automatically stops at midnight. In an E650 S4x, it restarts when any switch is activated.

3.4 Programmable Outputs/Inputs

The E650 S4x KYZ Option boards inputs and outputs are programmable in a variety of configurations. See section 8 for further details and possible configurations.

3.5 Initial Power-Up and Operation

Unless specified by the customer, E650 S4x meters are shipped unprogrammed. When powered up, the display on an unprogrammed device will show "S00 Error" at the end of the auto scroll sequence of displays, indicating an unprogrammed state. To clear this condition, the device needs to be programmed using 1132Com (Landis+Gyr Reader/Programmer Software package) through an optical serial communications cable or equivalent communication device. An unprogrammed E650 S4x will accumulate billing data, including energy and kW in 15-minute blocks but cannot be read using 1132Com. An E650 S4x is always a demand meter in an unprogrammed state.

3.5.1 Unprogrammed Displays

Upon powering up, an unprogrammed register goes through a power-up display sequence, and then stops on the S00 error code. The unprogrammed displays are as follows:

ID	Display	Mode
RXR	Firmware Version	Normal
DSP	DSP Version Number	Normal
TOT	Total kWh	Normal
MAX	Total kW Max Demand #1	Normal
(All LCD Segments On)	Segment Check	Normal

BAT	Days On Battery	Normal
PCO	Power Outage Counter	Normal
S00	Error (unprogrammed error)	Normal
FL	As Left 3 EL FL	Alternate
LL	As Left 3 EL LL	Alternate
PF	As Left 3 EL PF	Alternate
POW	Instantaneous Watts	Test
VAR	Test Mode VAR (RMS) Pulse	Test
VA	Test Mode VA (RMS) Pulse	Test
VA	Test Mode VA (Vectorial) Pulse	Test
VAR	Test Mode VAR (Vectorial) Pulse	Test

Table 3.2.1 Unprogrammed Displays

3.5.2 Programming Equipment

The E650 S4x registers are programmable using 1132Prog/1132Com for Windows based devices. Third party hand-held readers also have the ability to communicate to the E650 S4x. The E650 S4x offers a user-friendly environment for programming the registers. Consult the 1132Prog/1132Com help files for detailed instructions on programming the meter.

NOTE: The E650 S4x requires 1132 Suite, version 5.0 or higher!

3.5.3 Manual Loading of Service Type

In installations that are not ANSI standard, such as using a poly phase meter in a single phase application, ServiceScan allows the user to define the voltages and voltage angles to create up to five new service types. The following values can be programmed:

Voltage (rms) values: 0v, 60v, 104v, 120v, 208v, 240v, 277v, 347v, 416v, 480v

Phase angle values (in degrees): 0, 60, 90, 120, 180, 240, 270, 300

3.6 Accessing the Display Modes

Up to 96 individual displays may be selected in any order and can be used more than once. The ANSI firmware counts one display programmed for Normal, Alternate and Test Mode as three different displays. There are four display sequences: Normal, Alternate, GyrBox Diagnostics and Test.

3.6.1 Normal Display Sequence

The Normal Display Sequence is present on the LCD under normal operating conditions if no special action is taken.

3.6.2 Alternate Display Sequence

An alternate display sequence may be created for the LCD using 1132Prog/1132Com software. To activate the alternate display,

a. Place a magnet over the meter in the 12 O' clock position (over the reed switch) for 3 seconds to activate the reed switch or until you see " ALT". Quickly remove the magnet. The word "ALT" will appear on the display before the alternate display sequence starts. Alternate displays will be shown in sequence.

b. To exit… The meter will automatically exit back to the normal display sequence after one pass through the alternate displays.

3.6.3 GyrBox Display Sequence

The GyrBox is a sequence of displays designed to facilitate troubleshooting problems in the meter installation. All normal meter functioning continues while in the GyrBox display sequence. The

GyrBox sequence is pre-defined, but GyrBox displays may also be programmed to appear in the other display sequences, i.e., normal, alternate and test mode.

This is the method for obtaining the GyrBox display sequence:

3.6.3.1 Reed Switch

1) Activate reed switch by placing a magnet at the 12 O'clock position for six seconds or until you see the first display of the Gyrbox sequence.
2) The meter will then show the first GyrBox display. Swipe the magnet over the reed switch to advance the display OR allow auto-scroll to advance the display automatically.
3) To exit Gyrbox mode, hold the magnet over the reed switch until the first display of the normal display sequence appears.

You can view the GyrBox displays using 1132Com by selecting the View Data operation in the read menu. You can select this operation using the following procedure:

3.6.3.2 Using 1132 Com

1) In 1132Com highlight a meter file in the meter file window on the left-hand side. Selecting "New Meter" will automatically establish a connection to a meter.
2) Select View Data under the read menu.
3) View each screen of data. Use the tree on the left to move through the different portions of the E650 S4x meter's program and registers, GyrBox Diagnostics and Instantaneous Data are the two GyrBox related branches.
4) To exit…In 1132Com exiting is performed by selecting the 'X' in the upper right corner of the program or selecting Exit in the File menu.

3.6.3.3 Power Down Display Sequence

The E650 S4x is capable of displaying pre-programmed displays during a power outage if the meter is equipped with a battery. If the meter is programmed in a Demand Only format (no battery installed), a battery can be installed on the spot to access the Power Down Display Sequence if needed. The Power Down Display Sequence will be the same sequence that is displayed during normal meter operation.

With the meter powered down, hold a magnet over the reed switch at the 12 O'clock position for six seconds. The Power Down Display mode will start and auto scroll one time through the display sequence programmed into the meter. The default setting will allow this function to be performed twice per hour, however the number of times and duration of each display is programmable in 1132Prog.

Note: Optical port access to and programming of the meter is not possible during power outage conditions and is not supported by the meter battery if so equipped.

3.7 Test Mode Sequence

Flipping the Test Mode switch enters the Test Mode. "TEST" will appear on the LCD. While in test mode, the displays must be manually scrolled by swiping the magnetic reed switch.

3.7.1 Using 1132 Com

1. In 1132Com highlight a meter file in the meter file window on the left-hand side. Selecting "New Meter" will automatically establish a connection to a meter.
2. Select Toggle Test Mode under the Meter Tools menu.

3. The meter is now in Test Mode and the Test Mode Displays can be observed on the meter display. The displays can be advanced with a magnet at the 12 O'clock position (reed switch)
4. To exit **...**repeat step 2 to toggle the meter out of test mode and back into normal mode. Click the Disconnect tab in the lower right hand corner to end the session.

3.8 Scroll Modes

3.8.1 Auto-scroll Mode

The display continually cycles through the programmed Normal Display Sequence, referred to as auto-scrolling. The LCD displays each quantity for a selectable time of 1 to 15 seconds. The default is 3 seconds. The auto-scroll mode operates by default and is only affected by a manual activation of another display mode, by activating the reed switch or by the occurrence of an error that is programmed to stop the auto-scroll sequence. Auto-scrolling is not active in test mode.

3.8.2 Manual Scroll Mode

While the E650 S4x register is auto-scrolling, the reed switch can be activated by swiping a magnet over it at the 12 O'clock position. The display will then advance to the next item in the sequence and auto-scrolling will be suspended. Each subsequent swipe over the reed switch causes the display to show the next item in the sequence. The display resumes auto-scrolling when the switch has not been activated for one minute. Manual scrolling operates in this manner for both the normal, alternate, and GyrBox sequences. The test mode sequence never auto-scrolls.

Note: In Time of Use meters' manually scrolling for the first time causes a battery test on TOU meters. If the battery voltage is low, an error code, **"S08"** is indicated on the meter.

3.8.3 Scrolling in the Alternate Display Sequence

If a magnet is held over the reed switch for approximately 3 seconds, the Alternate Display Sequence is initiated, starting with the ALT display then continuing with the first alternate display item. Once the end of the Alternate Display Sequence is reached, the E650 S4x register reverts back to the Normal Display Sequence.

3.8.4 Scrolling in the GyrBox Mode

Once in the GyrBox sequence (entered via the reed switch), the GyrBox displays auto-scroll. Swiping a magnet across the reed switch stops the auto-scrolling and the E650 S4x will be in the manual scroll mode starting with the first GyrBox display. Subsequent swipes of the magnet will advance the GyrBox displays 1 at a time. Unlike the alternate display sequence, which just makes one pass before returning to the normal sequence, the GyrBox sequence wraps around to its first display and continues scrolling until GyrBox mode is exited. Placing the magnet at the twelve O'clock position again and holding it there for 6 seconds will cause the display to exit GyrBox mode and return to normal display mode.

3.9 Test Mode

Test Mode feature allows meter testing without affecting billing data, data collected is for test mode purposes only. Test mode is entered through the optic port or by activating the test mode switch on the face of the device.

3.10 Test Mode Display

Swiping the reed switch causes the next item to be displayed. Each test mode display value is updated continuously.

3.11 Actions upon Entering Test Mode

Upon entering test mode, the current demand interval is terminated and all billing data is stored. As a result, this demand interval will be shorter than normal. The end-of-interval (EOI) output and display indicator both activate as if a normal EOI has occurred. If the present demand is greater than the previous maximum demand, maximum demand will be updated.

3.12 Action upon Exiting Test Mode

Upon exiting test mode all billing data is restored and a new demand interval is started. The EOI output switch and display indicator activates, indicating the end of test mode and the start of a new demand interval and subinterval.

3.13 Test Mode Demand Functions

1132Prog/1132Com allows programming of separate demand interval length and Kh for test mode purposes. This allows for quicker verification of demand by using a shorter interval. Using a large Kh value allows display of kWh on the LCD with small accumulation. A demand reset performed in test mode starts a new test mode interval and zeroes accumulated demand, maximum demand, and the energy recorded.

3.14 Operation of Outputs during Test Mode

While the meter is in test mode, the optional outputs work as they would in normal mode, with the following exceptions:

- EOI activates upon entering and upon exiting test mode and with every EOI.
- Demand Threshold Alert (DTA), Voltage Threshold Alert (VTA) and Power Factor Threshold Alert (PFTA) are cleared upon exiting test mode.
- Load Control will not work in test mode.

3.15 Miscellaneous Functions During Test Mode

Power on demand delay (PODT) is not in effect during test mode, although timing continues. For example, if PODT is 10 minutes and the meter is put into test mode for 4 minutes immediately on power up, the meter will start accumulating demand 6 minutes after exiting Test Mode.

3.16 Test Mode Time-out

After a prescribed length of time, the test mode is automatically ended and the meter returns to normal mode. 1132Prog allows the user to program the test mode time-out value from 1 to 255 minutes (a value of 0 disables the time-out function) into the meter. Once test mode is entered, the test mode counter begins timing. If the meter is left in test mode longer than the time-out value, test mode will end.

Note: If a meter leaves test mode due to inactivity time-out and the mechanical switch stays activated for longer than 4 minutes, the stuck switch error, if programmed, will be displayed. This error will be cleared after the switch is deactivated.

4 GyrBox Operation

4.1 Overview of GyrBox

GyrBox diagnostics are designed to quickly conduct a meter and installation system electrical check. The E650 S4x GyrBox continually performs a complete diagnostic analysis on the metering installation equipment, the service wiring, and the load characteristics. This allows the E650 S4x to continually monitor the service and load for equipment failures, improper installation wiring, poor load conditions, power quality conditions, and tampering. The GyrBox monitors the installation for phase polarity, inactive phases, phase angle displacement, phase imbalance, voltage imbalance, and energy flow polarity.

The voltage and current per phase information that the meter automatically calculates and displays will indicate if the meter is installed and operating properly. Continuous voltage and current measurements are rms values and are updated every 200 ms and are available in Mfg Table 34. The display updates every 500ms.

4.1.1 ServiceScan: Service Recognition and Verification

ServiceScan automatically detects the service type and voltage, displaying the information on the LCD and properly configuring the GyrBox for a complete diagnostic check of the installation. This feature checks if the service matches the meter form type, i.e., a 8/9S meter form will not function as a 6S meter form. In cases where all three potentials are not initially present when the meter first powers up (e.g. installing a meter in a 480V site), ServiceScan will not be able to identify the service at first and will then rescan the voltage and phase information every minute until correctly identifying the service type. Therefore, an E650 S4x can be re-installed as a different type without needing to be re-programmed.

For all E650 S4x meters, ServiceScan is performed at power up. ServiceScan is performed not only at power up but also in one minute intervals following power up until the device recognizes a valid service.

ServiceScan can also be initiated from 1132 COM software using "Trigger Service Scan" from the Meter Tools dropdown.

Refer to Appendix C entitled "Service Types" for a table listing various devices and their compatible service types.

4.1.2 Service Scan Displays

A 120V four wire wye service will illuminate the "Y" annunciator, the "120" nominal service voltage, and the three potential indicators ("Va, Vb and Vc").

A 240V four wire delta service will illuminate the "Δ", the "240" nominal service voltage (even though the phases individually measured line to neutral would be 120, 120 and 208), and the three potential indicators.

For single phase loads on test boards, only the nominal voltage will be illuminated.

4.1.3 Programmable Service Types

GyrBox accommodates these service types: network, 3 wire delta, 4 wire wye, and 4 wire delta. Up to five non-standard service types can be programmed using 1132Com.

4.1.4 GyrBox Activation

GyrBox may be activated while the register is operating in either the normal or alternate mode of operation. Normal energy measurement continues while GyrBox is activated.

4.2 Methods for entering GyrBox

This is the method for entering GyrBox:

Reed Switch (see section 3.1.3)

a. Place a magnet on top of the meter in the 12 o'clock position.
b. After six seconds, the display will go blank briefly.
c. The meter will then show the first GyrBox diagnostic.
d. Swipe the magnet across the reed switch to stop auto-scrolling.
e. Swipe the magnet again to advance the GyrBox displays, one at a time for each swipe of the magnet.

To exit

i. Hold the magnet over the reed switch for six seconds to return to the normal sequence.

4.2.1 Digital Power Indicator (DPI) during GyrBox Activation

The DPI shows the direction of energy flow during each phase check. It runs at a rate consistent with the load, in the direction of the energy flow.

4.2.2 Display Format and Reference

The phase information is displayed with no leading zeros and one fixed decimal point. The diagnostic counters are displayed with no leading zeroes, similar to the following example:

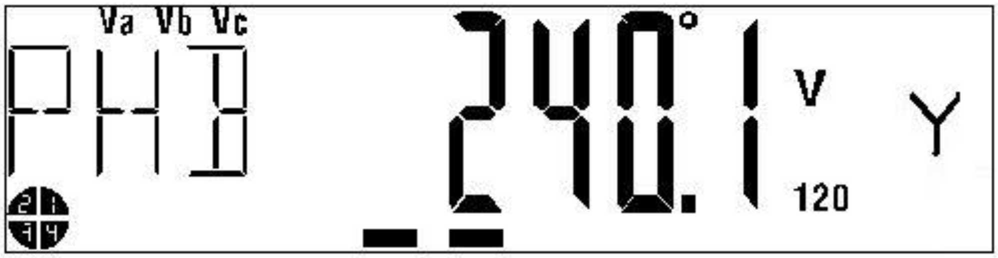


Figure 5.2.2 Sample GyrBox Display on LCD

The meter sets the "A" phase voltage phasor to 0.0° and calculates all other voltage and current phasors with relation to phase "A" voltage. Thus, phase "A" voltage angle will always be displayed as 0.0. The displayed value is based upon a long-term average. The current angle calculations also use Phase A as a reference, and are based upon the following relationship:

$$\theta = \tan^{-1}\left(\frac{Var}{Watt}\right)$$

Quadrant of the angle is based upon the polarity of watt and Var.

4.2.3 GyrBox Display List

The GyrBox scrolls through the following set of diagnostic items/counters:

Description	Indicator	Display Form	Suffix
Phase "A" Voltage Angle	PhA	0.0°	V
Phase "A" Voltage	PhA	xxx.xxx	Vrms
Phase "A" Current Angle	PhA	xxx.x°	I
Phase "A" Current	PhA	xxx.xxx	Irms
Phase "B" Voltage Angle	PhB	xxx.x°	V
Phase "B" Voltage	PhB	xxx.xxx	Vrms
Phase "B" Current Angle	PhB	xxx.x°	I
Phase "B" Current	PhB	xxx.xxx	Irms
Phase "C" Voltage Angle	PhC	xxx.x°	V
Phase "C" Voltage	PhC	xxx.xxx	Vrms
Phase "C" Current Angle	PhC	xxx.x°	I
Phase "C" Current	PhC	xxx.xxx	Irms
Number of Diagnostic 1 Errors	D1	xxxxx	
Number of Diagnostic 2 Errors	D2	xxxxx	
Number of Diagnostic 3 Errors	D3	xxxxx	
Number of Diagnostic 4 Errors	D4	xxxxx	
Number of Diagnostic 5 Errors	D5	xxxxx	
Number of Diagnostic 6 Errors	D6	xxxxx	
Number of Diagnostic 7 Errors	D7	xxxxx	

Table 5.2.1 GyrBox Displays

Note: Phases that are unused will still show up in the GyrBox display list.

4.2.4 Diagnostic Counters

The GyrBox diagnostic counters record the number of times (0 to 65535) that a diagnostic error was detected since the last counter reset. Any diagnostic conditions still existing when the counters are cleared will count to 1 within 15 seconds. You can clear the diagnostic counters by performing a cold start, either manually or optically, or a demand reset.

4.2.5 Diagnostic Check Display Options

The following section lists the possible display formats for diagnostic errors. Each diagnostic error can be programmed for display in one of these formats.

Note: The meter must pass two consecutive checks before the diagnostic error will be cleared from the LCD.

Lock: The selected error remains on the LCD display. The diagnostic display causes auto-scrolling to stop at the first Error Code display. Diagnostic check code displays appear at the end of the normal/alternate scroll sequence, just before any Error Code in the sequence that may be present (See Section 9 for a discussion of Error Codes).

Scroll: The diagnostic error does not cause auto-scrolling to stop. The error code byte is inserted at the end of the display sequence.

No Display: The diagnostic error is not displayed on the LCD. The diagnostic counter is still increased by one.

Disable: The diagnostic error will not be displayed on the LCD and the diagnostic counter will not be increased.

4.3 Diagnostic Checks

The following sections describe each of the diagnostics that GyrBox performs. When a diagnostic check is triggered it will appear on the normal display sequence if it has been programmed to lock or scroll. After seeing the particular diagnostic error in the LCD display, compare the Phase A, B and C readings to the expected values found in section 5.4. Note which values are inconsistent and use that information to help track down the source of the error.

4.3.1 D1 Voltage Phase Angle (Polarity and Cross-phase)

The D1 diagnostic checks for proper phase relationships of voltage, incorrect polarity of voltage, internal meter measurement malfunction, and faulty site wiring. The envelope of the voltage phasors has a default value of plus or minus 10 degrees, however this value can be programmed. The range is any number from 0 up to 90 degrees. If any voltage phasor angle values measure more than plus or minus the programmed value, from their nominal, expected position, an error will be detected. This error can only occur on poly-phase forms (i.e. 12S, 25S, 16S, 9S, 36S, 45S, etc.) and cannot occur on single-phase forms (i.e. 1S, 2S, 2SE, 2K, 3S, 4S, etc.) since single-phase forms only have a single voltage measurement.

4.3.2 D2 (Phase Voltage Deviation Check)

The Phase Voltage Deviation Check verifies loss of phase voltage, incorrect phase voltage, shorted voltage transformer windings, or incorrect voltage transformer ratio by detecting differences between phase voltage magnitudes. This check uses the nominal voltage per phase as a reference. The tolerance range of the voltage deviation (%) is programmable using 1132Prog/1132Com software.

4.3.3 D3 (Inactive Phase Current Check)

The Inactive Phase Current Check verifies that the service is maintaining an acceptable current level and is expected to detect current diversion and an open or shorted CT circuit. The low current value is programmed into the register using 1132Prog/1132Com software and will have a limit starting at the creep level of the meter and up to 200A in increments of 1mA. Each phase can have a separate threshold. The error flag will trip if one or more currents fall below its threshold and at least one current remains above this value for more than 15 seconds. The error flag will not trip if all phase currents fall below their thresholds.

4.3.4 D4 (Phase Angle Displacement Check)

The Phase Angle Displacement Check diagnostic verifies that the elements are sensing and receiving the correct current for each phase of the service and indicates poor load power factor system conditions and reversed CT's. The phase displacement angle (°) is programmable through the 1132Prog/1132Com software package. Angles for leading and lagging loads are separately programmable. The current phasors must be within this programmable phase with respect to their voltage phasor to pass this diagnostic check. This is calculated with respect to its respective voltage phasor, not necessarily phase A's voltage phasor. The check is not performed if Diagnostic #3 did not pass or if phase A voltage is missing.

4.3.5 D5 (Voltage Imbalance Detect)

The D5 Diagnostic is programmed according to the settings in 1132Prog with a variable threshold. This diagnostic compares the voltage of each phase with the other phases in the installation. If the ratio between any phase voltage and the average of all phase voltages exceeds the user programmable percentage, then this diagnostic flag is tripped. However for delta configurations, it's the phase to phase voltages that are compared to each other.

4.3.6 D6 (Current Magnitude Imbalance Check)

This diagnostic compares the current of each phase with the other phases in the installation. If the ratio between any phase current and the average of all phase currents exceeds the user programmable percentage, then this diagnostic flag is tripped. The check is not performed if Diagnostic #3 did not pass, if the average current is below 0.5% of class, or if phase A voltage is missing.

4.3.7 D7 (Energy Polarity Check)

The D7 diagnostic checks for reverse energy flow of one or more phases. If the energy polarity (watts) for any phase is negative, this flag will be tripped. This check is not performed if phase A voltage is missing.

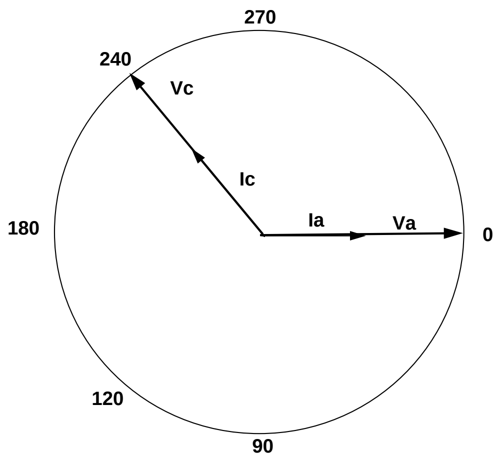
4.4 Normal phase angles

The following charts outline the ideal voltage phase and current phase angles. Phase and current voltages will depend upon the application.

4.4.1 3-Wire Network Service

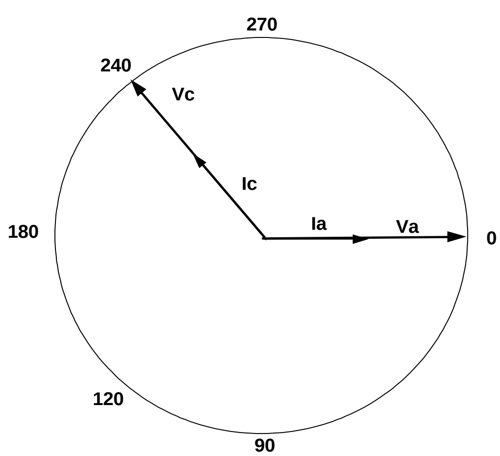
45S (5S)--Unity power factor with load connected line to neutral

	Phase A (Left)	Phase B (Center)	Phase C (Right)
Voltage Angles	0°	N/A	240°
Current Angles	0°	N/A	240°



12S--Unity power factor with load connected line to neutral

	Phase A (Left)	Phase B (Center)	Phase C (Right)
Voltage Angles	0°	N/A	240°
Current Angles	0°	N/A	240°

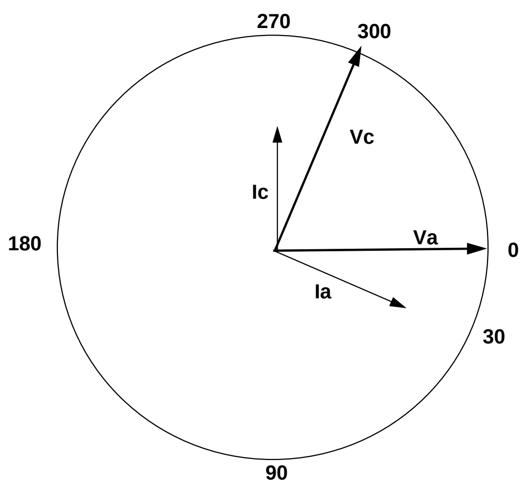


4.4.2 3-Wire Delta Service

45S (5S)

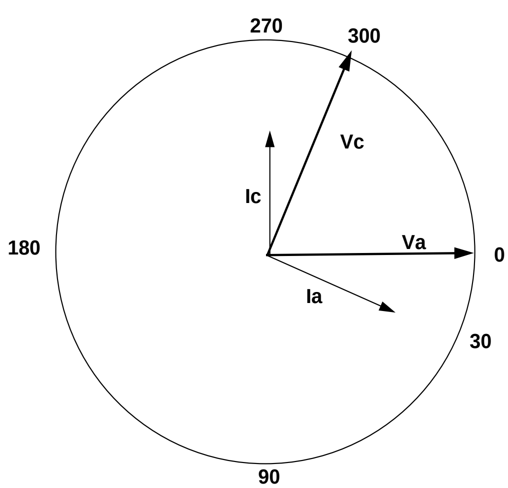
	Phase A (Left)	Phase B (Center)	Phase C (Right)

	Phase A (Left)	Phase B (Center)	Phase C (Right)
Voltage Angles	0°	N/A	300°
Current Angles	30°	N/A	270°



12S

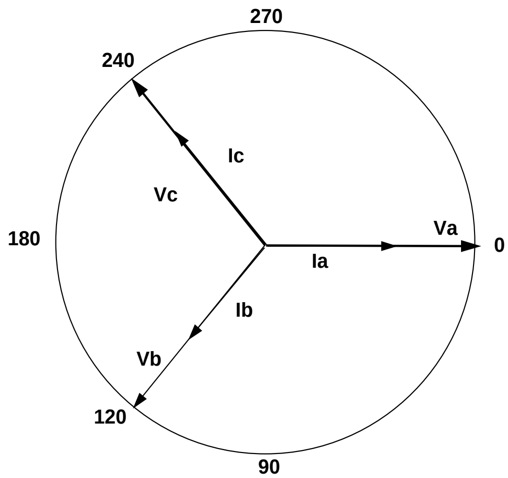
	Phase A (Left)	Phase B (Center)	Phase C (Right)
Voltage Angles	0°	N/A	300°
Current Angles	30°	N/A	270°



4.4.3 4-Wire Wye Service

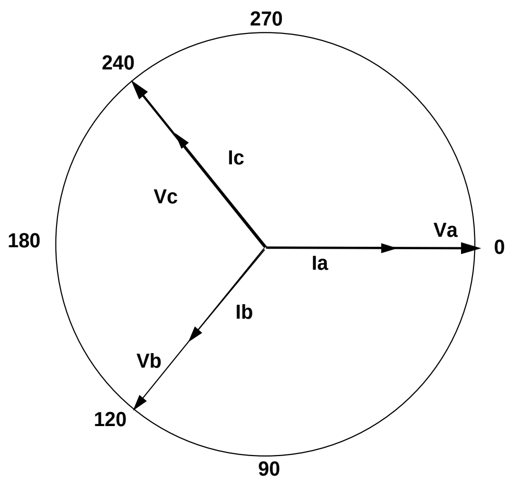
36S (6S)--Unity power factor with load connected line to neutral

	Phase A (Left)	Phase B (Center)	Phase C (Right)
Voltage Angles	0°	120°	240°
Current Angles	0°	120°	240°



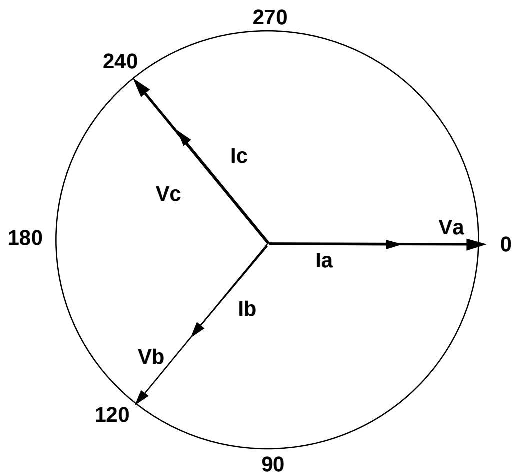
9S/8S--Unity power factor with load connected line to neutral

	Phase A (Left)	Phase B (Center)	Phase C (Right)
Voltage Angles	0°	120°	240°
Current Angles	0°	120°	240°



16/15/14S--Unity power factor with load connected phase to neutral

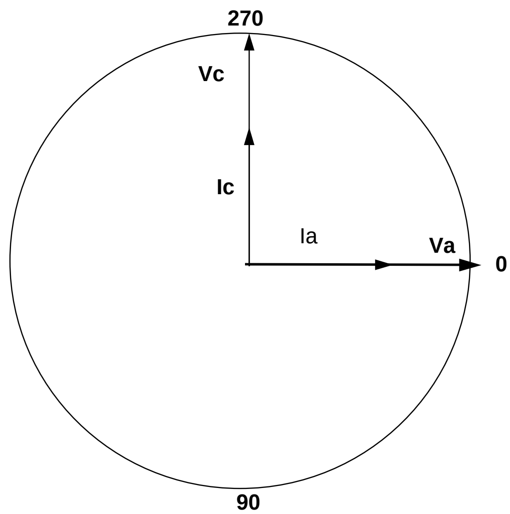
	Phase A (Left)	Phase B (Center)	Phase C (Right)
Voltage Angles	0°	120°	240°
Current Angles	0°	120°	240°


270
240
Ic
Vc
180
Va
0
Ia
Ib
Vb
120
90

4.4.4 4-Wire Delta Service

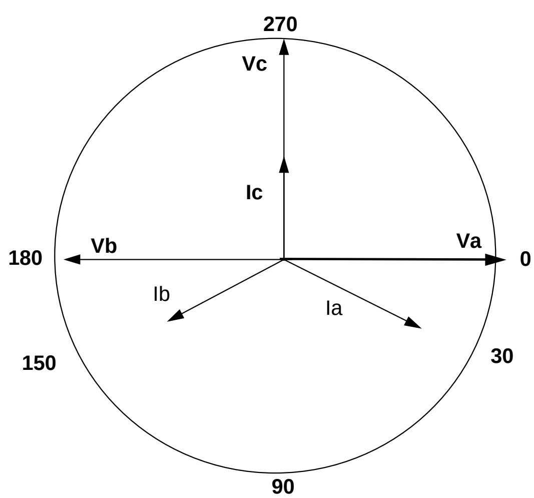
45S (5S)--Unity power factor with balanced loading

	Phase A (Left)	Phase B (Center)	Phase C (Right)
Voltage Angles	0°	N/A	270°
Current Angles	0°	N/A	270°



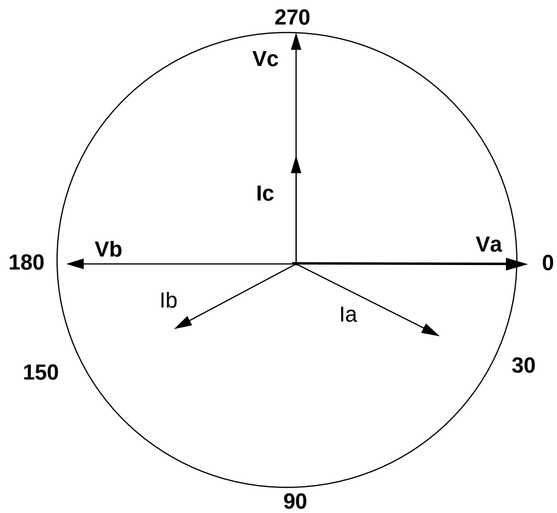
9S/8S--Unity power factor with balanced loading

	Phase A (Left)	Phase B (Center)	Phase C (Right)
Voltage Angles	0°	180°	270°
Current Angles	30°	150°	270°



16/15/14S--Unity power factor with balanced loading

	Phase A (Left)	Phase B (Center)	Phase C (Right)
Voltage Angles	0°	180°	270°
Current Angles	30°	150°	270°



4.5 Common sources for diagnostic alerts

The following section outlines the most common causes for the diagnostic alerts. All of the examples are based on a 120 Volt, 4 wire wye, 9S/8S application. The following examples are sorted by the diagnostics that are triggered for each possible problem. Each example lists the cause of the problem and the voltage, voltage angle, current angle, and current values shown for each phase as a result of this problem. The values that change for each phase as a result of a problem are listed in bold in each table. Fields marked float designate that the value isn't constant.

4.6 Loss of Potential on Any Phase (Diagnostic 1 & 2)

Normal GyrBox Displays

	Phase A	**Phase B**	**Phase C**
Voltage Angle	0.0°	120°	240°
Voltage	120V	120V	120V
Current Angle	0.0°	120°	240°
Current	2.5A	2.5A	2.5A

Phase C voltage is missing

	Phase A	**Phase B**	**Phase C**
Voltage Angle	0.0°	120°	**floats**
Voltage	120V	120V	**0.0V**
Current Angle	0.0°	120°	**floats**
Current	2.5A	2.5A	**0.0A**

Phase B voltage is missing

	Phase A	**Phase B**	**Phase C**
Voltage Angle	0.0°	**floats**	240°
Voltage	120V	**0.0V**	120V
Current Angle	0.0°	**floats°**	240°
Current	2.5A	**0.0A**	2.5A

Phase A voltage is missing

This situation powers down the meter unless the meter is equipped with the optional 3 phase power supply.

Diagnostic #s	Possible Problem
4 and 7	CT's are reversed. The current is flowing in the wrong direction.

4.7 CT's Reversed, Current Flowing in Wrong Direction.

Normal GyrBox Displays (resistive loads)

PF = 1.0rms/1.0td; Total Watts = 900

	Phase A	Phase B	Phase C
Voltage Angle	0.0°	120°	240°
Voltage	120V	120V	120V
Current Angle	0.0°	120°	240°
Current	2.5A	2.5A	2.5A

Phase A current is reversed

PF = 0.333rms/1.0td; Total Watts = 300

	Phase A	Phase B	Phase C
Voltage Angle	0.0°	120°	240°
Voltage	120V	120V	120V
Current Angle	**180°**	120°	240°
Current	2.5A	2.5A	2.5A

Phase B current reversed

PF = 0.333rms/1.0td; Total Watts = 300

	Phase A	Phase B	Phase C
Voltage Angle	0.0°	120°	240°
Voltage	120V	120V	120V
Current Angle	0.0°	**300°**	240°
Current	2.5A	2.5A	2.5A

Phase C current reversed

PF = 0.333rms/1.0td; Total Watts = 300

	Phase A	Phase B	Phase C
Voltage Angle	0.0°	120°	240°
Voltage	120V	120V	120V
Current Angle	0.0°	120°	**60°**
Current	2.5A	2.5A	2.5A

Phase A and B reversed

PF = 0.333rms/1.0td; Total Watts = -300

	Phase A	**Phase B**	**Phase C**
Voltage Angle	0.0°	120°	240°
Voltage	120V	120V	120V
Current Angle	**180.0°**	**300°**	240°
Current	2.5A	2.5A	2.5A

Phase A and C Current Reversed

PF = 0.333rms/1.0td; Total Watts = -300

	Phase A	**Phase B**	**Phase C**
Voltage Angle	0.0°	120°	240°
Voltage	120V	120V	120V
Current Angle	**180.0°**	120°	**60°**
Current	2.5A	2.5A	2.5A

Phase A, B and C Current Reversed

PF = 1.0rms/1.0td; Total Watts = -900

	Phase A	**Phase B**	**Phase C**
Voltage Angle	0.0°	120°	240°
Voltage	120V	120V	120V
Current Angle	**180°**	**300°**	**60°**
Current	2.5A	2.5A	2.5A

Diagnostic #s	Possible Problem
4, 7, and sometimes 1	Potential transformer reversed.

7.5 Normal GyrBox Displays (resistive loads)

	Phase A	Phase B	Phase C
Voltage Angle	0.0°	120°	240°
Voltage	120V	120V	120V
Current Angle	0.0°	120°	240°
Current	2.5A	2.5A	2.5A

Phase A voltage reversed: Diagnostic # 1, 4, 7

PF = 0.333rms/1.0td; Total Watts = 300

	Phase A	Phase B	Phase C
Voltage Angle	0.0°	**300°**	**60°**
Voltage	120V	120V	120V
Current Angle	**180.0°**	**300°**	**60°**
Current	2.5A	2.5A	2.5A

Phase B voltage reversed: Diagnostic # 1, 4, 7

PF = 0.333rms/1.0td; Total Watts = 300

	Phase A	Phase B	Phase C
Voltage Angle	0.0°	**300°**	240°
Voltage	120V	120V	120V
Current Angle	0.0°	120°	240°
Current	2.5A	2.5A	2.5A

Phase C voltage reversed: Diagnostic # 1, 4, 7

PF = 0.333rms/1.0td; Total Watts = 300

	Phase A	Phase B	Phase C
Voltage Angle	0.0°	120°	**60°**
Voltage	120V	120V	120V
Current Angle	0.0°	120°	240°
Current	2.5A	2.5A	2.5A

Phase A and B voltage reversed: Diagnostic # 1, 4, 7

PF = 0.333rms/-1.0td; Total Watts = -300

	Phase A	**Phase B**	**Phase C**
Voltage Angle	0.0°	120°	**60°**
Voltage	120V	120V	120V
Current Angle	**180°**	**300°**	**60°**
Current	2.5A	2.5A	2.5A

Phase A and C voltage reversed: Diagnostic # 1, 4, 7

PF = 0.333rms/-1.0td; Total Watts = -300

	Phase A	**Phase B**	**Phase C**
Voltage Angle	0.0°	**300°**	240°
Voltage	120V	120V	120V
Current Angle	**180°**	**300°**	**60°**
Current	2.5A	2.5A	2.5A

Phase B and C voltage reversed: Diagnostic # 1, 4, 7

PF = 0.333rms/-1.0td; Total Watts = -300

	Phase A	**Phase B**	**Phase C**
Voltage Angle	0.0°	**300°**	**60°**
Voltage	120V	120V	120V
Current Angle	0.0°	120°	240°
Current	2.5A	2.5A	2.5A

All Voltages Reversed: Diagnostic # 4, 7 (not 1)

PF = 1.0rms/-1.0td; Total Watts = -900

	Phase A	**Phase B**	**Phase C**
Voltage Angle	0.0°	120°	240°
Voltage	120V	120V	120V
Current Angle	**180°**	**300°**	**60°**
Current	2.5A	2.5A	2.5A

5 Events and Logs Available in the E650 S4x

There are many Events available in the E650 S4x. The first list below are Manufacturers (dedicated) Events. Manufacturers Events are ones that will always be posted in the meter's History log when they occur. These are events that cannot be disabled. The second list are Optional Events and each of these events can be included or excluded from the Optional Events log when creating the meter program in the 1132 Prog software.

5.1 Manufacturers (dedicated) Events:

Power Down
Power Up
Time Change Old

Time Change New
Meter Program
Reset List Pointer
History Log Cleared
Event Log Cleared
Event Log Updated
DST On
DST Off
Enter Test Mode
Exit Test Mode
Meter is Re-programmed
Meter Configuration Error
Clock Error
Measurement Error
End Device Sealed
End Device Unsealed
Authentication Enabled
Cold Start
Meter Flash
Standby Exit
Meter FW Image Verification
Meter Upgrade
Flash Pointer Corruption
Enter Factory Mode
Exit Factory Mode
Expected Sequence Number
Actual Sequence Number
Cover Was Installed
Cover Was Removed
L5/AMR Security Is Disabled By Programming
L5/AMR is Re-enabled By Under-cover Switch Sequence
Disable OPT Port Lockout via MGF Procedure 19
Disable OPT Port Demotion via MFG Procedure 22
Power Down Cover
Power Down Magnet
Power Down Unknown

5.2 Optional Events (can be enabled or disabled)

Primary Power Down
Primary Power up
Time Changed – Old Time
Time Changed – New Time
End Device Accessed for Read
End Device Programmed
Communication Terminated Normally
Communication Terminated Abnormally
Reset List Pointers
Update List Pointers

History Log Cleared
History Log Pointers Updated
Event Log Cleared
Event Log Pointers Updated
Demand Reset Occurred
Self-Read Occurred
Daylight Savings Time On
Daylight Savings Time Off
Season Change
Rate Change
Special Schedule Activated
Tier Switch / Change
Pending Table Activated
Pending Table Activation Cleared
Test Mode Started
Test Mode Stopped
Meter is Re-programmed
Configuration Error Detected
RAM Failure Detected
ROM Failure Detected
Nonvolatile Memory Failure Detected
Clock Error Detected
Measurement Error Detected
Low Battery Detected
Demand Overload Detected
Tamper Attempt Detected
Reverse Rotation Detected
End Device Sealed
End Device Unsealed
Authentication Enabled
Log On Failure
Voltage Sag or Swell Started or Stopped
Temperature Threshold Exceeded Error
Excessive Leading Current
Enter / Exit Real Time Rate
Cold Start
Unauthorized Request
Meter Flash
Line Frequency Range Adjust Error
Standby Exit
Meter FW Image Verification
Meter Upgrade
End Device Programming Started
Tilt Detected
VHoldUp Event Detected
Flash Pointers Corrupted
Meter ROM Verification
Arm Seal Bit Cleared Due To Tamper
Enter Factory Mode
Exit Factory Mode

Expected Sequence Number
Actual Sequence Number
Alert Occurred
Cover Was Installed
Cover Was Removed
L5 / AMR Security is Disabled by Programming
L5/ AMR Security is Re-enabled by Under-Cover Switch Sequence (Menu Mode)
Disable OPT Port LOCKOUT via MFG Procedure 19
Disable OPT Port Demotion via MFG Procedure 22
Power Down Cover
Power Down Magnet
Power Down Unknown

NOTE…The tamper detection triggers are active even when the meter is not powered so long as there is a lithium battery installed, however they will be reported only after power is restored to the meter.

5.3 The Audit Trail (Audit Log)

The Audit Trail Log is kept in STD table 76 and is a continuous record of events that are considered vital as a reliable reference of activities when changes are made to the meter's programming or status. It does not specify what changes have been made, however it does indicate that a change was attempted or executed, and includes possible tamper activities. This log is not selectable and permanently resides in the meters STD table 76. When it is full and a new event is added to the log, the oldest event will be deleted and so on. The audit trail log currently includes the following events:

Meter Program Event Log Cleared Event Log Updated Meter is Re-Programmed End Device Sealed End Device Unsealed Authentication Enabled Cold Start Meter Flash	Meter Programming Started Enter Factory Mode Exit Factory Mode L5/AMR Security is Disabled by Programming L5/AMR Security is Re-Enabled by Under the Cover Switch Sequence Disable OPT port LOCKOUT via MFG Procedure 19 Disable OPT port Demotion via MFG Procedure 22

6 Demand Metering

The E650 S4x meter can calculate active (kWh) energy or reactive (VAR Phasor, VA Phasor, VArms) energy and demand in block, or rolling block. Demand interval length and the number of subintervals are established through programming. The possible arrangements of subintervals per interval for "rolling demand" are shown in Table 7.0. Rolling demand is sometimes referred to as "sliding demand". A new demand interval timing sequence begins when power is applied/restored, upon programming when the demand interval is changed, and when entering or exiting test mode. The number of minutes remaining in the current subinterval is available for display.

	Number of Subintervals							
Interval Length	1	2	3	4	5	6	10	15

	Demand Subinterval Length (minutes)							
1 Block Only!								
2	2	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	-
4	4	2	-	-	-	-	-	-
5	5	-	-	-	-	-	-	-
6	6	3	2	-	-	-	-	-
10	10	5	-	-	2	-	-	-
12	12	6	4	3	-	2	-	-
15	15	-	5	-	3	-	-	-
20	-	10	-	5	4	-	-	-
30	-	-	-	-	-	-	2	-
60 Block Only!	-	15	10	-	6	5	3	2

Table 7.0 Demand Subintervals/Intervals

6.1 DEMAND TYPES

Demand can be displayed in three different ways:

6.1.1 Maximum (Indicating) demand

The maximum demand since the last demand reset.

6.1.2 Cumulative demand

The sum of the maximum demands from all demand resets.

6.1.3 Continuous cumulative demand

The sum of indicating and cumulative demands.

6.1.4 Three Highest Demands

The highest three demands during a billing period are recorded with the time and date of occurrence for all demand metrics. This is true for the Total **and** each Rate.

6.1.5 Demand (Billing Period) Reset

Block: The following actions occur upon Demand Reset:

1) For each of the rates the following is done to the present season values:

   a) Max kW is added to the Cumulative kW value and Max VAR phasor, VA phasor, or VA rms is added to the Cumulative value for each metric.

   b) Max kW is reset to zero. Max VAR phasor, VA phasor, and VA rms are reset to zero.

2) The three highest kW and VAR phasor, VA phasor, and VA rms values and coincident values are reset to zero (TOU Only).

3) For block demand, all demand data for all previous intervals is zeroed, and all demand data in the present interval (including before the Demand Reset) is retained.

4) Date of last reset is updated (TOU Only) (see exception under No. 5).

5) If it is an automatic Demand Reset as a result of season change, then all present season values are written to last season registers before any data is zeroed. Date of last reset is not updated.

6) If a season change results from this Demand Reset, then all present season values are written to last season registers before any data is zeroed.

6.1.6 Rolling, Demand Reset Type I

Same as Block Demand Reset except demand data from current subinterval is not cleared. As a result the Present kW register is not affected.

6.1.7 Rolling, Demand Reset Type II

Same as Block Demand Reset except all demand data from all previous subintervals is zeroed, and all demand data in the present subinterval (including before the Demand Reset) is retained.

Automatic Demand Reset upon Season Change
A demand reset may be programmed to occur automatically at each season change. In order to not lose the demand data, all present season demand values are copied into last season demand registers, before clearing the present season values to zero. The last season values can be displayed and can be read by any compatible reader.

6.2 Demand Reset Methods

6.2.1 Manual Method

A Demand Reset can be initiated manually via the reset mechanism installed in the front of the meter cover. Upon initiating a Demand Reset, all LCD display segments are briefly displayed. No further Demand Resets are allowed to occur until the completion of one normal display sequence. After a Demand Reset, the display sequence will begin at the first programmed display of the normal display sequence.

6.2.2 Software Method

A Demand Reset may also be accomplished optically or remotely (via AMI device, RS232, RS485, or Ethernet) using Landis+Gyr's 1132Prog/1132Com software package on a PC or other compatible device (AMI system with I/O capabilities). The meter is also capable of automatically doing a demand reset daily, monthly, as a part of a Self-Read, or on season change.

6.2.3 Power on demand delay timing

Power on demand delay timing (PODT) allows for demand measurement to be delayed when power is restored after a power outage. The length of time for which demand is delayed, after power resumes, is programmable. The demand measurement may be delayed for times of 0 to 255. A time of zero minutes would cause no delay to occur. The value of PODT left is available for display. Additionally, a PODT Trigger can be set to designate how long an outage has to be for the meter to utilize the PODT. This value can be programmed from 0 to 255.

7 TOU Metering

This section of the instruction manual covers the Time of Use function and operation of the E650 S4x meters where TOU and recorder capabilities are employed.

7.1 TOU without Battery

The meter is configurable to ignore all errors and events resulting from a low or missing battery including clock error. The meter is configurable such that after a power outage, if it is not able to determine the current time, it defers some power up handling until it can, and enters stand-by mode.

7.2 "Stand-By" mode

When configured for Time of Use without battery and to allow stand-by mode, the meter enters stand-by after a power outage during which clock function was lost. Stand-by mode is designed to enable a utility to continue recording demand and Load Profile data while the meter is uncertain of the correct time.

Upon entering stand-by, the meter's clock is set to 12:00AM 1/1/2000, a clock error is asserted, and an enter stand-by event is logged. The day of week is also set to "7" (unassigned day of week) In an operational AMI network, the meter should only remain in stand-by for a few seconds. However if a wide scale outage has occurred, the AMI network might take a period of time to fully function and to propagate the correct time to the meter. The meter does not exit stand-by unless the clock is set.

7.3 Stand-By Mode in Practice

Stand-by mode records Load Profile data. The meter stores up to the full capacity of load profile memory (256K or 1Meg) while in Stand-By Mode. The number of days the meter is able to store is dependent on the interval lengths and number of channels being used. All power up and down events are recorded as in normal operation. The season and special schedule (aka Holiday) are retained. The rate changes to the Stand-By rate set in Mfg table 15 and does not change due to any calendar event. Self reads and season changes are skipped.

On subsequent power outages in which the time is lost, the meter creates a new stand-by start event in the log, but no stop event. The clock error is retained until the time is set and is not reset with a "Clear Standard Status flags" request. Test mode remains available, and data is not logged while in this mode (as normal). The Stand-By data will merge with normal load profile data using the current time as a reference point, upon exiting stand-by via a time set.

8 Main Clock

The E650 S4x register maintains its clock by counting the line cycles. The clock maintains accurate time-keeping from the line while power is present. On battery carry over, the E650 S4x register maintains its clock using a 32kHz crystal with an accuracy of ±0.02%, or ±1 minute per month. Optionally, the E650 S4x may be programmed to always maintain its clock from the 32kHz crystal.

8.1 Time Display Format

The register clock displays time in a 24-hour format of XX hour and XX minutes or with XX seconds. Midnight is considered to be the beginning of a day and is displayed as 00:00 or 00:00.00 with seconds.

8.2 Date Display Format

The E650 S4x can be programmed to display the date in month/day/year, day/month/year, year/day/month or year/month/day (Canada) format. The time and date are always stored in the same manner. The format only affects the display of the data.

8.3 Date and Time Setting

Changing the software clock is achievable through any compatible programmer such as a handheld device, AMI (with time keeping functionality), or a PC with the proper software and hardware without prior knowledge of the program in the meter. Changing the time in the meter will not result in a loss of register data.

8.4 Daylight Savings Time

Daylight savings time shifts either follow U.S./Canada dates or user programmed dates. On a spring time shift the time moves from 2 to 3 AM and from 2 to 1 AM on a fall time shift. In the following table Rate A is programmed from 12 to 1:30 AM and Rate B is programmed from 1:30 AM to end of day.

Event	**Action**
Time reaches midnight	Rate A activated
Time reaches 1:30 AM	Rate B activated
Time reaches 2:00 AM	Time changed to 1:00 (on Fall DST date), Rate A activated
Time reaches 1:30 AM again	Rate B activated
Time reaches 2:00 AM again	No action

8.5 Time On Carryover

Time on battery carryover is measured to log the cumulative time the battery has been in use. Time on carryover is measured in seconds, has an internal recording capacity of 136 years, and is displayed on the LCD in minutes (the expected capacity of the battery is 2 years, if the battery is connected and no power is applied to the meter). Performing a cold start resets the time on battery carryover. Time on carryover will roll over to 0 when the monitoring of battery usage extends past 999999 minutes (694 days) on the display. Time on battery is available for display. While minutes are available for display, the internal resolution of time on carryover is seconds.
When installing a new battery, the battery carryover time can be reset to zero using 1132 COM the “Test Battery and Clear Time” function in the Meter Tools dropdown.

9 Programmable Dates and Schedules

9.1 Programmable Dates

The register has enough memory to provide a 20 year calendar when using 15 holiday or season change dates. Users may define their own fixed date perpetual dates. Perpetual dates also signal season changes or holidays. Examples of perpetual dates are:

Jan. 1	New Year's Day
July 1	Canada Day
July 4	Independence Day
Nov. 11	Veteran's Day
Dec. 25	Christmas Day
Dec. 31	New Year's Eve

9.2 Seasonal Rate Changes

TOU schedules for up to four seasons per year are available. Seasonal rate changes occur at the first hour of programmable dates (midnight). At season change, all energy and demand accumulators are copied into last season storage.

9.3 TOU Daily Schedules

Two hundred and fifty-five transitions are available to divide between the daily schedules. The switch points are shared among the five TOU rates and the optional TOU Load Control switch.

9.4 Day Select for Schedules

Each of the seven days of the week may have one of the TOU schedules assigned to it. Any schedule may be used as an exception to the TOU daily schedule (i.e. a holiday).

9.5 Load Control/TOU Switchpoints

A switchpoint is a quarter-hour boundary during the day that defines a TOU rate change and/or a programmable output option change. TOU schedules are made up of switchpoints. Each schedule may have from 1 to 96 switchpoints.

The meter allows for up to five TOU rate periods, Rates A, B, C, D and E. Any rate may last for as short as one switchpoint (changing every quarter-hour) or for as long as an entire day. Switchpoints may also be used to enable or disable programmable outputs. Control of the outputs may occur in conjunction with rate changes or apart from them. Therefore, a switchpoint may either change the TOU rate; change the state of the programmable outputs, or both.

This action directs the load control relay to energize or de-energize. Energizing a load control relay should close or open the KY contact (depending upon the normal off state of the relay, either open or close). Load control actions in a TOU schedule will have no effect unless one of the optional general purpose relays is programmed for load control.

9.6 Rate Indicator Outputs

Rate indicator outputs may be accomplished by programming an output relay for TOU Load Control as stated in the above section.

9.7 Load Profile

9.7.1 Load Profile Memory Capacity

The E650 S4x Load Profile memory sizes are 256K and 1Meg. The reader/programmer will initialize load profile memory or disable load profile recording completely. On the E650 meter, the Load profile maximum is 1Meg.
The number of days of capacity is dependent upon the interval length duration and the number of channels used. Table 7.10.3 on the following page shows the relationship between capacity and load profile interval length.

9.7.2 Upgrade of Load Profile Memory

E650 S4x meters can be upgraded from 256K to 1Meg with a softkey and bullets (credits on a hardlock key).
Note…The meter can also be configured to have a (optional) dual recorder or "Second Load Profile". This is where intervals of a different length from the 1st Load Profile (in minutes) can be configured. How the two load profiles are apportioned is flexible. See section 7.10.4.1

9.7.3 Load Profile Interval Length with Single Load Profile

Load Profile interval lengths include, 1, 5, 15, 20, 30, and 60. Load profile interval length and TOU demand interval length are independent and may be different.

Number of Days (approximate*) in Load Profile:

LP_MEMORY_LEN	INT_LEN	NBR_CHNS	NBR_DAYS
256K (262.144K)	1	1	35.60
	5	1	178.00
	15	1	534.00
	30	1	1068.00
	60	1	2136.00
	1	2	17.87
	5	2	89.33
	15	2	268.00
	30	2	536.00
	60	2	1072.00
	1	4	9.40
	5	4	47.00
	15	4	141.00
	30	4	282.00
	60	4	564.00
	1	8	4.80
	5	8	24.00
	15	8	72.00
	30	8	144.00
	60	8	288.00
	1	16	2.40
	5	16	12.00
	15	16	36.00
	30	16	72.00
	60	16	144.00

LP_MEMORY_LEN	INTERVAL_LENGTH	NBR_CHNS	NBR_DAYS
1 Meg (1024k)	1	1	142.60
	5	1	713.00
	15	1	2139.00
	30	1	4278.00
	60	1	8556.00
	1	2	71.60
	5	2	358.00
	15	2	1074.00
	30	2	2148.00
	60	2	4296.00
	1	4	37.73
	5	4	188.67
	15	4	566.00
	30	4	1132.00
	60	4	2264.00
	1	8	19.33
	5	8	96.67
	15	8	290.00
	30	8	580.00
	60	8	1160.00
	1	16	9.80
	5	16	49.00
	15	16	147.00
	30	16	294.00
	60	16	588.00

Table 7.10.3 Number of Days in Different Load Profile Configurations

**NOTE…Because engineering units (and not pulses) are used, capacity of load pro may increase with light loads*

9.7.4 Load Profile Recording Channels

The register with single recorder Load Profile records up to 16 channels of load profile data. The number of channels is programmable. The available memory is distributed equally among each channel.

The metric for each load profile channel is selectable by the reader/programmer and may be different from the additional metric used elsewhere in the register for energy and demand calculation. Each channel has a configuration byte defining its selected metric. All calculations are based on the meter's true kh. These configuration bytes may be read by the reader/programmer. The metrics available are as follows (all channels must use the same interval lengths with Single Load Profile recorder):

Delivered kWh	Q3 kVArh Phasor	Q2 kVAr RMS
Received kWh	Q4 kVArh Phasor	Q3 kVAr RMS
Total kWh	Phase A RMS Volts	Q4 kVAr RMS
Q1 kWh	Phase B RMS Volts	Delivered KVA RMS
Q2 kWh	Phase C RMS Volts	Received kVA RMS
Q3 kWh	Phase A RMS Amps	Total kVA RMS
Q4 kWh	Phase B RMS Amps	Q1 kVA RMS
Delivered kVarh	Phase C RMS Amps	Q2 kVA RMS
Received kVarh	Phase Neutral RMS Amps	Q3 kVA RMS
Total kVarh	Average Power Factor	Q4 kVA RMS
Q1 kVarh RMS	Frequency	Delivered kVA Phasor
Q2 kVarh RMS	External Input 1	Received kVA Phasor
Q3 kVarh RMS	External Input 2	Total kVA Phasor
Q4 kVarh RMS	Voltage Sag Phase A	Q1 kVA Phasor

Delivered kVAh RMS	Voltage Sag Phase B	Q2 kVA Phasor
Received kVAh RMS	Voltage Sag Phase C	Q3 kVA Phasor
Total kVAh RMS	Voltage Sag Any Phase	Q4 kVA Phasor
Q1 kVAh RMS	Voltage Swell Phase A	Delivered kVAr Phasor
Q2 kVAh RMS	Voltage Swell Phase B	Received kVAr Phasor
Q3 kVAh RMS	Voltage Swell Phase C	Total kVAr Phasor
Q4 kVAh RMS	Voltage Swell Any Phase	Q1 kVAr Phasor
Delivered kVAh Phasor	Temperature (Degrees C)	Q2 kVAr Phasor
Received kVAh Phasor	Delivered kW	Q3 kVAr Phasor
Total kVAh Phasor	Received kW	Q4 kVAr Phasor
Q1 kVAh Phasor	Total kW	For Future Use
Q2 kVAh Phasor	Q1 kW	For Future Use
Q3 kVAh Phasor	Q2 kW	For Future Use
Q4 kVAh Phasor	Q3 kW	For Future Use
Delivered kVArh Phasor	Q4 kW	For Future Use
Received kVArh Phasor	Delivered kVAr	For Future Use
Total kVArh Phasor	Received kVAr	For Future Use
Q1 kVArh Phasor	Total kVAr	For Future Use
Q2 kVArh Phasor	Q1 kVAr RMS	For Future Use

Table 7.10.4 Load Profile Metrics

9.7.5 2nd Load Profile Option (Dual Recorder)

An additional and separate, 2nd Load Profile option can be added to the E650 S4x through 1132COM with a soft key upgrade. Once upgraded, the meter can provide up to 16 additional channels. This separate, 2nd Load Profile may use different interval lengths than the 1st Load Profile. The available (256K or 1Meg) memory can be divided between the two Load Profiles in various proportions by percentage, using whole numbers.

9.7.6 Load Profile Engineering Units

Size of LP interval values are 32 bit signed integers. This size allows for the storage of energy metrics in the same engineering units as the summations (mWh, mVAh, mVARh) without the possibility of overflow. If demand instead of energy is desired, then this option is exposed and the meter will divide out the time to give demand in the same units as max demands (mW, mVA, mVAR). Diagnostic values (like voltages, currents, frequency and temperature) are stored in micro (1 millionth) and have the time factored out of them (they are in units of uV, uA,uHz,u°C, not uVh, uAh, etc.). Minimum LP capacity can be calculated. It is dependent on the number of channels, interval length, and whether end block readings (a device used to validate energy channels against the summations in Std. 23) are enabled. For normal size LP (256K), this calculation yields a hard amount of days of LP that will be available. For the large LP (1Meg), the capacity will be guaranteed to be at least 4 times that of the normal LP. There is a status flag in the LP for overflow and the code is looking for and will set this condition if detected.

9.7.7 Load Profile Status Flag

The statuses flagged in load profile are overflow, partial interval, long interval, skipped interval, test mode, power fail, clock set forward, clock set backward, and Daylight Savings Time in effect during interval. Under normal circumstances an overflow error should not occur as the metrics have been scaled to units that preclude this, but with a large backward time set or perhaps some other circumstances, it could be set.

9.8 Long Outage Detection

Before a load profile interval has a power outage indicator bit set, the cumulative power outage time during the interval must exceed a programmable length of time. This length of time is programmed in seconds and may range from 1 to 16.

Note: Long outage time for load profile is a different quantity than the long outage time used to trigger demand delay.

Note: A power fail in load profile is defined as loss of voltage below roughly 85 volts, depending on conditions, for 6 or more line cycles.

9.9 Real Time Billing

Real time billing may be entered via the demand or power factor threshold alerts. Refer to Section 8.2 for real-time communication links.

10 Master Reset

A master reset clears all billing data in the register, while leaving the customer program unchanged. The master reset can be performed in two ways: 1) optically using 1132Prog/1132Com software package and 2) manually using the switches located on the display of the register.

10.1 Performing a master reset optically using 1132Prog/1132Com

Follow the instructions for performing a master reset listed in the help file for 1132Prog/1132Com.

10.2 Performing a master reset manually using switches

NOTE…The meter cover must be removed for this procedure

1. Enter Gyrbox mode by holding a magnet to the 12 O'clock position (top and front of the meter for 6 seconds.
2. The phase voltage and angles should now be displayed…Remove the magnet.
3. lift the Test Mode switch…you should now see Normal mode display "01 rESET", which is MASTER reset, the first display in the sequence.
4. To execute the "**01 rESET**" menu item, fully depress the reset switch once.
5. To exit the menu display mode, flip the Test Mode switch back to its "at rest" position (flush with the register housing).

If the steps are not completed correctly and in a timely fashion,"01 rESET" will NOT show on the display. No menu item function will occur, but a demand reset will occur if the reset switch is pressed.

10.3 Cold Starts

A cold start will initialize all memory and return the register to an unprogrammed state. The register will accumulate energy and demand data for 15 minute intervals while in this condition. <u>Test mode will not function as normal</u>

Caution: Cold starting a device will result in an irreversible loss of billing data and the meter programmed must be restored.

A cold start may be accomplished in two ways: optically or manually.

10.3.1 Method 1, Optical Cold Start

The instructions for performing a cold start can be found in the 1132Com help file.

10.3.2 Method 2, Manual Cold Start

NOTE…The meter cover must be removed for this procedure!

1. Enter Gyrbox mode by holding a magnet to the 12 O'clock position (top and front of the meter for 6 seconds).
2. The phase voltage and angles should now be displayed…Remove the magnet.
3. lift the Test Mode switch…you should now see Normal mode display "01 rESET", which is MASTER reset, the first display in the sequence.
4. To change the displayed Menu item, swipe the magnet once for each display menu item until you see "**02CLd St**". This is the Cold Start menu item.
5. To execute the menu item, fully depress the reset switch once.
6. To exit the menu display mode, flip the Test Mode switch back to its "at rest" position (flush with the register housing).

If the steps are not completed correctly and in a timely fashion,"01 rESET" will NOT show on the display. No menu item function will occur, but a demand reset will occur if the reset switch is pressed.

10.3.2.1 Register Displays following a Cold Start

After the meter is cold started the meter auto-scrolls through a power-up display sequence and then stops on the error code S00. If you wish to review the power-up display sequence, please consult Section 3.2.1 of this manual entitled "Power-Up Displays".

11 Manual Unlock Procedure

(Set Communications security temporarily from L4 to L5)

1. Enter Gyrbox mode by holding a magnet to the 12 O'clock position (top and front of the meter for 6 seconds
2. The phase voltage and angles should now be displayed…Remove the magnet.
3. lift the Test Mode switch…you should now see Normal mode display "01 rESET", which is MASTER reset, the first display in the sequence.
4. To change the displayed Menu item, swipe the magnet once for each display menu item until you see "**03UNLOCK**". This is the Communications unlock (optical or AMI) menu item.
5. To execute the menu item, fully depress the reset switch once.
6. To exit the menu display mode, flip the Test Mode switch back to its "at rest" position (flush with the register housing). You now have 2 minutes to execute communication before the L4 security re-engages

If the steps are not completed correctly and in a timely fashion,"01 rESET" will NOT show on the display. No menu item function will occur, but a demand reset will occur if the reset switch is pressed.

12 ANSI Type II Optical Communications Port

An ANSI Type II optical communications port mounted on the meter cover provides bi-directional communications between the register and an external programmer or reader. To gain access to any optical port functions, the register must first verify a security code.

All billing and program information in the register is readable via the optical port. Communications through the optical port is at 38400 baud and is asynchronous. Data transfer is compatible with a PC serial port or USB port.

12.1 Security

When the E650 S4x is programmed, a range of security features can be used. The E650 S4x security scheme consists of five levels of access to the meter, involving two communication security codes and a special switch sequence.
Once the meter has been programmed, an operator must log in to the meter to establish a security level before any further programming commands or meter operations will be accepted. The security level granted to the operator must be at least as high as the level programmed for the desired operation or the meter rejects the command.

12.1.1 Optical Port Lock-Out Feature (Gridstream feature only)

The E650 S4x has the ability to completely lock-out the optical port of the meter by sending a command over an AMI network. A meter's optical port can be made active (not locked out) either indefinitely or for a programmable period of time when the AMI unlock command is sent or a limited time unlock (2 minutes) via a series of switch actuations on the meter (this requires the removal of the meter cover). The AMI network can be configured to send the lock-out command once per day in the event the meter's optical port is left unsecured unintentionally. An unsecured optical port will follow the L1 – L5 meter security as it exists in today's Landis + Gyr ANSI meters. An intervening outage keeps the optical port unsecured for the remaining duration of the lock-out. If the outage duration exceeds the lock-out time OR if the outage duration causes stand-by mode, the meter secures the optical port upon power up. Any attempt to initiate an optical port lock-out procedure, optically will be rejected by the meter.

12.1.2 Magnetic / DC Detection / Hall Effect Switch

The E650 S4x has the ability to set an error flag for each phase if leading current angles above 10° are detected. The error flags are based on a fixed per phase threshold angle of 10° meter form. Per phase start-stop events can be enabled to be logged in meter event log along with displaying optional error codes (M04) on LCD of meter. The triggering of this event indicates that conditions consistent with magnetic/DC tamper may be present. In addition, the meter is equipped with a Hall Effect sensor to detect the presence of an external magnetic field outright. This activity will trigger an event to be posted in the event log.

12.1.3 Tilt Tamper Detection

The E650 S4x has an on-board tilt sensor for detection of vibration and / or "tilt" as a means to alert a utility that a meter has possibly been removed from its socket.
• If vibration/tilt was detected in the 10 seconds before power down, reset, etc. this can indicate meter removal.
• If vibration/tilt was detected in the 10 seconds after power up, reset, etc. this can indicate meter insertion.

Note: If any of the above conditions are met, an event can be logged in the meter's event log.

12.1.4 E650 S4x ANSI Security Information

These are the five levels of security for E650 S4x meters. Each security code is 20 digits in length and all 20 digits must be used. Each level includes all capabilities of the lower levels:
L1 - Allows for the meter to be read only. No programming or procedures may be executed.
L2 - Allows for demand resets to be done.
L3 - Allows for the following additional programming tasks to be performed:

- Set date and time
- Program or modify TOU rates and calendar
- Program or modify the display table
- Program or modify the ANSI specific utility information

- Program or modify the tables associated with modem communication
- Program or modify network ID
- Program or modify output relays
- Program or modify load profile configuration

L4 - Allows for all programming and procedures to be done, with the exception of device configuration.

L5 - Allows everything to be done, including device configuration. This is needed when adding TLC, load profile capacity, or adding a second Load Profile recorder capability. It is what is required when altering which ANSI standard tables or Manufacturer tables are enabled in the meter.

13 Voltage Quality Information

The E650 S4x continually monitors voltage and provides information for evaluating voltage quality. Through 1132Prog/1132Com, the user can program in voltage sag and swell threshold values (such as 90% and 110%, for example). When a voltage exceeds the sag or swell threshold, the information is recorded in the meter's event log, load profile (if channels are programmed for that function), or communicated via a programmable output.

13.1 Sag Information

A threshold value is provided for detecting voltage sags in load profile. If the voltage drops below this threshold, then a sag counter is incremented once per 0.3 seconds. This counter continues to increment until the voltage is no longer less than the sag threshold. At the beginning of each new load profile interval, this counter is zeroed. A load profile channel may be selected to record the value of the sag counter at the end of each load profile interval. Although there is only a single sag threshold for load profile, each phase can have its own channel.

13.2 Swell Information

A threshold value is provided for detecting voltage swells in load profile. If the voltage exceeds this threshold, then a swell counter is incremented once per 0.3 seconds. This counter continues to increment until the voltage no longer exceeds the swell threshold. At the beginning of each new load profile interval, this counter is zeroed. A load profile channel may be selected to record the value of the swell counter at the end of each load profile interval. Although there is only a single swell threshold for load profile, each phase can have its own channel.

13.3 Voltage Sag Alert

A threshold is provided for alerting voltage sag. The voltage is inspected and an alert set when it drops below the sag alert threshold. This alert is cleared when the voltage is no longer below the sag alert threshold. This threshold is separate from the load profile threshold.

13.4 Voltage Swell Alert

A threshold is provided for alerting a voltage swell for output relays. The voltage is inspected and an alert is set when it exceeds the swell alert threshold. This alert is cleared when the voltage is no longer above the swell alert threshold. This threshold is separate from the load profile threshold.

13.5 Instantaneous Readings

All programmed Demand metrics are available as "instantaneous" values, and are displayable and available through the optical port or the communications link:

Voltage per Phase
Current per Phase
Neutral Current
kW
kVAR rms and kVAR Phasor

kVArms and kVA Phasor

These values will be updated at a rate based on the rate of incoming data. The update rate for voltage will be 1 second and for other values the update rate will be no longer than four seconds. On-line updates may vary depending on communications rate and query time.

13.6 Self-Reads

When actuated, the self-read function will save a copy of all energy and demand information, including TOU metrics, and mark the current date and time. Self-read data is available for display on E650 S4x as well.

Note: You do not need to have Load Profile programmed for self-reads to work.

13.6.1 Self-Read Data

The following list contains the self-read items that are captured at the time of a self-read. All Demand metrics (the three highest) will be Time and Date Stamped:
ENERGY (Total and for each rate programmed):

13.6.1.1 Delivered: kWh, kVArh RMS, kVAh RMS, kVAh Phasor, kVArh Phasor, Q1, Q2, Q3, Q4 for each Metric

Received: kWh, kVArh RMS, kVAh RMS, kVAh Phasor, kVArh Phasor, Q1, Q2, Q3, Q4 for each Metric
Total: kWh, kVArh RMS, kVAh RMS, kVAh Phasor, kVArh Phasor, Q1, Q2, Q3, Q4 for each Metric

13.6.1.1.1 DEMAND (Total and for each rate programmed):

Delivered: kW, kVAr RMS, kVA RMS, kVA Phasor, kVAr Phasor,
Received: kW, kVAr RMS, kVA RMS, kVA Phasor, kVAr Phasor
Total: kW, kVAr RMS, kVA RMS, kVA Phasor, kVAr Phasor
Cumulative: kW, kVAr RMS, kVA RMS, kVA Phasor, kVAr Phasor
Continuous Cumulative: kW, kVAr RMS, kVA RMS, kVA Phasor, kVAr Phasor
Max (3 highest): All demand metrics, including time, date, and rate

13.6.1.1.2 POWER FACTOR:

For Cumulative Demand, Continuous Cumulative Demand
For the Three highest Max Demands for each rate programmed
NOTE...the demand metric to be used for posting PF is selectable in 1132 PROG software.

13.6.1.1.3 COINCIDENT DEMAND (Total and for each rate programmed):

Total kW at Max Total kVAr: Three for each rate Programmed
Total kW at Max Total kVA: Three for each rate Programmed
Total kW at Min Power Factor: Three for each rate Programmed
Total kVA at Max Total kW: Three for each rate Programmed
Total kVA at Max Total kVAr: Three for each rate Programmed
Total kVA at Min Power Factor: Three for each rate Programmed
Delivered kW at Max Delivered kVAr Phasor-RMS: Three for each rate Programmed
Delivered kW at Max Delivered kVA Phasor: Three for each rate Programmed
Total kVAr Phasor-RMS at Max Total kW: Three for each rate Programmed
Total kVAr Phasor-RMS at Max Total kVA: Three for each rate Programmed
Total kVA Phasor at Max Total kW: Three for each rate Programmed

13.6.1.1.4 Coincident Power Factor:

Power Factor at Max Total kW: Three for each rate Programmed
Power Factor at Max Total kVAr RMS: Three for each rate Programmed
Power Factor at Max Total kVA RMS: Three for each rate Programmed
Power Factor at Max Delivered kW: Three for each rate Programmed
Power Factor at Max Delivered kVAr RMS: Three for each rate Programmed

13.6.2 Number of Self-Reads

The E650 S4x is capable of storing up to twelve sets of self-read data. A self-read initiates the transfer of current data into the next available self-read memory block, followed by a demand reset, if desired. Only the most recent twelve self-reads are retained. The oldest self-read is replaced by the most recent when the programmable number has been reached.

13.6.2.1 Self-Read at Season Change

If a season change and a self-read occur at 00:00:00 of the same day, the self-read actions occur before the season change. Previous season data is stored in the self-read information.

13.6.2.2 Initiating a Self-Read

You can program an automatic self-read to occur according to the methods listed below. The first three methods (day of the month, hours since the last reset, every day) are mutually exclusive, while the last two methods (after a manual reset and through an external input) can be selected in conjunction with one of the other methods.

13.6.2.2.1 A particular day of the month

Self-read occurs on one of the programmable self-read days from 1 to 28 at 00:00:00 on the specified day. Therefore, selecting the first day of the month will actuate self-read at midnight just after the last day of the previous month. Calendar month billing is obtained by selecting the first day of the month as the day which the read should occur.

13.6.2.2.2 Every day

Self-read will occur each night at midnight or 00:00 on the clock.

13.6.2.2.3 After a manual reset

A self-read occurs after a demand reset is performed using any method except for the demand reset method concurrent with a season change. The self-read data is stored prior to the actual reset of indicating and cumulative demands.

13.6.2.2.4 Through an external input

A self-read is initiated through external input #1. The input is only available when the E650 S4x optional relay board is installed. Using the external input to actuate self-reads may be programmed to occur on either the presence or absence of a signal on external input #1.
Note: Test Mode disables external inputs.

13.6.3 Self-Read Displays

When self-read displays are enabled, self-read data will follow the user-programmed display sequence. If the display is currently in the "normal" mode, self-reads are enabled, and there has been an automatically generated self-read, this data will follow the normal display sequence. Self-read data is displayed using the same programmed display sequence that normal real-time data uses.

Self-read data will be displayed in chronological order starting from the most recent block. For example, if the time, date, and maximum kilowatts are to be displayed in the normal mode sequence, then when self-reads are displayed, the time, date, and maximum power data recorded in the self-read will be displayed beginning with the most recent self-read data.

14 Outputs, Inputs, and Communications

The E650 S4x option board has up to four form "C", optoMOS, general purpose output relays (relays 1 through 4), and one or two general purpose inputs. Two different input/output option board combinations can be ordered and programmed as outlined in the following chart.

Input/Output Options	
Two Relays:	Each relay programmable for KYZ, EOI, LC, DTA, VTA, GyrBox Alert Output, and Power Factor Threshold Alerts.
One Input:	Input programmable for Real Time, Temperature Sensor, Load Profile Channel Input, or self-read activation.
Four Relays:	Each relay programmable for KYZ, EOI, LC, DTA, VTA, GyrBox Alert Output, and Power Factor Threshold Alerts.
Two Inputs:	Input 1 programmable for Real Time, Temperature Sensor, and Load Profile Channel Input. Input 2 programmable for Load Profile Channel Input.

Table 8.0 Option Board Inputs/Outputs

NOTE: In addition to the external relays, the E650 S4x has four additional internal or "virtual" relays (relays 5 through 8) available and programmable with the 1132 Software

14.1 Output Cables and Connectors

The E650 S4x meter equipped with options can be provided with an output cable which exits through the meter base via a 20 pin connector.

The electronic option board on the E650 S4x meter is a plug-in type in order to facilitate easy addition or removal. For quick reference, each meter has a tag on the option cable showing the option installed on that meter, along with the wire colors, see table below:

Option Connections					
PIN #	DESCRIPTION	WIRE COLOR	PIN #	DESCRIPTION	WIRE COLOR
1	Input 2A	Black	11	Input 1A	Blue/Black
2	Input 2B	White	12	Input 1B	Black/White
3	Relay 3 COM	Red	13	Relay 1 COM	Red/White
4	Relay 3 N/O	Green	14	Relay 1 N/O	Green/White
5	Relay 3 N/C	Orange	15	Relay 1 N/C	Blue/White
6	Relay 4 COM	Blue	16	Relay 2 COM	Black/Red
7	Relay 4 N/O	White/Black	17	Relay 2 N/O	White/Red
8	Relay 4 N/C	Red/Black	18	Relay 2 N/C	Orange/Red
9	Unused	Green/Black	19	Unused	Blue/Red
10	Unused	Orange/Black	20	Unused	Red/Green

Table 8.1 Option Connectors and Wire Colors for Output Cables

14.2 Inputs 1 and 2

14.2.1 Real-Time Communication Links

The real-time communications link allows the utility to change the active rate in real time. Real-time rates may be achieved in two ways: 1) External Input 1 may be programmed to initiate a real-time rate; or 2) a communication command may be used to initiate a real-time rate. Real time may be used to reduce system peak demand by switching to a premium rate or to encourage more usage by switching to a low-cost rate.

To use real-time communications, install a communications board in the meter. The active rate may be changed at any time by sending the appropriate command. Consult the 1132Prog/1132Com help file for more information about the necessary commands.

Using the real-time input

1) Program the meter so that Input 1 is configured for real-time.
2) Select a rate, A, B, C, D, or E, to use when real-time is active.
3) Select whether a high or low signal activates real-time (1132Prog/1132Com for more information).
4) Attach the activating device to Input 1 wires on the option cable. Polarity should match program.

Note: The activating device must be capable of supplying the voltage and current indicated in Section 8.4. To use the low range, resistors R1 and R2 must be removed with a wire cutter. Typically the real time rate used is a different rate from those defined in the TOU schedule.

14.2.2 External Load Profile Inputs

Inputs 1 and 2 may be programmed as load profile inputs. Each input may have its own channel in load profile. In this mode, the meter acts as load profile recorder with two inputs. Other channels may be used for recording any of the meters metrics explained in the load profile section.

14.3 Output Relays 1-4

Figure 8.3 provides an illustration of the suggested KYZ Output connection.

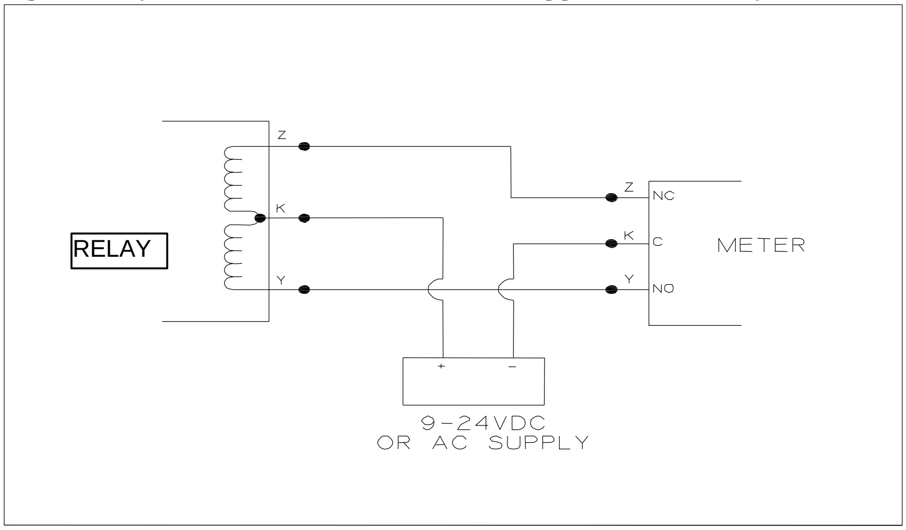


Figure 8.3 Suggested KYZ Output Connection

14.3.1 KYZ Pulse Outputs

Pulse Initiator Output circuits are provided by the programmable relays. Any of these measurement units may be assigned to any of the 4 programmable relays as KYZ outputs:

Delivered kWh	Delivered kVAh RMS	Delivered kVAh Phasor-RMS
Received kWh	Received kVAh RMS	Received kVAh Phasor-RMS
Total kWh	Total kVAh RMS	Total kVAh Phasor-RMS
Q1 kWh	Q1 kVAh RMS	Q1 kVAh Phasor-RMS
Q2 kWh	Q2 kVAh RMS	Q2 kVAh Phasor-RMS
Q3 kWh	Q3 kVAh RMS	Q3 kVAh Phasor-RMS
Q4 kWh	Q4 kVAh RMS	Q4 kVAh Phasor-RMS
Delivered kVARh	Delivered kVAh Phasor	Phase A Vh RMS
Received kVARh	Received kVAh Phasor	Phase B Vh RMS
Total kVARh	Total kVAh Phasor	Phase C Vh RMS
Q1 kVARh	Q1 kVAh Phasor	Phase A Ah RMS
Q2 kVARh	Q2 kVAh Phasor	Phase B Ah RMS
Q3 kVARh	Q3 kVAh Phasor	Phase C Ah RMS
Q4 kVARh	Q4 kVAh Phasor	Phase Neutral Ah RMS

14.3.2 8.3.2 KYZ Pulse Constant as kWh

Each KYZ output relay is assigned an independent kWh value (like .001 = 1 watt-hour) that represents the quantity of energy for the output pulse. The meter is programmed with a kWh value in units per pulse depending on the programmed functionality of the relay. The minimum value of kWh is 1 milliwatt-hour. A value of zero disables the KYZ output. Scale factor has no effect on KYZ relays. Below is a table of most commonly used Ke values:

Kh	Number of output pulses per DPI cycle (simulated "disk" revolution)				
-	1	2	4	6	12
0.6	0.0006	0.0003	0.00015	0.0001	0.00005
1.2	0.0012	0.0006	0.0003	0.0002	0.0001
1.8	0.0018	0.0009	0.00045	0.0003	0.00015
3.6	0.0036	0.0018	0.0009	0.0006	0.0003
7.2	0.0072	0.0036	0.0018	0.0012	0.0006
12	0.012	0.006	0.003	0.002	0.001
14.4	0.0144	0.0072	0.0036	0.0024	0.0012
21.6	0.0216	0.0108	0.0054	0.0036	0.0018

14.3.3 TOU Load Control (LC)

TOU Load Control may be assigned to any of the programmable relays. When TOU Load Control is selected, the TOU Load Control output operates at switch points on quarter hours. Load Control is normally based on a TOU schedule and is accomplished by using Schedule in the Normal Mode in a TOU database and also defining it as being scheduled in the rates database. For a Demand meter, it may be selected as always On or Off in a Mode.

14.3.4 End of Interval Output (EOI)

This optional programmable relay switch may be programmed for EOI, in which case it provides a 10 second relay closure at the end of each demand interval.

14.3.5 Demand Threshold Alerts (DTA)

Demand thresholds have the ability to operate from a designated metric and are based on the meter's true Kh. Any of the four programmable output relays can be selected to provide a contact closure when the demand exceeds the threshold programmed into the register. The demand threshold at which the DTA output is energized is programmable in the form: XXX.XXX. The DTA output is energized immediately when the programmed demand threshold is reached. Once energized, DTA will de-energize at the end of the first complete interval/subinterval in which the demand threshold is not exceeded. If the meter is in test mode the DTA will de-energize at the end of the interval and not at the end of the next. The DTA can be selected to operate only during specified TOU rates or at all times. Demand thresholds have the ability to operate from a designated metric. The DTA relay can also trigger the meter to enter real time rate. The E650 S4x uses a cumulative value for DTA.

Note: The relays can be programmed as either PFTA or DTA for real time activation but cannot be programmed as both PFTA and DTA.

14.3.6 Power Factor Threshold Alerts (PFTA)

The Power Factor Thresholds can be programmed to operate on lagging loads, leading loads, or both and with a value of .001 to 0.999. The relay is activated when the Power Factor threshold is exceeded and is deactivated at the end of the next complete subinterval in which the Power Factor does not exceed the threshold value. The register, through software, allows the PFTA function to cause the programmed real-time rate to go into effect.

14.3.7 Voltage Threshold Alerts (VTA)

Voltage Threshold Alerts operate in much the same way as DTA. The relay activates when the Voltage Threshold is exceeded and is deactivated at the end of the next complete subinterval in which the VTA does not exceed the threshold value. Voltage Thresholds can be selected to operate only during specified TOU rates or at all times.

14.3.8 Diagnostic Alerts (GTA)

One relay can be programmed for GyrBox Diagnostic Alerts. Whenever any diagnostic check fails, an alert is given. The alert is not cleared until all diagnostics are passed.

8.3.8.1 Temperature Alert (TA)

Temperature alerts operate from a threshold set in the 1132 Prog software. The threshold is in degrees Fahrenheit.

14.3.9 Operation of Outputs During Test Mode

During test mode, all outputs are available except for load control.

14.4 Electrical Specifications for KYZ Boards (absolute maximums)

14.4.1 Output Relays 1-4 (See Figure 8.3 in Section 8.3 for the suggested KYZ output connection)

60 mA maximum
350 Vdc/240Vac rms maximum
On resistance 50 ohms maximum

14.4.2 Inputs 1 and 2

Inputs 1 & 2	Standard	5V system*
Voltage	14-24V (DC) 16-26V (AC) Low: 0-4V (AC/DC	High: 4-6V (DC Low: 0-1V (DC)
Current	10 mA Max.	10mA Max.

*Requires removal of resistors (R5 and R6)

14.5 Optical Port Communications

The E650 S4x meters have an ANSI Type II optical port. The meter may be read by any ANSI device for this meter type.

14.6 RS-232/RS-485 Communications Board

An optional RS-232/RS-485 communications board is under development. It provides an alternate communications channel to the meter. Communications boards are installed parallel to the register board. The 12 pin connector plugs into the same header as the optional relay board. RS-232/RS-485 communications are transmitted via an isolated three-wire interface located in the meter's base using an RJ-11 connector. The three lines (transmit, receive, and ground) each provide 2500 Vrms isolation. This interface uses the same protocol as the optical port. A 38400 baud rate is supported.

14.6.1.1 Ethernet Communications Board

Ethernet I/O option is under development. The device's capabilities are similar to that of the **Lantronix** external box, but under the cover. The Ethernet option is usable in a 'standalone' application *and* as part of a RS485/RS232 network.

15 Troubleshooting and Error Codes

NOTE…A complete list of error definitions can be found in the Help content of the 1132 PROG software.

15.1 Error Codes

15.1.1 Non-Scrolling errors

If non-scrolling errors are selected in 1132Prog, the error code(s) byte will lock at the end of the display sequence. Activating the reed switch will cause the first display in the display sequence to appear. After 1 minute, auto scrolling will resume and continue until the error display once again shows and again, locks for 1 minute.

15.1.2 Scrolling errors

If scrolling errors are selected in 1132Prog, the selection will allow auto-scrolling to continue with the error code(s) byte inserted at the end of the display sequence. The display sequence will continue in auto-scroll.

Error Condition	Non-Scrolling Error Dis for Standard (S) Error	Scrolling Error Display Standard (S) Errors
Un-programmed Register Error	ERR S00	ERR S00
Configuration Error	ERR S01	ERR S01
RAM Failure Error	ERR S03	ERR S03
ROM Failure Error	ERR S04	ERR S04
Non-volatile Memory Error	ERR S05	ERR S05
Clock Error	ERR S06	ERR S06
Measurement Error	ERR S07	ERR S07
Low Battery Voltage Error	ERR S08	ERR S08
Demand Overload Error	ERR S10	ERR S10
Power Failure Error	ERR S11	ERR S11
Tamper Detect Error	ERR S12	ERR S12
Reverse Rotation Error	ERR S13	ERR S13

Error Condition	Non-Scrolling Error Disp for Manufacturer (M) Errors	Scrolling Error Display Manufacturer (M) Erro

Using Default Time Error	ERR M00	ERR M00
Line Freq Time Adjust Error	ERR M01	ERR M01
Voltage Phase Error	ERR M02	ERR M02
Teridian-PIC Sync Error	ERR M03	ERR M03
Magnetic Tamper Error	ERR M04	ERR M04
Stuck Switch Error	ERR M05	ERR M05
Temp Thresh Exceeded Error	ERR M06	ERR M06
Power Fail Data Restore Error	ERR M07	ERR M07
Phase A Voltage Out Error	ERR M08	ERR M08
Phase B Voltage Out Error	ERR M09	ERR M09
Phase C Voltage Out Error	ERR M10	ERR M10
Valid Service Error	ERR M11	ERR M11
Stand-By Energy Error	ERR M12	ERR M12
RTOS Event Present Error	ERR M13	ERR M13
Firmware Failure Error	ERR M15	ERR M15
Demand Overload Error #1	ERR M16	ERR M16
Demand Overload Error #2	ERR M17	ERR M17
Demand Overload Error #3	ERR M18	ERR M18
Demand Overload Error #4	ERR M19	ERR M19
Demand Overload Error #5	ERR M20	ERR M20
Demand Overload Error #6	ERR M21	ERR M21
Demand Overload Error #7	ERR M22	ERR M22
Demand Overload Error #8	ERR M23	ERR M23
Demand Overload Error #9	ERR M24	ERR M24
Demand Overload Error #10	ERR M25	ERR M25
Demand Overload Error #11	ERR M26	ERR M26

Demand Overload Error #12	ERR M27	ERR M27
Demand Overload Error #13	ERR M28	ERR M28
Demand Overload Error #14	ERR M29	ERR M29
Demand Overload Error #15	ERR M30	ERR M30
Demand Overload Error #16	ERR M31	ERR M31
Gyrbox D1 Diagnostic	ERR M32	ERR M32
Gyrbox D2 Diagnostic	ERR M33	ERR M33
Gyrbox D3 Diagnostic	ERR M34	ERR M34
Gyrbox D4 Diagnostic	ERR M35	ERR M35
Gyrbox D5 Diagnostic	ERR M36	ERR M36
Gyrbox D6 Diagnostic	ERR M37	ERR M37
Gyrbox D7 Diagnostic	ERR M38	ERR M38
Bottom Feed Active	ERR M40	ERR M40
Leading Current PhA	ERR M41	ERR M41
Leading Current PhB	ERR M42	ERR M42
Leading Current PhC	ERR M43	ERR M43
Audit Trail Log Full	ERR M44	ERR M44
Meter Not Sealed	ERR M45	ERR M45
Alert 1 Set	ERR M48	ERR M48
Alert 2 Set	ERR M49	ERR M49
Alert 3 Set	ERR M50	ERR M50
Alert 4 Set	ERR M51	ERR M51
Alert 5 Set	ERR M52	ERR M52
Alert 6 Set	ERR M53	ERR M53
Alert 7 Set	ERR M54	ERR M54
Alert 8 Set	ERR M55	ERR M55

External Input Error	ERR M56	ERR M56
Default SysConfig & Calibration Use	ERR M57	ERR M57
Default Phase to Phase Calibrat Constants in Use	ERR M58	ERR M58
Measurement Overrun Detecte	ERR M59	ERR M59
Measurement Timeout Detecte	ERR M60	ERR M60
Measurement Bad CRC Detecte	ERR M61	ERR M61
Measurement Lockout Detected	ERR M62	ERR M62
Incorrect CRC on Sys Config W Detected	ERR M63	ERR M63
Incorrect CRC on Cal Data Writ Detected	ERR M64	ERR M64

Table 9.1 Error Codes

15.2 Unprogrammed Register Error (Error S00)

If the meter is unprogrammed, error code S00 will be displayed, if it is enabled.
Suggested Action: To clear this error, program the meter.

15.3 Configuration Error (Error S01)

A configuration error indicates that essential data installed at the factory is missing or has become corrupt.
Suggested Action: To clear this error, cold start the meter. If the error persists, return the meter for servicing

15.4 Memory/Load Profile Errors:

- **RAM Error, S03**
- **ROM Error, S04**

- **Non-Volatile Memory Error, S05**

A hardware failure in the serial EEPROM or a checksum error in the ROM, SRAM, or EEPROM triggers a memory/load profile error. The error codes above indicate which is the area of memory in question.

Suggested Action: To clear the errors S03, S04 and S05, cold start and reprogram the meter. If the error reappears, return the meter for service.

15.5 Clock Error (S06)

A clock error is generated whenever the meter loses it's time reference. This is most often followed by the meter entering standby mode until the clock reference is restored by setting the time with 1132 COM software or by an AMI system that supports TOU time set functions.

Suggested Action: Set the meter time and date with 1132 COM or allow the AMI system (if the meter is equipped with an AMI device) to set the correct time and date.

15.6 Measurement Diagnostics Failure (Error S07)

This error indicates a problem with the measurement cuirtry and/or calculation processes. This is a critical error if the meter is out of calibration.
Suggested Action: To clear this error, cold start the meter. If the error persists, return the meter for servicing.

15.7 Low Battery Error (Error S08)

The battery voltage is automatically checked each day at 4 a.m. The error is set when the voltage drops to 2.5 ± 0.2 volts. A check of the battery may be initiated manually, any time a manual reset is performed or the register goes from Auto-scroll mode to Manual scroll mode by swiping the reed switch with a magnet.
Note: A good charge on the supercap does not mask the state of a bad battery.
Suggested Action: To clear this error, install a new battery and perform a battery retest as described above.

15.8 Demand Overload Error (S10)

This error indicates one of the Demand Overload thresholds has been exceeded.
Suggested Action: Identify the Demand Threshold that has been exceeded and change the threshold appropriately in meter program, or, with a transformer rated meter, use a higher ratio CT or with a self –contained, use a higher class meter. To clear the error use the "Clear Errors" function in the Reset dropdown of 1132 COM. The error can also be cleared when a demand reset is performed, if that function has been selected when setting up the meter program.

15.9 Power Failure Error (S11)

This is typically caused by an unexpected processor reset.
Suggested Action: Clear the error using the "Clear Errors" function in the Reset dropdown of 1132 COM. If the error re-occurs, return the meter for servicing.

15.10 Tamper Detect Error (S12)

The Tamper Detect Error is set when the meter detects a power outage followed by reverse energy flow (as when a meter has been pulled from its socket and then re-inserted upside down).

Reverse Rotation Error (S13)

This error is set when there is negative energy flow registered in the meter. The error can be disabled in the meter program if negative energy flow is expected at any given installation.

15.11 Demand Overload Errors (Errors M16 through M31)

At the end of every interval the current demand values for all metrics are compared against the programmed overload values. If the value of any is equaled or has exceeded the programmed threshold, an overload error code is latched. Programming the overload values to zero will disable this function.

The overload value is cleared if a cold start or reprogramming is initialized. Also, a demand reset may be programmed to clear the demand overload error. Typically, demand overload is set to 83.3% of the system's capacity.

Suggested Action: With a transformer rated meter, use a higher ratio CT. With a self –contained, use a higher class meter.

15.12 Stuck Switch Error (Error M05)

Error M05 is displayed when any one of the following situations occur: 1) Reset switch is in active mode for a period of four minutes; 2) Test Mode switch is in active mode for a period of 4 minutes after the exiting test mode via the optical command or test mode time out.

Suggested Action: This error will be cleared when the switches are returned to normal. If the error does not clear, return the meter for servicing.

15.13 Phase Errors:

- Phase A Voltage Out Error, M08
- Phase B Voltage Out Error, M09
- Phase C Voltage Out Error, M10
- Valid Service Error, M11

The E650 S4x registers the loss of phase voltage by blinking the potential indicator for that phase; see Figure 3.1.1. No displays appear other than the error code displays, which, if included in the program's display sequence, may be seen by swiping a magnet over the reed switch at the 12 O'clock position at the top and front of the meter. The Valid Service error occurs if the meter has never detected a valid service type.

Phase error displays disappear when voltage is restored. Normal scrolling continues automatically. The Valid Service type error clears when the meter is put in a valid service.

The E650 S4x meter is powered from phase A, so any loss to this phase powers down the whole register and is treated as a normal power failure (unless the "Metrology powered from any energized phase" (3 phase power supply option has been configured at the time the meter is manufactured). Loss of phase B or C will cause an error message to appear. A phase is considered lost at 50% of the nominal voltage. Based on the programmable option of the reader/programmer, the phase error display discontinues auto-scrolling either temporarily or completely. When auto-scrolling is temporarily discontinued, the phase error appears on the display until the reed switch is swiped with a magnet. Auto-scrolling then continues for one pass. Any other error codes will appear in their programmed manner with the phase error(s) display returning at the end of this sequence. If auto-scrolling is completely discontinued, the register may only be read electronically.

15.14 Disabling Display of Error Codes

Each error code may be individually programmed to be displayed or not displayed. All error codes will still be flagged by the register. Reference the 1132Prog/1132Com help file for more details. The reader programmer may clear any error flag, regardless whether or not it is displayable. The meter has a programmable mask to allow the reader/programmer to enable or disable individual error conditions. The reader/programmer may clear any error condition by toggling the appropriate mask bit. If cleared, the register retests for the error.

16 Measurement Techniques

The following sections briefly describe the methods of measurement for the E650 S4x meter. For a more detailed discussion of measurement techniques used in metering, please refer to the Handbook for Electricity Metering.

16.1 Metric Calculations

The term **metric** refers to any electrical units being measured. Typical metrics are watthours, VA hours, kVA, kVAR, volts, and amps, to name a few. Other values such as power factor are based upon these measurements.

16.1.1 Pulse Values and Energy Metrics

Arithmetic measurements are generated by basic mathematical functions such as multiplication, division, subtraction, and addition. Watthours are an example of arithmetic metric. Each voltage sample is multiplied by each current sample and the product is accumulated.

Pulse values: In E650 S4x, all values for energies and demands are calculated in engineering units, and therefore, no meter form specific constant (kFactor or kh) is needed to convert these values. Pulses are only used as a unit for a physical pulse signal that comes out of the meter (KYZ and calibration pulses). These do need a conversion and the traditional kh is used for the calibration pulse and the KYZ ke values are scalable via programming.

Energy metrics: The S4x calculates active energy (Wh) and reactive energy (VARh) from the voltage and current samples as described above. In the C12.19 Implementation specification these metrics are named "milliwatthours" and "milliVARhours". Then using Wh and Varh, apparent energy is calculated using the Phasor method (VAh = SQRT(Wh^2 + VARh^2)). This metric in the C12.19 Implementation specification is named "milliVAhours phasor". Additionally, the apparent energy is calculated using the RMS method which uses the RMS voltage and current values where VAh = ∑Vrms*Irms across all phases. For delta services the voltages are the line to line voltages and the currents are those on each leg of the delta, where the meter performs a transformation on the measured line to neutral values in order to derive these values. This metric in the C12.19 Implementation specification is named "milliVAhours". Finally a reactive metric is computed from the Wh and milliVAhours using the phasor equation and solving for VARh as such VARh = SQRT(VAh^2-Wh^2). This metric in the C12.19 Implementation specification is named "milliVARhours phasor-rms". For each of these five energy metrics, there are 7 summations: Delivered, Received, Total, Q1, Q2, Q3, and Q4. For each of these 5 metrics there are 3 demands: Delivered, Received, and Total. There is a PF demand value and it is calculated using one specified active metric and one specified reactive metric of all of the 15 metrics available as demands.

16.2 Digital Implementation

For a digital implementation, the voltage and current waveforms must be transformed into a digital format. Once digitized, the values must be used to calculate metrics, and the metrics are then stored and made available for end use. Metrics are either presented on an LCD display or read from memory through a communication port.

17 Overview of E650 S4x Implementation

Voltage and current transducers provide a representation of the actual voltage and current waveforms as input to a **power meter interface ASIC (ASIC).** The ASIC contains a **digital signal processor (DSP)** where energy, power, and other measurements are calculated.

17.1 Input Circuitry

The design of the input circuitry allows for the meter to withstand 10KV transient surges without damage. Resistors are used to reduce the line voltage to a level compatible with the solid state circuitry. The scaled potential is input into the ASIC. Similarly, the current is converted for input to the ASIC. The transformer-rated E650 S4x uses current transformer sensors while the self-contained K-base version uses an embedded coil sensor in each phase. Embedded coils provide an output that is proportional to the rate of change of the load current with respect to time, and the external input to the ASIC provides an integration function to restore the current wave form to its original shape. Both types of current sensors provide 10 kV of isolation.

17.2 Sampling Rate

Voltage and current pairs are sampled by the delta sigma converters at a sampling frequency of 2.52 kHz. These samples are digitally filtered to provide a 21 bit representation of the input signal.
Note: Frequency is calculated when potential is applied to phase A.

17.3 Register Section

The DSP in the measurement ASIC calculates metric values. A communications serial bus is used to transfer metric data from the ASIC to the micro-controller. These are both on the primary printed wiring board. All metric data is calculated by the DSP except for VA. VA is calculated by the micro-controller.

17.4 Negative Energy Metric

The E650 S4x register may be programmed to treat negative energy in three different ways, security (add) mode, detent (ignore) mode, and net (positive + negative). In all instances of negative energy measurement, the digital power indicator will operate from right-to-left and the negative energy accumulator increments.

17.5 Security (Add) Mode

In security (add) mode, negative energy is treated as if it were positive energy. kWh is accumulated positively in the total kWh register. Demand functions operate in their normal manner. All optional outputs function normally. Negative energy is also accumulated in the negative energy register.

17.6 Detent (Ignore) Mode

Negative energy is accumulated in the negative energy register and ignored in the normal (positive) energy register used for billing purposes. In detent mode, all negative watt and watthour measurements are ignored for billing purposes.

17.7 Net Mode

In Net mode negative watthour measurements are accumulated and subtracted from the normal (positive) energy register for billing purposes.

18 Reactive Metrics in the E650 S4x Meter

The E650 S4x is a true four quadrant and as such differs from the S4e. All Reactive metrics are displayed recorded in the read record at face value. In other words, there is no assigning of those metrics to a "kM" or "kM3"" designate as there was in S4e and in 1132Prog, the program building software. In an 1132 meter read file, the meter will present all reactive metrics labeled appropriately.

18.1 VArms, VARrms, kVAR Phasor, and kVA Phasor measurements

We have intentionally avoided using the terms lead and lag and have chosen Delivered and Received, where the definition of these summations and the resultant Total register can be defined by the customer in terms of quandrants (e.g. which quadrant(s) the meter is in to accumulate in its Delivered VARh summation). Which combinations are ultimately available is controlled by the software (as can be imagined, there are many possibilities, many of which are ambiguous, and so these are not exposed as choices). As a rule then, the Total quantity can be set to Add, Net, or Ignore, where Add means Total = Delivered + |Received|, Net means Total = Delivered – |Received|, and Ignore means Total = Delivered.

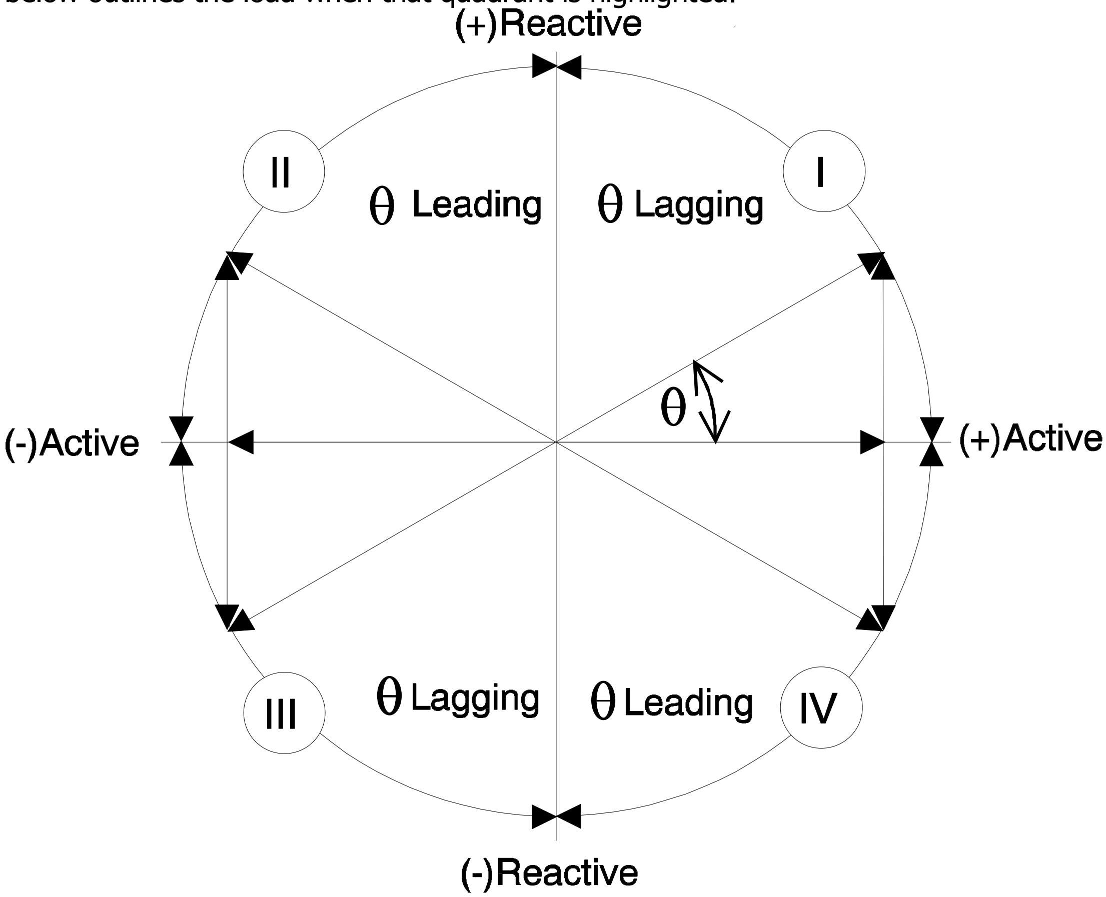
NOTE…”|Received|” means the absolute or positive value of the received metric.

18.2 50 Hz Operation

The E650 S4x meter is normally calibrated at 60 Hz, but will operate at either 50 or 60 Hz. Upon power-up, the meter checks the frequency, and operates on the frequency it registers.

18.3 Power Quadrant Indicators

On the LCD, a numbered four quadrant "pie" indicates the combined load on the meter. The chart below outlines the load when that quadrant is highlighted.



Quadrant I	Positive watts (delivered)	VAR (delivered) / (lagging power factor)
Quadrant II	Negative watts (received)	VAR (delivered) / (leading power factor)
Quadrant III	Negative watts (received)	VAR (received) / (lagging power factor)
Quadrant IV	Positive watts (delivered)	VAR (received) / (leading power factor)

19 Overview of the E650 S4x Measuring Element

The E650 S4x utilizes a digital sampling technique to measure voltage and current in a customer load. The E650 S4x calculates active, reactive, and apparent power in quadrants one and four. Apparent power is calculated as the product of the square-root of the mean-square value of the current (Irms) and voltage (Vrms). Calculations include harmonics of the fundamental.

19.1 E650 S4x Measurement Metrics—Landis + Gyr Terminology

The E650 S4x offers the following metrics: kWh, kVAh, kVArh, Kw, kVA Phasor, kVA RMS, kVAr Phasor, kVAr RMS. All metrics are measured bi-directionally. All are presented as face value and, where appropriate, are labeled as "Phasor" or "RMS" for easy identification. The metrics are recorded per true quadrant and as totals. The meter's program can be configured to allow combinations of quadrants to satisfy specific utility methodology for registration. See the 1132Prog software for detail on how this is done.

19.2 Neutral Current Calculations

Measurement of the neutral current of an E650 S4x is a calculated quantity. Note that when certain meter forms such as the Form 12 (25) and Form 5 (45) are used in a "network" installation, the information necessary to determine neutral current is not available. This is because typical network application may have several meters supplying kWh information from a single three phase, four wire "Y" distribution transformer. There are three phase currents, but only two are metered by any one single meter. Each meter shares the common neutral.

To calculate true neutral current, all phase currents must be known by a single meter. As a result, neutral current cannot be determined by any of the meters and should be ignored in these applications.

19.3 Register Metric-Hour Constant (Kh)

Registration of energy is based upon the register constant Kh. The Kh value is normalized to 120 volts. Since the E650 S4x meter operates from 120-480 volts, the registration of energy at 480 volts is at a rate four times greater than at 120 volts for the same load current. Thus, one Kh value suffices for all applicable voltages. The meter is capable of registering energy at this rate, but some external devices, such as pulse recorders, may not be. See Section 11.2 for a discussion of output pulse rates for calibration verification.

Kh is used to calculate the proper kWh and kW values for display. The E650 S4x uses one Kh value per meter form. For each form, the Kh value is based on 120V. As the voltage changes from service to service, the Kh remains the same. A Kh value can be programmed to a value other than the meters true Kh. If this is done, the energy and demand registers will be affected by the new Kh, however, the KYZ output relays will continue to use the meter’s true Kh.

For S base, A base and SE base:

Form	**Kh**
9/8	1.8
12	14.4
16/15/14	21.6
25	14.4
29	1.8
36 (6)	1.8
45 (5)	1.2
2SE	12
2	7.2
4	0.6
3	0.6
1	3.6

For K base:

Form	**Kh**
12	28.8
16/15/14	43.2
27	28.8

19.4 Transformer Factor (TF)

A transformer factor can be programmable as a 6-digit number available for display only or as a multiplier to achieve direct primary readings for display.
Transformer factor = CT ratio x the PT ratio

19.5 Power Factor

True power factor is calculated as the ratio of active power to apparent power.
Note: The power factor calculations described below are based on true power factor; power factor is calculated using the following two methods:

$$rmsPowerFactor = \frac{W}{VA}$$

where V*A is based on rms quantities and using the kVA rms calculation, or:

$$ReactivePowerFactor = \frac{W}{\sqrt{W^2 + VAR^2}}$$ using the kVA Phasor power factor calculation

19.5.1 Available Power Factor Measurements

The following power factor measurements are calculated, stored, and available for display:

- Instantaneous power factor
- Previous interval power factor
- Average power factor since last reset
- Smallest power factor since last reset
- Power factor for each maximum demand, including kW,
- Power factor for the three highest demand metric maximums and coincidents, totals and for each rate
- Power factor cumulative demand
- User selectable power factor (See 1132 Prog for full listings and options)

20 Calibration Verification and Testing

20.1 E650 S4x Factory Calibration

Calibration of voltages, currents and phase angles per element is accomplished through calibration constants stored in non-volatile memory. These constants cannot be changed except by recalibration at the factory

20.2 How to Verify the E650 S4x Calibration

20.2.1 Verification of Watt Calibration

E650 S4x watt calibration may be verified using standard procedures. The watt calibration LED is the left LED located inside the Type II optical port on the face of the polycarbonate cover. The infra-red output pulses from the LED can be changed through programming with the 1132Prog/1132Com software packages. The optical pulse rate can be selected to be either medium (one pulse per equivalent revolution), fast (12 pulses per equivalent revolution), or slow (1 pulse for every 4 equivalent revolutions).

20.2.2 Calibration Pulse Displays

Four Test Mode calibration pulse displays, used in the test mode sequence, give calibration pulses other than watts. Whenever the meter is in test mode and scrolled to one of these Test Mode displays VA Pulse (RMS), VA Pulse (Vectorial), VAR Pulse (RMS), and VAR Pulse (Vectorial), the meter will start pulsing in these metrics. At all other times the meter will give watt pulses. Each RMS calibration metric display will show the "RMS" enunciator on the right side of the LCD. If the "RMS" is not being display, the metric is vectorial

20.2.3 Test Times

The minimum test times required to obtain accurate verification for E650 S4x calibration are given below. Testing at power factors other than those specified below will require longer test times.

Quantity	Present	Minimum Test Time
Watthour	TA	21.6 seconds @ unity PF
VA phase shift	TA	90 seconds
VAR	TA	90 seconds
VArms	TA	90 seconds

When testing, the test board should have a 6 second settling time programmed. This will allow 6 seconds for the calibration pulse to stabilize when the current changes. Allow 15 seconds if the meter has a modem.

20.2.4 Field Testing

To test the meter in the field using test mode, complete the following procedure:

1) Remove the cover.
2) Flip the test mode switch. The LCD will indicate the meter is in test mode.
3) Swipe a magnet over the reed switch to scroll through the displays.
4) Exit test mode by returning the test mode switch to its original position.

20.2.5 Demand Measurement Verification

In order to test the demand measurement of an E650 S4x meter, complete the following procedure:

1) Connect the reference standard to the meter.
2) Select the voltage test to match the application.
3) Turn on the pulse counting device and make sure it is set to 0.
4) Flip the test mode switch.
5) Press the Demand Reset button.
6) Turn on the current to the meter and the standard at the same time.
7) After the End of Interval flag is displayed; turn off the current to the meter and the standard, again at the same time.
8) Record the pulse counter total and compare it with the total on the E650 S4x display.

General Conditions

Nameplate Voltage	Vn = 120- 480 VAC (W/O Device Onboard)
Rated Frequency	Fn = 50 or 60 Hz ± 5%
Power Factor	PF = 1.0
Ambient Temperature	TA = 23° C ±5° C
Temperature (inside cover)	-40° C to + 85° C
Operating	-40° F to +185° F
Humidity (non-condensing)	Relative Humidity <=95% Rh

Input Specifications

Voltage Withstand:

Effect of High Voltage Line Surges (ANSI/IEEE C62.41)	6KV (1.2/50µs-8/20µs combination wave and 100kHz ring wave at .05µs-100kHz)
Surge Withstand Capability (ANSI C37.90A)	
Oscillatory	3 kV (1 mHz; 100 Hz, 10 seconds)
Fast Transient	5Kv (50 pulses/sec, 20 seconds)
Temporary Overvoltage Withstand (0.5 seconds) (I 61000-4-4)	150% of Vn
Continuous Overvoltage Withstand (5 hours)	130% of Vn

Internal Meter Losses (Burden), exceeds ANSI Standards Below:

Class 20, 200, 320		Phase A & B	Phase C
Potentia	120V	20 VA	20 VA
	240V	20 VA	20 VA
	480V	20 VA	20 VA
Current	20 Amps	1.0 VA	1.0 VA
	200 Amp	1.0 VA	1.0 VA
	320 Amp	1.0 VA	1.0 VA

Length of 100% Power Loss Resulting in No Power Down of the Register:

Power loss duration @ Vn 100 milliseconds Minimum

Current System:

	Test Amps	Starting Load
Class 20	2.5 Amps	
Class 120	30 Amps	
Class 200	30 Amps	
Class 320	50 Amps	
Class 480	50 Amps	

No Load (Creep)

With potential applied over the entire line voltage range of the meter and no current flowing in the current circuit, there shall be no pulse accumulation in the register. The test for no pulse accumulation shall be conducted over a period of 24 hours.

Applicable Standards

- ANSI C12.1 - for electricity metering
- ANSI C12.10 - for watthour meters
- ANSI C12.18 – Protocol Specification for ANSI Type 2 Optical Port
- ANSI C12.19 – Protocol Specification for Utility Industry End Device Tables
- ANSI C12.20 – for Electricity Meters – 0.2 and 0.5 Accuracy Classes
- ANSI C12.21 – Protocol Specification for Telephone Modem Communication
- CAN3-C17-M84 Canadian specifications for approval of type of electricity meters
- CAN3-Z234.4-79 Canadian specifications for all-numeric dates and times
- IEC (Electrical Specifications)
- FCC Class B Emissions
- Landis+Gyr Engineering Specification 69343

Weights and Dimensions

Form	Net I	Single Pacl Weight	Single Pack Dimensions	Four-Pack Wei	Four-Pack Dimensions
45S (5S)					
36S (6S)					
9S/8S					
12S(E)					
16S(E)					
45A (5A)					
36A (6A)					
10A/8A					
12K					
16/15/14I					
27K					

E650 S4x Meter Component Description

P.B.T. Baseplate:

The E650 S4x baseplate is made of ENV13-1502GFR-BK Polycarbonate Injection Molding Grade, Black,10% Fiberglass Reinforced, Flame Retardant, RoHS Compliant.

Meter Frame:

The injection molded polycarbonate frame is designed with unique "snap-in" features that allow quick and easy assembly or disassembly of major meter components. Connector is made with a "gas-tight" connection to insure electrical connection over time.

Cover:

The cover is made of high strength polycarbonate that will not break even under extreme physical abuse.

FCC Requirements

1. This equipment complies with Part 68 of the Federal Communication Commission (FCC) Rules and Regulations. These rules permit this device to be directly connected to the telephone network. Standardized jacks are used for these connections. This equipment should not be used on party lines or coin lines.
2. If the Type E650 S4x Electronic Watthour Meter is malfunctioning it may cause harm to the telephone network; the telephone company will notify you in advance that temporary discontinuance of service may be required. If advance notice is not practical, the telephone company will notify you of the discontinuance as soon as possible. You will be advised of your right to file a complaint with the FCC if you believe it is necessary.
3. The telephone company may make changes in its technical operations and procedures; if such changes affect the compatibility or use of this device, the telephone company is required to give adequate notice of the changes. You will be advised of your right to file a complaint with the FCC if you believe it is necessary.
4. If the telephone company requests information on what equipment is connected to their lines, inform them of:
   a. The telephone number this unit is connected to
   b. Ringer Equivalence Number (REN) for this equipment

c. The USOC jack required
d. The FCC Registration Number

The label on the left side of the meter contains the FCC Registration Number and the Ringer Equivalence Number (REN) for this equipment.

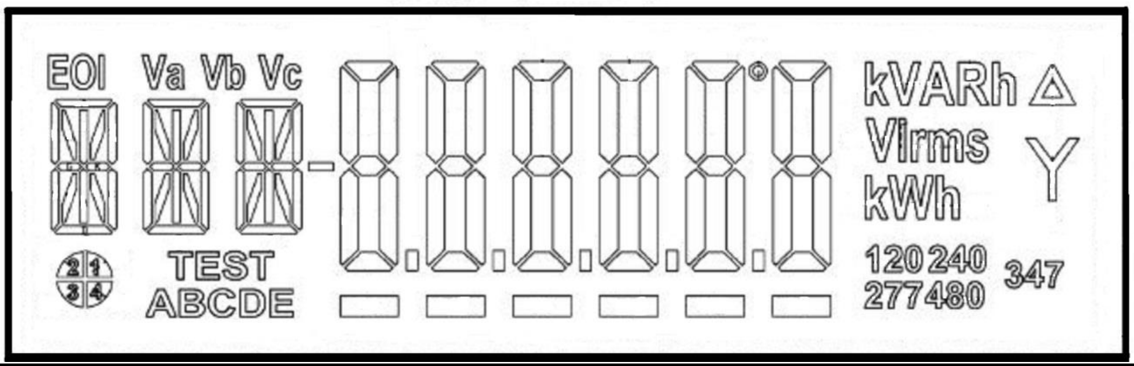
The REN is useful to determine the quantity of devices that may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of the RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to the line, as determined by the total RENs, contact the telephone company to determine the maximum REN for the calling area.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

In the event of equipment malfunction, repairs should be performed by our Company or an authorized agent. It is the responsibility of users requiring service to report the need for service to our Company or to one of our authorized agents.
If you experience trouble with the Landis+Gyr E650 S4x Electricity Meters please contact your authorized Landis + Gyr distributor or Landis + Gyr agent for repair and/or warranty information. Changes of modifications not expressly approved by Landis+Gyr Inc could void your authority to operate the equipment.

Appendix B: Register Displays

Each display includes a three digit identification number on the left side of the LCD. The identification number can be any number from 0 through 999 or can be a three character alphanumeric code. The identifiers are merely labels; numbers may be repeated and may be in any order.
Except for countdown timers, present demand, instantaneous measurements, and Test Mode displays, display values will not be updated as they are shown, even if the value is changing internally in the meter. To display an updated value, it will be necessary to scroll through all the display items until the value desired appears again.



For a full listing of available displays for the E650 S4x consult the 1132 Prog software.

Appendix C: Polyphase Service Types

Form 9S/8S, 10A/8A Service Type Table

Meter For	Service Ty	Rotatio	Va	Phase A	Vb	Phase I	Vc	Phase (
10/9/8	4WY-120\	ABC	120	0	120	120	120	240
	4WY-277\	ABC	277	0	277	120	277	240
	4WY-120\	CBA	120	0	120	240	120	120
	4WY-277\	CBA	277	0	277	240	277	120
	4WD-120\	ABC	60	0	60	180	104	90
	4WD-240\	ABC	120	0	120	180	208	90
	4WD-480\	ABC	240	0	240	180	416	90
	4WD-120\	CBA	60	0	60	180	104	270
	4WD-240\	CBA	120	0	120	180	208	270
	4WD-480\	CBA	240	0	240	180	416	270

Form 29S, 36S (6S), 36A (6A) Service Type Table

Meter For	Service Ty	Rotatio	Va	Phase A	Vb	Phase I	Vc	Phase (
29, 36 (6	4WY-120\	ABC	120	0	IGNORE		120	240
	4WY-277\	ABC	277	0	IGNORE		277	240
	4WY-120\	CBA	120	0	IGNORE		120	120
	4WY-277\	CBA	277	0	IGNORE		277	120

Form 45S (5S), 45A (5A) Service Type Table

Meter For	Service Ty	Rotatio	Va	Phase	Vb	Phase	Vc	Phase
45 (5)	3WY-120	ABC	120	0	IGNORE		120	120
	3WY-277	ABC	277	0	IGNORE		277	120
	3WY-120	CBA	120	0	IGNORE		120	240
	3WY-277	CBA	277	0	IGNORE		277	240
	3WD-120	ABC	120	0	IGNORE		120	60
	3WD-240	ABC	240	0	IGNORE		240	60
	3WD-480	ABC	480	0	IGNORE		480	60
	3WD-120	CBA	120	0	IGNORE		120	300
	3WD-240	CBA	240	0	IGNORE		240	300
	3WD-480	CBA	480	0	IGNORE		480	300
	4WD-120	ABC	120	0	60	180	104	90
	4WD-240	ABC	240	0	120	180	208	90
	4WD-480	ABC	480	0	240	180	416	90
	4WD-120	CBA	120	0	60	180	104	270
	4WD-240	CBA	240	0	120	180	208	270
	4WD-480	CBA	480	0	240	180	416	270
	3WY-240	ABC	240	0	IGNORE		240	180
	3WY-480	ABC	480	0	IGNORE		480	180

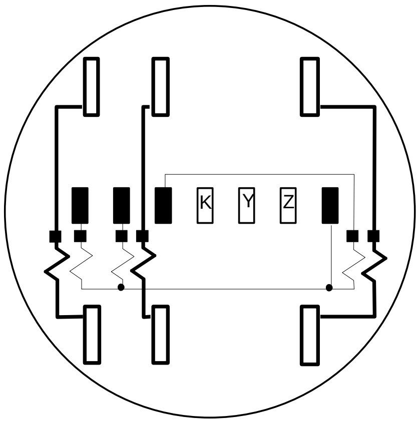
Form 16/15/14S, 16/15/14A, 16/15/14K Service Type Table

Meter For	Service Ty	Rotatio	Va	Phase A	Vb	Phase I	Vc	Phase (
16/15/1	4WY-120\	ABC	120	0	120	120	120	240
	4WY-277\	ABC	277	0	277	120	277	240
	4WY-120\	CBA	120	0	120	240	120	120
	4WY-277\	CBA	277	0	277	240	277	120
	4WD-120\	ABC	60	0	60	180	104	90
	4WD-240\	ABC	120	0	120	180	208	90
	4WD-480\	ABC	240	0	240	180	416	90
	4WD-120\	CBA	60	0	60	180	104	270
	4WD-240\	CBA	120	0	120	180	208	270
	4WD-480\	CBA	240	0	240	180	416	270
	3WD-120\	ABC	120	0	0	0	120	60
	3WD-240\	ABC	240	0	0	0	240	60
	3WD-480\	ABC	480	0	0	0	480	60
	3WD-120\	CBA	120	0	0	0	120	300
	3WD-240\	CBA	240	0	0	0	240	300
	3WD-480\	CBA	480	0	0	0	480	300
	3WY-120\	ABC	120	0	0	0	120	120
	3WY-277\	ABC	277	0	0	0	277	120
	3WY-120\	CBA	120	0	0	0	120	240
	3WY-277\	CBA	277	0	0	0	277	240

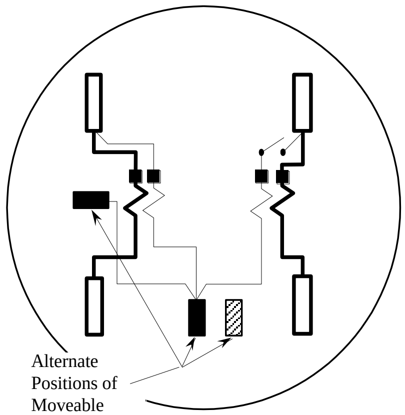
Form 12S, 12SE, 12K, 25S, 27K (Network) Service Type Table

Meter For	Service Ty	Rotatio	Va	Phase A	Vb	Phase B	Vc	Phase C
12, 25, 2	3WD-120v	ABC	120	0	IGNORE		120	60
	3WD-240v	ABC	240	0	IGNORE		240	60
	3WD-480v	ABC	480	0	IGNORE		480	60
	3WD-120v	CBA	120	0	IGNORE		120	300
	3WD-240v	CBA	240	0	IGNORE		240	300
	3WD-480v	CBA	480	0	IGNORE		480	300
	3WY-120v	ABC	120	0	IGNORE		120	120
	3WY-277v	ABC	277	0	IGNORE		277	120
	3WY-120v	CBA	120	0	IGNORE		120	240
	3WY-277v	CBA	277	0	IGNORE		277	240

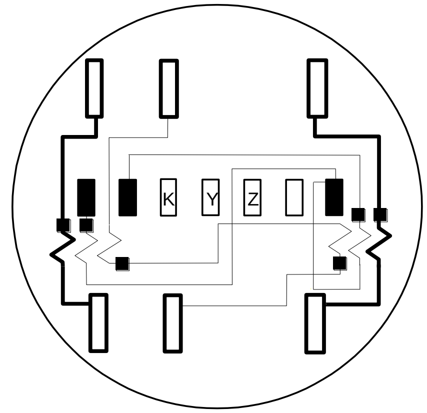
S-Base Forms



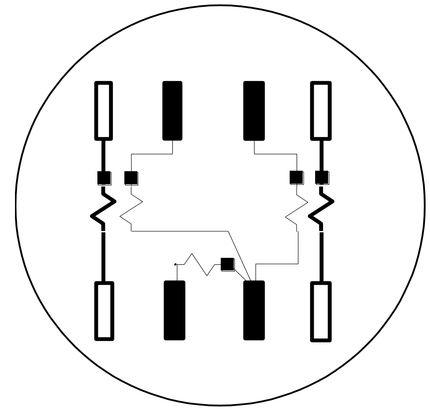
2/3-Element
4-Wire
FORM 9/8S



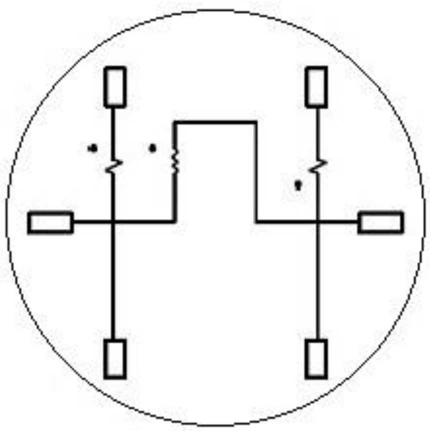
2-Element
3-Wire
FORM 12S



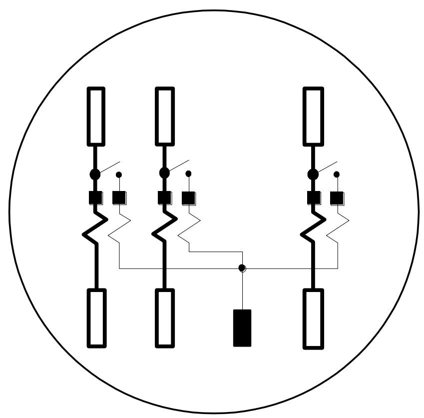
2-Element
4-Wire
FORM 36S (6S)



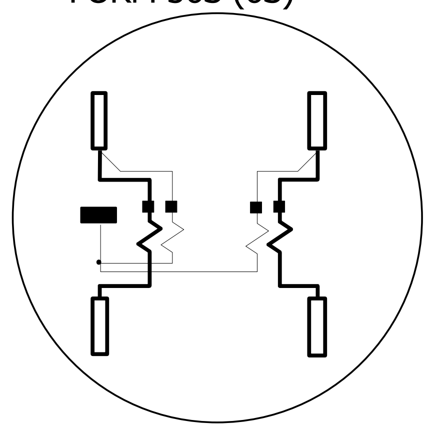
2-Element
3-Wire
FORM 45S (5S)



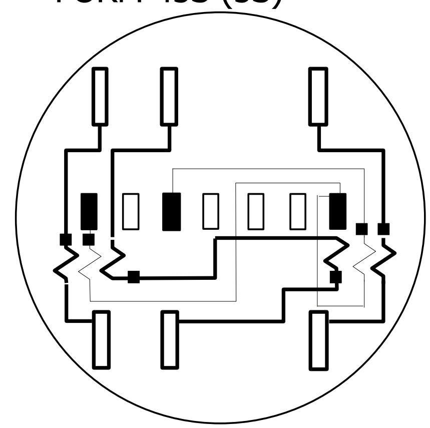
1 1/2 Element
3 - wire
Form 4S



2/3-Element
4-Wire
FORM 16/15/14S

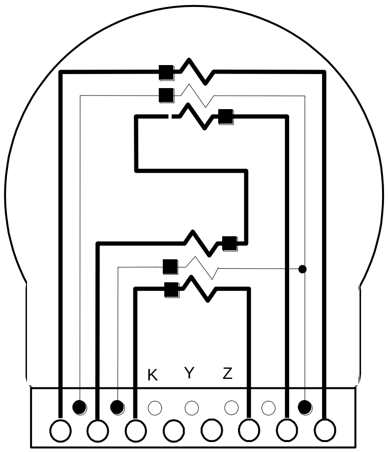


2-Element
3-Wire
FORM 25S

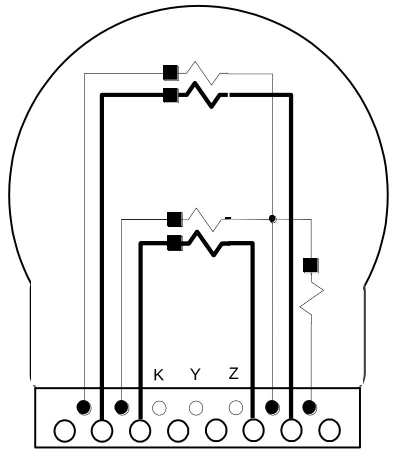


2-Element
4-Wire
FORM 29S

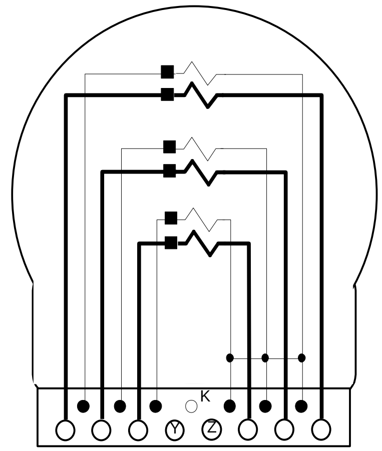
A-Base Forms



2-Element
4-Wire
FORM 36A (6A)

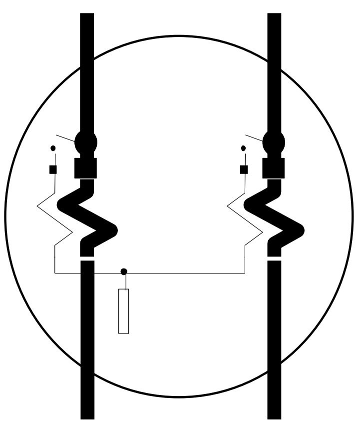


2-Element
3-Wire
FORM 45A (5A)

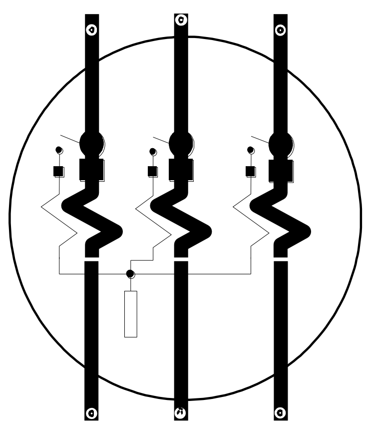


2/3-Element
4-Wire
FORM 10/8A

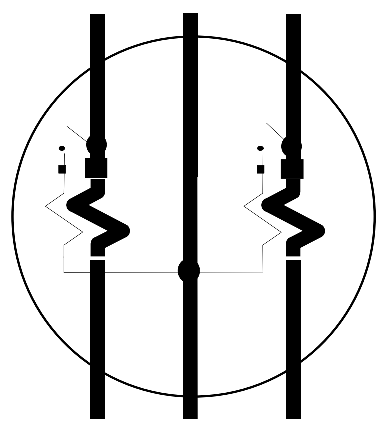
K-Base Forms



2-Element
3-Wire
FORM 12K

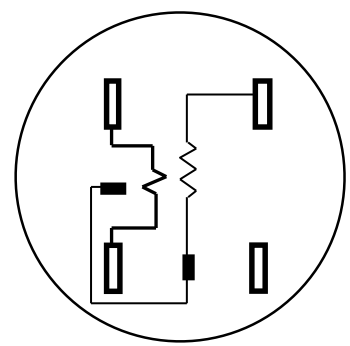


2/3-Element
4-Wire
FORM 16/15/14K

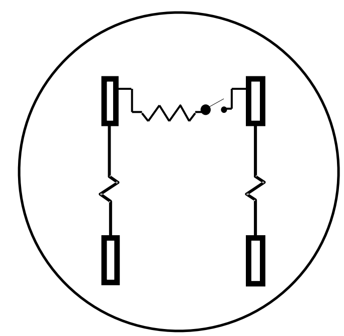


2-Element
3-Wire
FORM 27K

Singlephase Forms

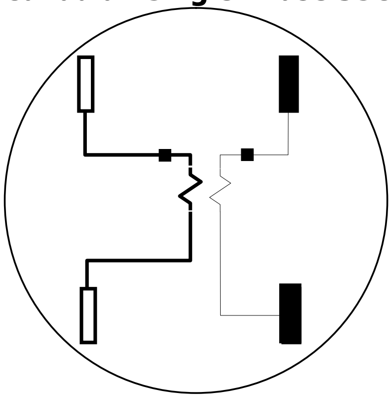


Single Phase
2-Wire
Form 3S



Single Phase
3-Wire
Form 2S

Canadian Single Phase 3SC



2-Wire
FORM 3SC

Appendix E: Definitions

NOTE: Items marked with * are under development and not yet available.

1132Prog/1132Com/1132Gyr: 1132Suite is Landis+Gyr's windows based software package. 1132Prog is the program development portion,1132Com is the reader/program portion, and 1132Gyr is the report generation portion. Note…1132Gyr requires a yearly licensing/Maintenance fee.

ANSI Protocol: ANSI C12.19 is an industry standard communication protocol that is used in the ANSI E650 S4x meter.

Ethernet*….Under development, TBD.

RS232*: RS-232 is a communication, Recommended Standard, for serial interface devices. Using this standard and an RS-232 add-on board the meter can communicate with RS-232 based devices. The RS-232 standard defines communications between two devices only.

RS485*: RS-485 is a newer communication standard that is similar to RS-232. Using this standard and an RS-485 add-on board the meter can communicate with RS-485 based devices. The RS-485 standard supports communications between several devices on an RS-485 bus.

Remote Communications Alert: (Availability TBD at a future time)

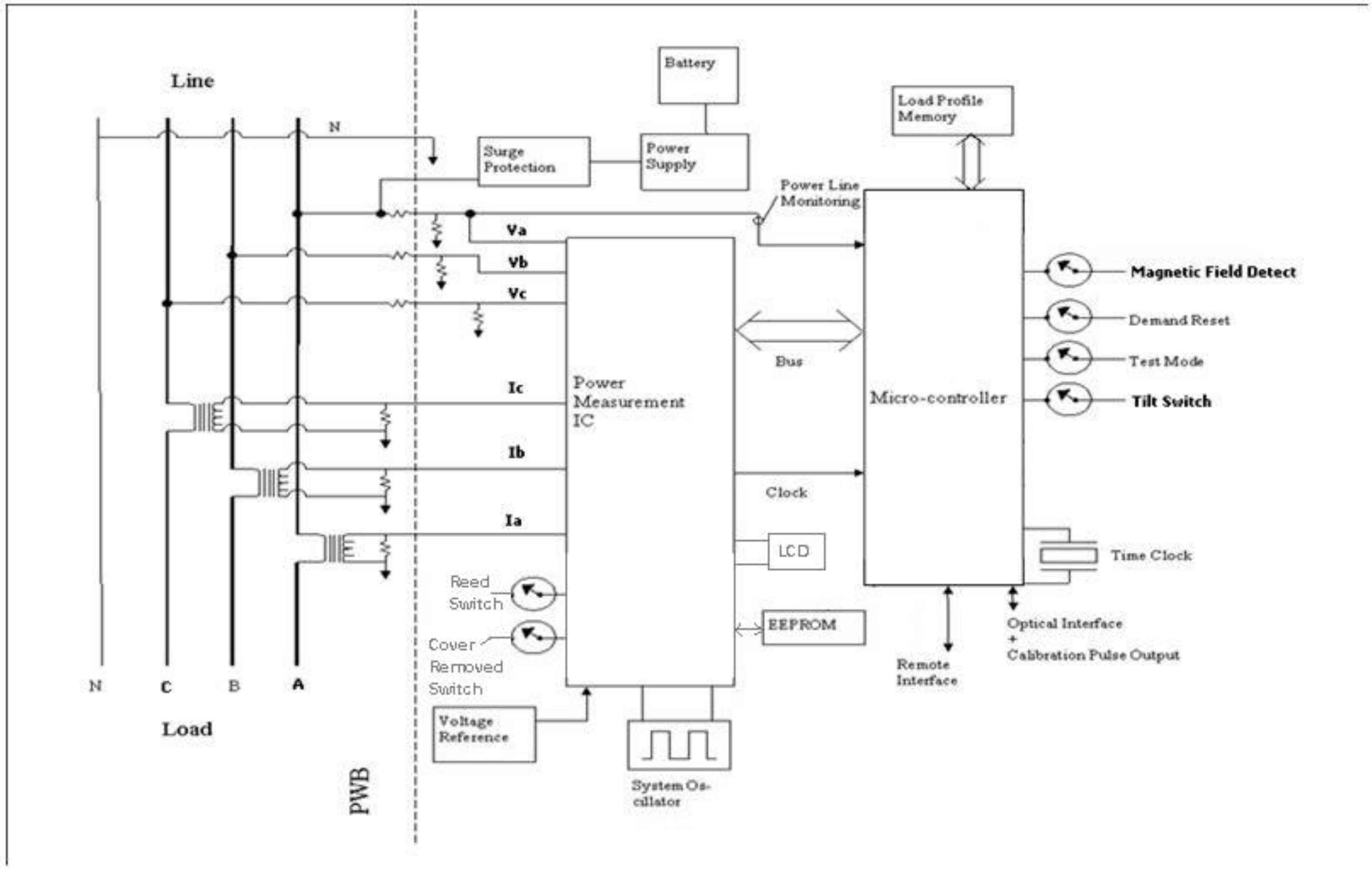
Active and Reactive Metrics: The E650 S4x can be programmed for all of the following aspects of energy: kW, kWh, kVA/kVAh rms, kVA/kVAh Phasor, kVAR/kVARh Phasor. In an optical meter read, the metrics will appear as these values.

VArms: Root mean squared measurement of Volt-Amperes.

VA Phasor: Vectorial measurement of Volt-Amperes. At unity power factor VA Phasor is equal to watts.

VAR Phasor: Vectorial measurement of Volt-Amperes reactive

Appendix F: Block Diagram (Single Phase Power Supply) with Legend



Appendix G: Diagram of Parts

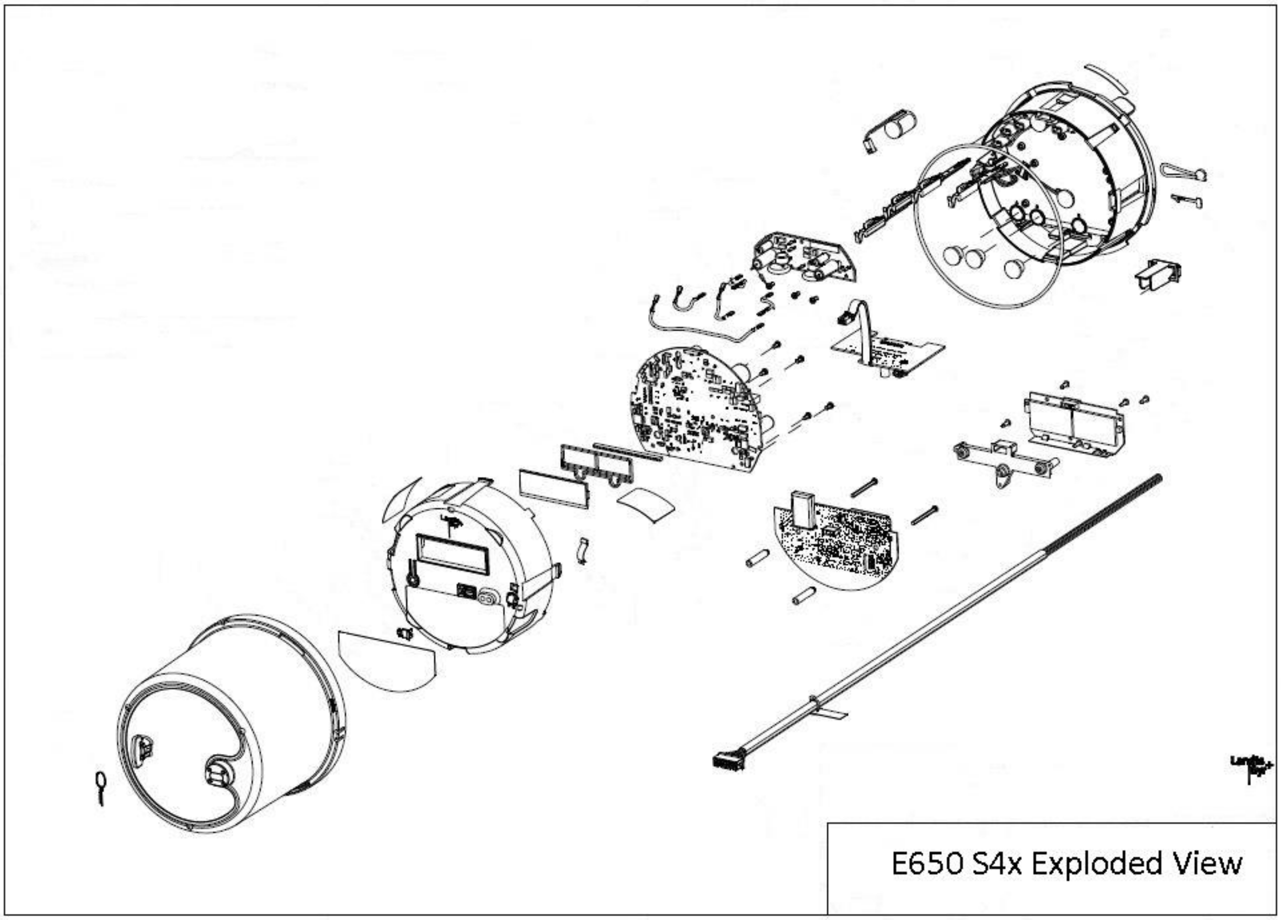


Figure 3.1.2 Exploded Diagram of E650 S4x

Appendix H: Notes and Notices

Current Manuals, Notes, Generation Documents, Software, etc. can be found on the website:
http://eportal.landisgyr.us/ePortal/Applications/login.aspx

A User ID and Password will be required to access this website.

Legend

Battery – 3.6V Lithium battery for backup during outages maintains timekeeping and registers.

Bus – The connection between the microcontroller and the power measurement IC.

Clock – Maintains the timing for energy and demand calculations

Cover Removed Switch – Triggers event in the log when the meter cover is removed and another event if/ when it is subsequently re-installed on the meter.

Demand Reset – Switch activates the demand reset sequence.

EEPROM – EEPROM stands for Electronic Erasable Programmable Read Only Memory and is non-volatile storage location for programming constants and for meter data. Data is retained during an outage.

LCD – Display on top of the meter, can be programmed to scroll through 96 displays.

Load Profile Memory –Memory used for storing load profile register data. (256K or 1Meg for an E650 S4x)

Magnetic Field Detect - Triggers and logs an event if the presence of a foreign magnetic field is detected.

Microcontroller – Processor that controls the meter, performs data calculations, and meter I/O.

Optical Interface + Calibration Pulse Output – This an ANSI type II optic port that operates as a calibration LED during testing.

Power Line Monitoring – Monitors AC power for line loss detection. After 6 missing line cycles on phase A the meter shuts down, saves data, and runs off the battery in TOU programmed meters (unless the meter is equipped with an optional 3 Phase power supply).

Power Measurement IC – The power measurement IC analyzes the incoming voltage and current inputs to perform basic measurement calculations.

Power Supply – Converts incoming AC on phase A to low voltage DC for meter operation.

Reed Switch – Switch activated magnetically and used to access Alternate mode and GyrBox mode.

Remote Interface (Port) – Serial Port communication used for communications devices including RS232, RS485, Ethernet, cellular modems, and AMI devices.

Surge Protection – The surge protection protects the meter against voltage spikes and surges.

System Oscillator – Crystal controlled oscillator which provides measurement time base.

Test Mode – The test mode switch activates test mode.

Tilt Switch – Triggers event in the event log when meter significantly shifts position.

Time Clock – Time keeping device maintaining TOU time during power outages.

Voltage Reference – Stable reference used by Power Measurement IC