Trilliant® Libra Series Edge Ready Smart Electric Meter Specifications

Presented By: Trilliant

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Trilliant Holdings Inc.
401 Harrison Oaks Blvd.
Suite 300 Cary, North Carolina 27513

Proprietary Notice

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TABLE OF CONTENTS

1.0 Product Description

The LIBRA is a solid-state, poly-phase electricity meter for residential, commercial and industrial (C&I) market. It meets or exceeds the American National Standards Institute (ANSI) standards for electricity metering and is certified for use by industrial and electric utility customers.

- ✓ Configurations can meet a wide range of you metering requirements: from metering energy rates and collecting critical quality of service to collecting load analysis information.
- ✓ Provides utilities with unparalleled digital accuracy and reliability as well as a flexible platform that allows utilities to integrate their customers more easily into large-scale AMR systems.

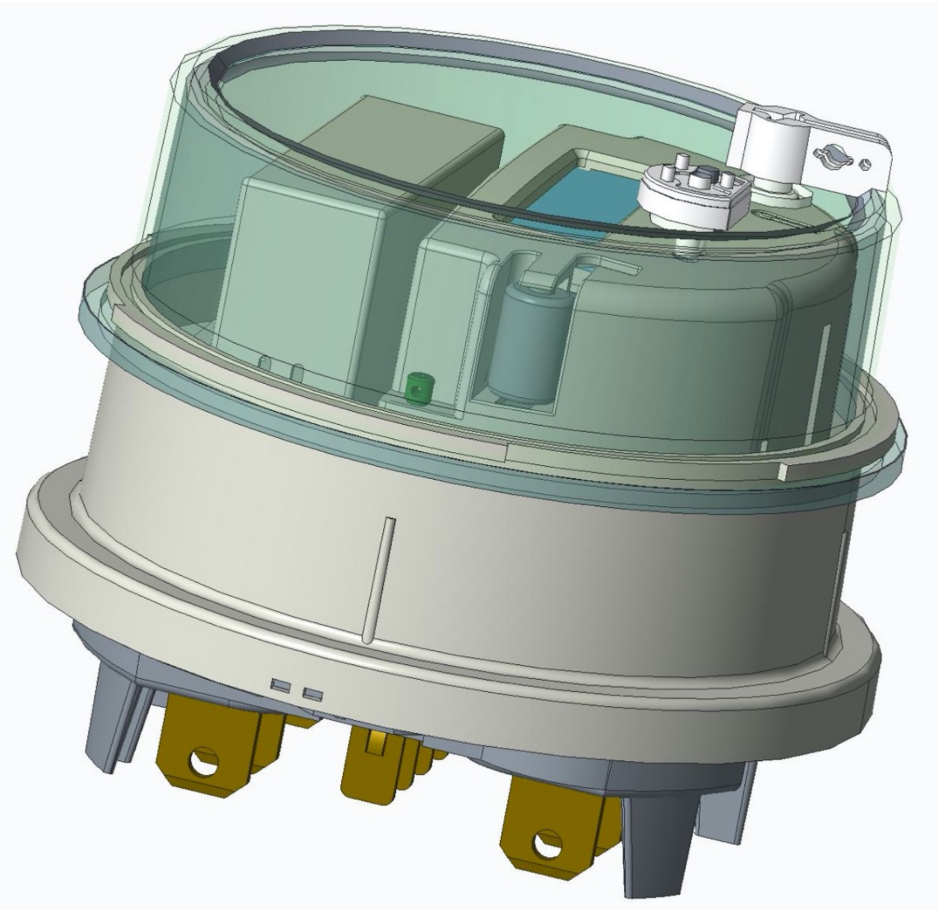


Figure 1:Trilliant® Libra Edge Ready Smart Electric Meter

1.1 General Information

The LIBRA Polyphase is designed to grow and change with the utility industry. Simplified register changes, interchangeable communications modules and a developer's toolkit are proven advantages for boosting operational performance and simplifying C&I data acquisition.

Instrumentation

Libra meter can display over 50 different instrumentation quantities. With this highly integrated capability, the Libra meter can provide the equivalent function of all of the following devices: voltmeter, wattmeter, VA meter, distortion indicator, ammeter, VAR meter, phase angle meter, phase rotation indicator.

Dependable apparent power measurements for unbalanced loads and asymmetrical services. IEEE-defined vector calculations of polyphase quantities.

Revenue metering

Libra meter is a very accurate revenue meter (0.2 accuracy class). The meter provides advanced four quadrant revenue functions, transformer and line loss compensation, and increased data profiling without adding hardware option boards.

Power Quality Monitoring

A power guard component identifies load power quality problems before they become complaints.

ANSI Communications Protocols

The meter provides full support for ANSI C12.18, C12.19, C12.21, and C12.22, etc. communications protocols and data structures to read and program.

Interval Data Recording and Self Reads

The main chip in the Libra meter has more than 8MB of nonvolatile memory for storing profile, data logs, self-read data and upgrade firmware images. This feature provides an easy upgrade path without the need for an additional option board.

Input-output options

- ✧ KYZ with Programmable Pulse Output Value
- ✧ EOI

- ✧ Demand Threshold Alert
- ✧ Voltage Threshold Alert
- ✧ Diagnostics
- ✧ Load Control
- ✧ Up to 2 Inputs from External Devices
- ✧ Pulses Input to Load Profile
- ✧ Activate Real-Time Rate

The meter measures kWh/kVARh energy and is rated as an ANSI C12.10 class 0.2 meter. However, it is expected that accuracy under many operating conditions and loads will typically be within 0.2%. The meter is configured at the factory. Resetting energy is accomplished with MPMS® software (Version 3.0 or greater) and some keys which used to operate meter.

1.1.1 Physical Description

The meter uses a poly carbonate cover. The cover is molded in one piece and has an integrated optical communications port and demand reset mechanism. An optional battery port can be ordered in the cover to enable changing the battery without removing the meter Guard Circle and Meter Enclosure.

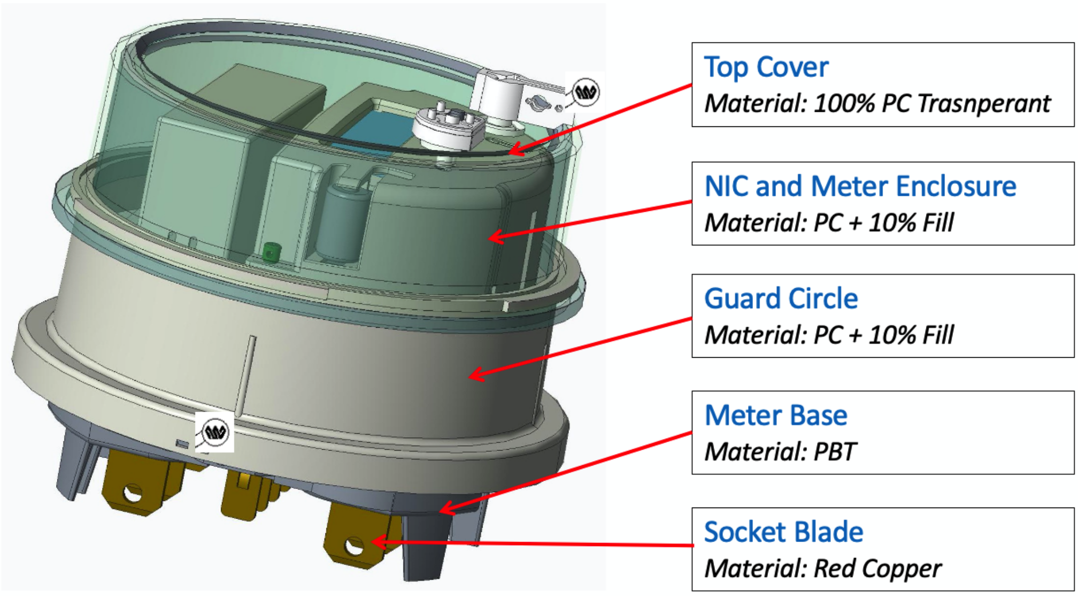


Figure 2: Trilliant Libra Edge Ready Smart Meter

The meter base assembly provides provision for connection of the meter to the electrical service to be metered, the basic physical structure, and current scaling devices. All common S base and A base (bottom connected) configurations are optional.

The electronics module contains the circuit power supply, all circuits for measurement, calculation, and display of meter data, and the connector for attachment of option boards.

The liquid crystal display indicates energy consumption and various other data. The display is covered in detail in Chapter 2, Operating Instructions. The 8 large characters of the display can display either numeric or alphabetic information.

The alternate display switch is located on the right side of the meter face slightly below the 3 o'clock position and is activated by a magnet. The switch and its use also described in detail in Chapter 2, Operating Instructions.

The demand reset and test switches are located at the 5 o'clock position of the meter face. The test switch has no external access. The cover must be removed to operate the switch.

An optical port is located in the 7 o'clock position of the meter face. The optical port allows a computer to communicate with the meter for reading and programming using Standard Tables (ANSI C12.19) and PSEM (Protocol Specification for Electricity Meters [ANSI C12.18]).

The battery for the time-of-use option is visible at the 8 o'clock position. It is the industry standard battery.

1.1.2 Meter Forms

The meter is available in several variants, which can be selected depending upon the application. The ANSI Standard S Base Meter Forms are shown in Table below.

Form	Volts	Elements	SC/TR	Class
1S	120V	1	SC	200
2S	240V	1.5	SC	200
3S	120V to 240V	1	TR	20
4S	120V to 240V	1.5	TR	20
9S	69/120V to 277/480V	3	TR	20
9S	120/208V to 347/600V	3	TR	20
12S	120/208V and 600V	2	SC	200

Form	Volts	Elements	SC/TR	Class
12S	120/208V and 600V	2	SC	320
16S	120/208V to 347/600V	3	SC	200
16S	120/208V to 347/600V	3	SC	320
35S	69/120V to 277/480V	2	TR	20
35/45S	120/208V to 347/600V	2	TR	20
36/46S	120/208V to 347/600V	2.5	TR	20

1.1.3 Physical variants

The basic physical description of the meter and available S base forms have been described above.

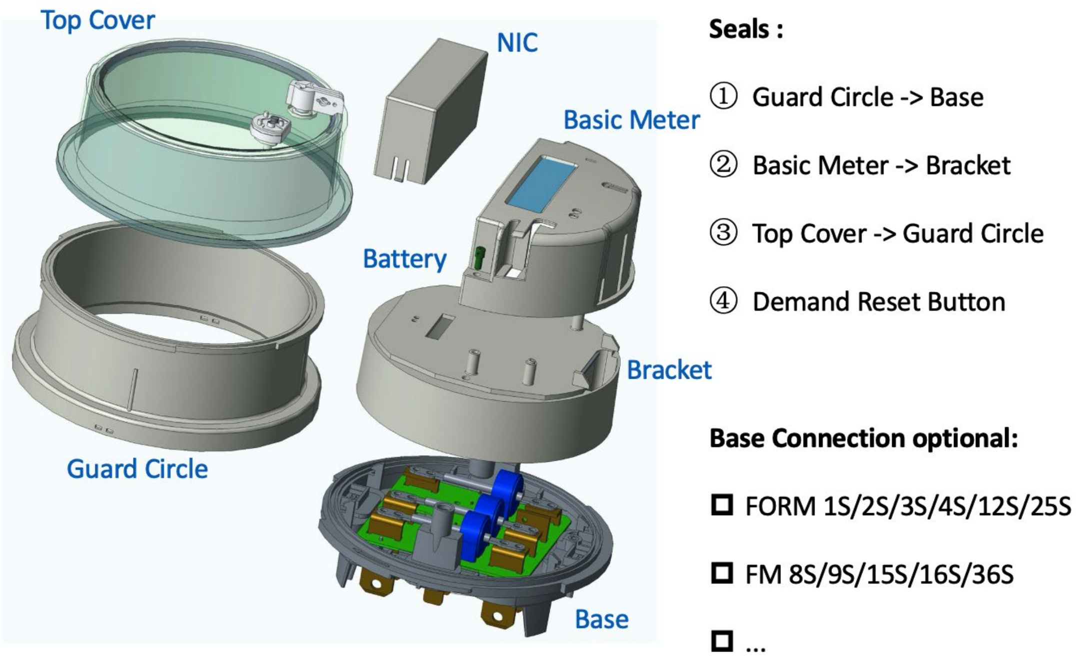


Figure 3: Physical variants

1.1.3.1 Voltage ratings

Meters are available that operate at a nominal supply voltage of 120 to 600 VAC +10% - 20%, meeting ANSI accuracy class 0.2 requirements. A low voltage version is also available for 57V to 120V applications. The operating voltage must be specified when the meter is ordered.

1.1.3.2 Time base

There are two time base:

- ✧ Primary time base meets the ANSI limit of 0.02 % using the 32.768 kHz crystal. Initial performance is expected to be equal to or better than ±55 seconds per month at room temperature.
- ✧ Secondary time base is power line frequency (50 Hz or 60 Hz), with selectable crystal oscillator.

1.1.3.3 Test Amp Rating

The test Amp (design full load value) value for each Class are shown below:

- ✧ 50 Amps for Class 320
- ✧ 30 Amps for Class 200
- ✧ 15 Amps for Class 100
- ✧ 2.5 Amps for Class 20

These values are traditionally the current value used in conjunction with the rated nameplate voltage to conduct the “Full Load” and “Lag” calibration test. It is printed on the nameplate and referred to as “TA”.

1.1.3.4 Frequency

The meter operates and correctly measures energy associated with 50 or 60 Hz electrical systems. Meter operation frequency must be specified when the meter is ordered.

1.1.3.5 Temperature

The meter will withstand and operate properly through temperature variations from -40℃ to +85℃. The LCD display may cease to function at temperatures below -35℃ and above +80℃. The meter will also withstand storage temperatures ranging from -40℃ to +85℃.

1.1.3.6 Typical Watts Loss

The typical watts loss will be less than 5W.

1.1.3.7 Weight

The weight of the meter with a poly carbonate cover is around 1.8lbs(0.9Kg), which is depend on the Forms and Hardware options.

1.1.4 Hardware options

Each of the features described in this section is a hardware option that can be added to the meter.

1.1.4.1 Battery

The Libra meter offers a cover battery port enabling changing of the meter (TOU) battery without removing the meter inner cover. This battery is used for time keeping during power outages. Covers with battery ports may be ordered with the meter or retrofitted in the field.

1.1.4.2 Communication option boards

There are several communications options boards are offered for the Libra.

One is an internal 2400 baud telephone modem circuit board (type T-2). The second is the WH109 board (type WH109-2), which is used to connect the meter to an external modem via a RS-232 interface or to provide for data connection to a RS 485 system.

Either the internal modem or WH109 board may be installed, but not both at the same time.

The 3rd communication NIC (Network Integration Card) can be plug-in too.

These communications options may be ordered with the meter or installed in the field.

1.1.4.3 Edge computing board

It integrates a CoreMCU which can support Linux OS and open source platform, then 3rd APP can design and run in the board to extend the functions of smart meter.

1.1.4.4 Input/output option board

Two types of I/O option boards are available for the Libra meter.

The Simple I/O board (type LBS-1) provides two form C outputs, one form A output, and one Real Time Pricing input to the meter. The outputs are programmable to provide a variety of functions including energy pulses, alerts, or End of Interval indication.

The Multiple I/O board (type LBM-1) provides two form C outputs, six form A outputs (with one common connection), one Real Time Pricing input, and four pulse inputs to the meter which may be used as either 3 wire (form C) or 2 wire (form A) inputs. Pulse inputs are used as data inputs to the meter. Processing of this data is very flexible, including most processes used for internal measurements and totalization.

Either of the I/O boards may be installed, but not both at the same time. These options may be ordered with the meter or installed in the field.

Note that throughout this document when we refer to Form A pulse initiator outputs we are technically referring to two-wire, bi-stable outputs. Every contact change of state represents the programmed value of wh/varh/Qh/VAh. Strictly speaking, a traditional Form A output represents a normally open, momentary closure type of output where one cycle (from open to closed to open again) represented the desired output value. Most modern solid-state metering products, including the kV and Libra meters, have adopted the revised definition of Form A outputs where each change of state (from open to closed, or from closed to open) represents the desired output value. Similarly, every change of state is counted as a pulse for the external inputs (Form A or Form C).

1.1.5 Libra basic operating features

The Libra meter has several operating modes. It provides:

- Energy measurement (5 quantities)
- Fundamental only and fundamental plus harmonics measurements (both are

  available simultaneously)
- Bidirectional energy measurements with various detecting choices
- Self monitoring of meter operation for 7 error conditions, and 5 caution conditions.
- Alternate display scroll
- Test mode to test meter operation and site characteristics without effect on billing quantities or load profile data.
- Input/Output board support for pulse outputs, alert outputs, pulse inputs,

and real time pricing input

- ✧ Programming Seal function for enhanced security
- ✧ Security Table of key meter events

1.1.6 On site user features

1.1.6.1 Operation

The meter has many features for easy to use on site.

- ✧ Nameplate and label information
- ✧ Numeric display with key Annunciator
- ✧ Several display parameters including Energy accumulation, Instantaneous power/voltage/current/frequency/temperature, demand, Delivered/Received indication and Disk analog etc.

These features are described in detail in Section 2, “Operating Instructions” of this manual.

1.1.6.2 Maintenance

Maintenance instructions are covered in Section 3 of this manual.

1.2 Software Tool

The meter is supported by the MPMS® Software (version 3.0 or greater), which facilitates the resetting of the energy accumulation to zero, calibrate and other functions. Refer to Reading and Programming Instruction manual for MPMS®.

There is a reset adaptor that is available, part number WH109. The adaptor fits over a remote IR to connect to PC’s RS232 port.

This software facilitates setting up and using many meter features:

- ✧ Meter calibration
- ✧ Creation of custom meter programs
- ✧ Loading programs into the meter
- ✧ Setting site specific meter parameters
- ✧ Viewing real time data
- ✧ Reading meter data
- ✧ Load Profile data analysis and reporting
- ✧ Meter program and meter data reporting

- ✧ Batched meter communications
- ✧ Meter mode conversion and soft switch upgrading

1.3 Technical Information

This section contains the theory of operation and general circuit configuration of the Libra Meter.

1.3.1 Theory of Operation

The theory of operation of Single-Phase Three-Wire FORM 2S meter is explained in conjunction with the block diagram as an example shown in Figure 1-3.

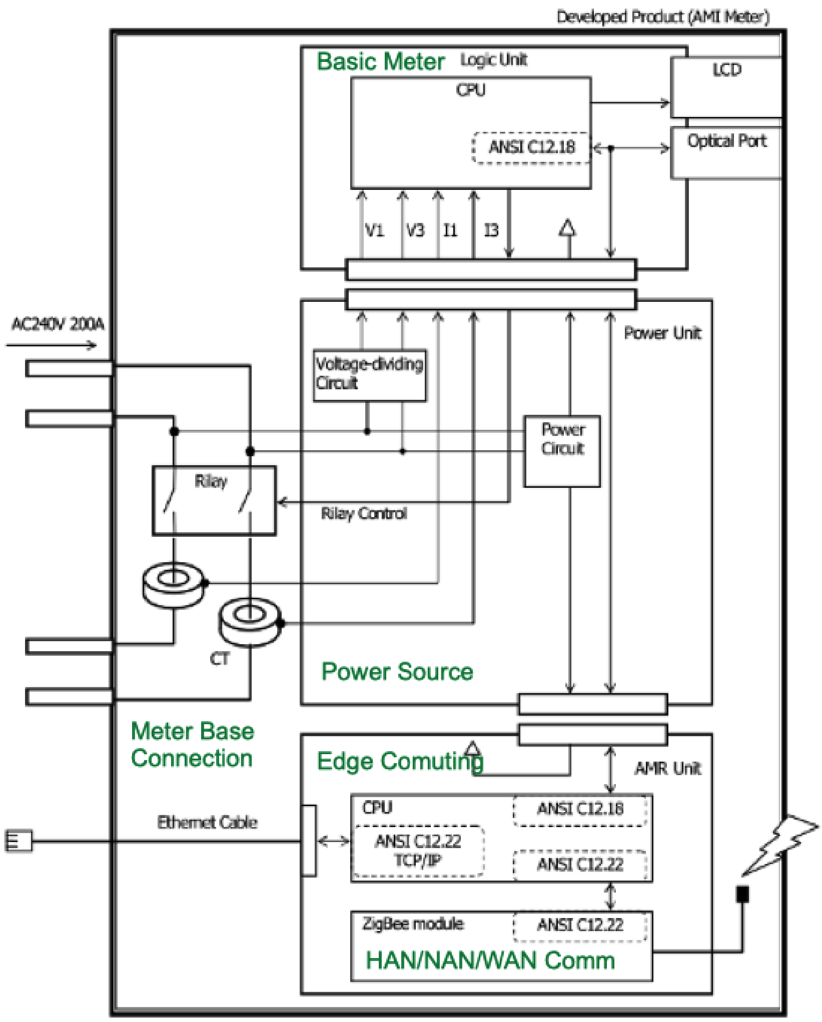


Figure 4: Meter Block Diagram

1.3.1.1 Sensing Devices

The current transformer feed the scaled current signals to the meter chip senses current. The voltage signal is scaled for measurement using a precision resistor divider circuit.

1.3.1.2 Meter Chip

The Libra has a Cotex0 ARM MPU core with 512K Flash and 80K SRAM , High precision RTC, FLASH and LCD driver.

1.3.1.3 EEPROM

The meter is equipped with a non-volatile memory that is used to store the metered data, calibration parameters, configuration constants and the program parameters. The non-volatile memory does not require a battery to retain information when line power is not present.

- ✧ Write Protect Pin for Hardware and Software Data Protection
- ✧ High Reliability
- ✧ Data Retention: 40 Years

1.3.1.4 LCD

LCD is designed to meet all requirements of C12.10, e.g. kWh, kVARh, VA, Voltage, Current, Demand, TOU, Relay control etc. But the ANSI C12.10 meter only implement basic function.

1.3.1.5 Infrared optical port

The optical port meets to C12.18-1996 physical layer standard. This port is used to communication with computer tools. The computer tools can be used to program meter.

1.3.1.6 AMR UART port

The AMR port is a UART, which meets to C12.18-1996 and C12.19-1997 standard. This port can be used to communication with inner AMR module, such as RF/PLC/Zigbee etc.

1.3.1.7 Pulses output LED

The Libra meter is equipped a IR that is used to kWh pulse output.

1.3.1.8 Seal Key

This key is used to clear the demand and energy. It will be sealed after the action.

1.3.1.9 Time Keeping Battery

A standard 3.6V, half-size AA, lithium battery maintains the meter clock when the meter is programmed as a time-of-use meter or demand meter with Load Profile recorder.

Since all billing and programming information is stored in nonvolatile memory, the battery is primarily used for maintaining date and time information during a power outage.

Under normal conditions, the battery can provide more than 1 year of service during outage conditions (time on battery backup) and more than 10 years of service during storage conditions (disconnected from terminals) or when properly installed in an energized meter.

2.0 Physical Attributes

2.1 Mechanical Structure

2.1.1 Cover

See the following figure for a graphic representation of the meter cover.

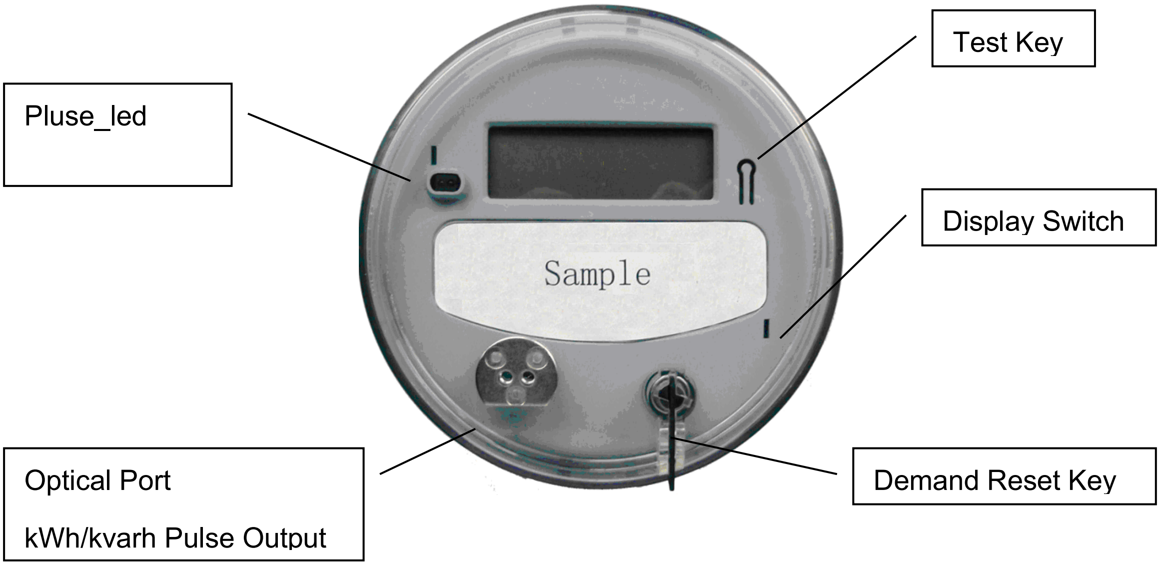


Figure 5: Meter Cover

Description:

1) **Pluse_led**, it is used to output the kWh pulse.
2) **Display switch**, Switch display contents. (This is a non-touch switch)
   - ✧ When the power on, the screen is in auto-scroll mode.
   - ✧ In auto-scroll mode, it will switch one page per 3 seconds.
   - ✧ When the Alternate Key pressed, it will stop auto-scroll. Then the next press will switch one page.
   - ✧ If there is not any press for 30 seconds, it will revert back to auto-scroll mode.
3) **IR,** remote communication with PC software or Handle (hand-held) read device. Also, it is used to output the kWh/kvarh pulse.
4) **Demand Reset Key**.
5) **Test Key,** switch to Test Mode.

2.1.2 AMR module

Libra can equip with all kinds of AMR modules.

2.2 Nameplate Information and Labels

See the following figure for a graphic representation of the meter nameplate. The meter nameplate is found on the front of the meter.

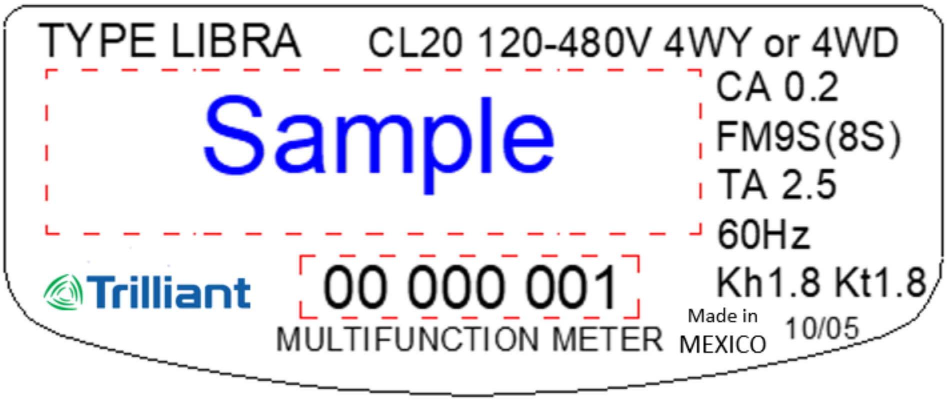


Figure 6: Meter Nameplate

2.2.1 Nameplate Information

The nameplate information is shown in Figure 2-2. The following numbered list coincides with the numbers in the figure.

- ✧ **CL20** - Current Class
- ✧ **120~480V** - Nominal Voltage operating range
- ✧ **4WY or 4WD** - Number of wires for the metered service
- ✧ **TYPE LIBRA** - The type of meter: Libra
- ✧ **TA2.5** - Test amperes:30A
- ✧ **Kh1.8 Kt1.8** - Watthour test constant
- ✧ **CA 0.2** - ANSI C12.20 Accuracy Class | S-base CA 0.2
- ✧ **FM9S(8S)** - ANSI C12.10 Form Number
- ✧ **60Hz** - Nominal Frequency

2.3 Display

2.3.1 Display elements

The Liquid Crystal Display (LCD) indicates energy consumption, instantaneous power, demand, frequency and other. All values are refreshed every second.

Description:

1)  **:** The four small characters are used to display the current display label or code. “CA” or “Er” appearing in this location indicates a Caution or Error message in the display.

2)  **(Six big digits)** display the value of quantities.
   - ✧ The open ◎ between the rightmost character and the character to its left is a degree symbol for fundamental lagging phase angles.
   - ✧ The short bar to the left of the first large digit indicates a minus sign.
   - ✧ There are four possible decimal point positions located between the five rightmost digits.
   - ✧ There are two colons located mid of six digits which is used to display date and time.

3) **TEST:** the annunciator indicates the meter is in Test mode.

4) **ALT:** the Annunciator indicates the meter is in Alternate display mode.

5) **Prev:** this part of the display indicates the previous season or billing period data is being shown.

6) **ContCum: CUM** is displayed when the meter is displaying cumulative demand measurements. When **CONT** and **CUM** are displayed, it indicates that the meter is displaying continuously cumulative demand measurements.

7) **EOI:** this display indicates an end of interval (EOI) condition.

8)  **:** 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. If blinking, the respective voltage is low.

9) **Unit**. The unit icon can display individually as –
“kWh”, ”kVArh” , ”kVAh”, ”kW”, ”V”, ”A”, “Hz”.

10) ■ ■ ■ ■ **(DPI, Digital Power Indicator)**. These are the disk analog blocks to indicate the percentage of energy accumulated in comparison to the 1.8 Wh value. If the energy direction is “Received”, this icon will blink. The left arrow indicates energy is being received from load and the right arrow indicates energy is being delivered to the load.

11) A B C D **:** The letters A through D indicate the Time-Of-Use (TOU) rate that is in effect. Only one letter is displayed at a time when operating in a TOU Mode. If no letters are lit, the meter is in a non-TOU rate.

12) ◄ ▲ ▼ ► ,power quadrant indicators.

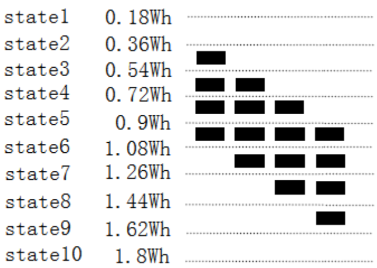
2.3.1.1 Display Detail

The display scroll sequence is programmable at the factory or by the user with MPMS® Software. The time of display can be programmed from 1 to 15 seconds in one-second increments.

2.3.1.2 Digital Power Indicator

The meter has a digital power indicator and consists to ten segments.

The DPI moves from left to right at a rate proportional to energy imported to the load and moves from right to left at a rate proportional to the energy exported from the load.The DPI makes one pulse of metered energy. For example



2.3.1.3 Real Time Energy Direction Indicators

The meter LCD has a method of indicating the positive or negative nature of energy accumulation relative to normally correct meter installation.

The two icon combined with the indicators “Left Arrow” (Received) and “Right Arrow” (Delivered) indicate whether the energy accumulated is Delivered /Exported to the load or Received /Imported from the load.

The “Right Arrow” icon will illuminate when energy accumulation is positive (Delivered). The “Left Arrow” icon will illuminate when the energy is negative (Received)t. If the energy is not above the anti-creep threshold, both indicators will be displayed.

2.3.1.4 Power Up Display Sequence

All meter display segments, including the DPI segments and others, illuminate after the meter is powered up for 2 second regardless of the display. After that the display will display the Firmware version for 1 seconds. Then the display begins its programmed scroll sequence.

2.3.2 Display Mode

There are four display modes:

- ✧ Nomal
- ✧ Alternate
- ✧ Test (be not support by LibraK)
- ✧ Frozen (be not support by LibraK)

The user can switch between display mode using the display switch and the test switch.

2.3.2.1 Display Switch Actions

The display switch is actuated using a magnet. Holding a magnet next to the display switch for varying lengths of time causes the meter to change display modes:

Less than 3 seconds: Enters the Alternate Display mode for one scroll then returns to the Nomal Display mode.

3 to 6 seconds: Restarts the Normal Display scroll or produces one Normal Display scroll if an Error, Caution or Diagnostic is frozen on the display.

2.3.2.2 Nomal display mode

In Normal Display mode, the meter display scrolls continually through the Normal Display items until one of the following occurs:

- ✧ Demand reset is invoked.
- ✧ Display switch is actuated.

Note the test mode push button is not accessible with the cover in place.

Normal Display items are selected during program development using MPMS software.The meter returns to the Normal Display mode when other display modes have completed or timed-out.

TIP While the meter is communicating, the data annunciators are off and the LCD displays“BUSY”.

2.3.2.3 Alternate Display Mode

The Alternate Display is used to display information for the meter technician that is not contained in the Normal Display.

- ✧ Display Items: selected during MPMS program development.
- ✧ Initiate: actuate the Display Switch for 3 to 6 seconds.
- ✧ Scroll: the meter automatically scrolls through the Alternate Display items.
- ✧ Exit: the meter automatically returns to the Normal Display mode after the last Alternate Display item.

2.3.2.4 Frozen Display Mode

The Frozen Display mode stops the Normal Display to draw attention to an Error, Caution, or Diagnostic in the meter.

- ✧ Display Items: select Errors, Cautions and Diagnostics to freeze the display during MPMS program development.
- ✧ Initiate: automatic when the meter detects a frozen Error, Caution or Diagnostic.
- ✧ Scroll: use a magnet to activate the Display Switch. The meter will perform one Normal Display scroll and then return to the Frozen Display.
- ✧ Exit: clear the condition that caused the error, caution or diagnostic to return to the Normal Display mode.

2.3.3 Display Information

There are different user selectable quantities are available for display. As the meter is very flexible, a wide range of quantities can be defined for mapping to meter calculations and display.

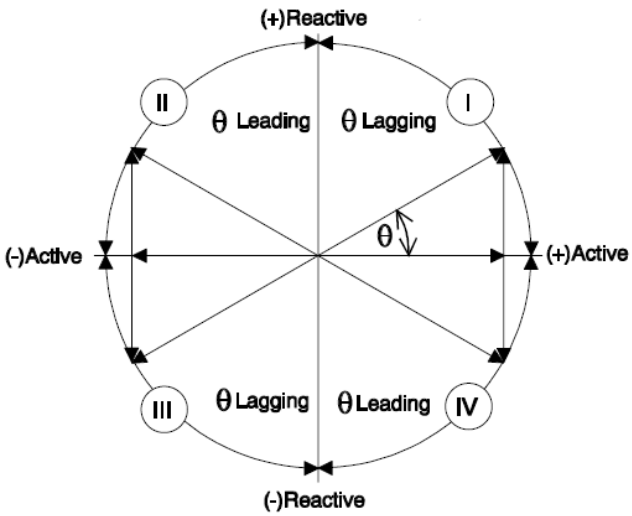
In the table below “UOM” refers to “Unit of Measure”, a general term for a range of measurements which can be displayed, as defined by the meter program. UOM quantities can be kWh or other integrating volt-amp quantities (such as kVA), currents, voltages, or numeric (pulse count) values.

1	Total active Energy	2	Phase A active Energy
3	Phase B active Energy	4	Phase C active Energy
5	Total Reactive Energy	6	Phase B Reactive Energy
7	Phase C Reactive Energy	8	Phase D Reactive Energy
9	Phase A Voltage	10	Phase B Voltage
11	Phase C Voltage	12	Phase A Current
13	Phase B Current	14	Phase C Current
15	Vphase_AC	16	Vphase_AB
17	Frequency	18	Real-time DATE
19	Real-time Time	20	Total Active power
21	Phase A active Power	22	Phase B active Power
23	Phase C active Power	24	Total Reactive power
25	Phase A Reactive power	26	Phase B Reactive power
27	Phase C Reactive power	28	Phase A Power factor
29	Phase B Power factor	30	Phase C Power factor
31	Real-time Temperature		

3.0 Libra Technical Specification

3.1 LibraK Measurements Specification

The Libra has the capability to calculate a wide range of quantities. this is a list of up to 20 quantities that the meter will accumulate.



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 powerfactor)

3.1.1.1 Watt-hour Measurements

The Libra meter provides the following Wh measurement choices:

- Wh sum of elements delivered only
- Wh sum of elements received only
- Wh sum of elements |delivered| - |received|
- Wh sum of elements |delivered| + |received|
- Wh per quadrant
- Wh per element delivered
- Wh per element received
- Wh per element |delivered| - |received|
- Wh per element |delivered| + |received|

- ✧ Wh per element per quadrant

3.1.1.2 Varhour Measurements

The Libra meter provides the following Varh measurement choics:

- ✧ Varh sum of elements lagging only
- ✧ Varh sum of elements leading only
- ✧ Varh sum of elements |lagging| - |leading|
- ✧ Varh sum of elements |lagging| + |leading|
- ✧ Varh per element lagging
- ✧ Varh per element leading
- ✧ Varh per element |lagging| - |leading|
- ✧ Varh per element |lagging| + |leading|
- ✧ Varh per element per quadrant

3.1.1.3 Volt-ampere-hour Measurements

The Libra meter provides the following VAh measurement choics:

- ✧ Apparent VAh
- ✧ Arithmetic apparent VAh
- ✧ Phasor VAh
- ✧ Apparent VAh per quadrant
- ✧ Arithmetic apparent VAh per quadrant
- ✧ Phasor apparent VAh per quadrant
- ✧ Apparent VAh per element
- ✧ Apparent VAh per element per quadrant

3.1.1.4 Voltage Measurements

The Libra meter provides the following Voltage measurement choics:

- ✧ Voltage line-to-neutral
- ✧ Voltage line-to-line

Voltages are calculated every momentary interval and are the average RMS values for that momentary interval.

3.1.1.5 Current Measurements

The Libra meter provides the following Current measurement choics:

- In (neutral current)
- Current

3.1.1.6 Other Available Momentary Interval Quantities

In the Libra meter, there is a set of pre-defined quantities that are updated every momentary interval. There is no operation (sum, maximum, minimum, store) associated with any of the quantities in this set.

They may be displayed on the meter's LCD. The following are available:

- kW per element
- kvar per element
- Apparent kVA per element
- Line-to-neutral voltages
- Line-to-line voltages
- Currents
- Power factor (calculated as net Wh divide by Apparent VAh, where net Wh = |delivered Wh| - |received Wh|)
- Frequency (of fundamental voltage signal)
- Current total harmonic distortion per element
- Voltage total harmonic distortion per element
- Distortion power factor, per element and total

4.0 Maintenance Instructions

WARNING: The information contained within this document is intended to be an aid to qualified metering personnel. It is not intended to replace the extensive training necessary to install or remove meters from service. Any work on or near energized meters, meter sockets, or other metering equipment presents the danger or electrical shock. All work on these products must be performed by qualified industrial electricians and metering specialists only. All work must be done in accordance with local utility safety practices and the procedures outlined in the current edition of the Handbook for Electricity Metering.

4.1 Recommended Test Procedures

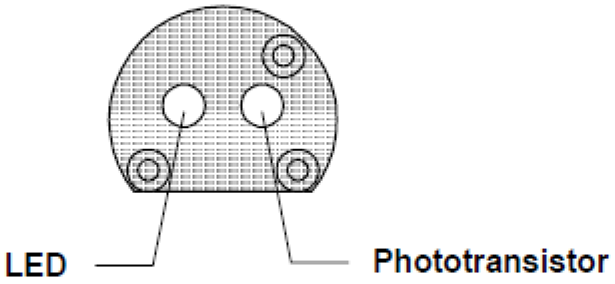
The Procedures described below are suggested test procedures for use with the Libra meter. They are not intended to replace local utility operating practices. Any procedures not described herein or referenced herein are not.

4.1.1 Meter Testing Tools

The meter is equipped with a light-emitting diode (IR LED) for verifying calibration and a liquid crystal display with disk analog.

4.1.1.1 Calibration LED

The Infra-Red LED emits optical pulses proportional to kWh/kvar accumulation. The output of the calibration LED is compatible with commercially available test equipment designed to verify the calibration of Multifunction meters in the shop and field. Each calibration pulse represents Kh watt-hours of energy accumulated by the meter. The duration of each output pulse is approximately 10 milliseconds.



4.1.1.2 LCD Display for test

The meter display has annunciators for quadrant, phase voltage, and energy flow indication as shown in Figure as below. The annunciators provide valuable information during the testing process.

Quadrant annunciators: The left and right arrows indicate reverse and forward energy flow, respectively. An up arrow indicates lagging quadergy (varh), and a down arrow indicates leading quadergy (varh). These arrows can be used to determine the quadrant in which the meter is currently operating.

Phase voltage: Three annunciators labeled A, B, and C are used to indicate the presence of voltage on their respective phases. If the annunciator is not displayed, there is no meter element in that phase or no phase voltage is expected for the metered service. For example, a 2 or 2½ element meter will show only A and C phases. If an expected voltage is low (below the value programmed into the meter, the phase indicator blinks.

4.1.2 Disk Analog Testing

The disk analog provides a means of checking the calibration of the meter. There are some practical limits to this method of testing. For example, if the load on the meter is very low, the test may take a long time. Conversely, if the load is high, it may be difficult to accurate time the apparent revolutions of the disk analog display.

For a complete description on the operation of the disk analog feature of Libra, refer to 2.3.4 *Digital Power Indicator*.

If a load is applied to the meter in service that is constant and reasonably well known, the accuracy of the meter can be estimated using the time-Watts method of testing. Since the apparent revolution of the disk analog is equal to the meter 1Whour, the amount of time required to accumulate a fixed quantity of energy can be timed with a stopwatch. By observing the disk analog display, the user can time the apparent revolutions by starting and stopping the watch when the disk analog has cycled through the required number of revolutions back to its beginning state.

The accumulation in WH divided by the accumulation time (in hours) will give a value in Watts that can be compared to the known value of the load to estimate the meter accuracy.

(Meter Kh * number of revolutions) / (t seconds / 3600) = Metered load in Watts

This method of testing is only applicable to providing a rough estimate of the meter performance since the actual load in operation is not normally known with a high degree of precision.

A more accurate field test of meter calibration can be performed using a reference watthour standard and a controlled load as described above. If the reference standard does not support an interface (optical pickup) for the calibration LED it is often possible to gate the reference standard manually using a switch.

1. Connect the portable standard and test load to the meter according to the wiring instructions provided by the test equipment manufacturer.
2. Reset the standard and apply an appropriate test load. A nominal Test Ampere rating (TA) is indicated on the meter nameplate.
3. Observe the disk analog. One complete apparent revolution of the disk analog display represents Kh Watthours as accumulated by the meter (The Kh value is printed on the meter nameplate.)
4. When the disk analog appears to transition off of the visible display start the standard manually.
5. Let the disk analog scroll through a predetermined number of evolutions(10, for example).
6. Stop the standard manually when the disk analog transitions off of the visible display after the required number of apparent revolutions are complete.
7. Calculate the accumulated Watt-hours as shown in the following equation.

   Accumulated Energy = (Kh) ×(the number of complete disk analog cycles)

8. Compare the results of the calculation to the reading on the reference standard.

The human reaction time in starting and stopping the reference standard is a significant source of measurement uncertainty when using this test technique. Increasing the number of apparent disk revolutions per test can reduce this uncertainty.

4.1.3 Instantaneous Power Testing

When programmed, the Libra displays instantaneous power with kW indicator in the LCD. The instantaneous power indication is useful for making a rough estimate of meter performance by comparing the displayed power to the expected load on the meter. The result is similar to the time-Watts test method and depends upon reasonable knowing the applied load and upon the displayed precision of the result.

The instantaneous power value may be useful to obtain meaningful data. The value is also useful to service personnel for providing immediate data on the applied load.

4.2 Shop Test

Shop testing consists of verifying the meter's accuracy.

4.2.1 Meter Shop Equipment

The Libra meter has a capacitive type power supply designed to operate at a single nominal supply voltage. The low burden design of the Libra should be compatible with most commercially available test equipment. Meters may be tested in any shop that meets the requirements outlined in the current editions of the Handbook for Electricity Metering published by the Edison Electric Institute and the American National Standard Code for Electricity Metering.

4.2.1.1 Equipment Setup

The meter mounting equipment and its electrical connections must be used as required for the meter form number on the meter nameplate. For some test equipment, the meter test link(s) must be opened in order to isolate the meter voltage and current circuits. Refer to the instructions provided by the test equipment manufacturer to determine if this is necessary. The Libra meter is also available in non-standard forms without test-links where improved reliability and/or tamper resistance is desired.

4.2.1.2 Testing

The Watthour constant (Kh) of a meter is defined as Watthours per disk revolution. Because electronic meters do not rely on disk revolutions to measure energy, the revolutions of the disk analog, described in Section 2.3.1.2 *Digital Power Indicator,* are associated with Kh. Kh is printed on the meter label as a reference to an equivalent electromechanical meter as required by applicable meter standards.

4.2.2 Watthour Test Procedure

To test the meter, proceed as follows:

1. Note the meter Kh value listed on the nameplate.
2. Select the desired voltage and current level(s) on the test equipment. Observe the appropriate voltage and current ratings for the Device Under Test. Exceeding the device ratings can result in permanent damage to the meter.
3. Install the meter in the test socket, making certain that the socket is wired and/or configured for the appropriate meter form.
4. Align the optical pickup of the test equipment with the calibration LED.

5. Begin testing according to standard test procedures. Allow 15 seconds of setting time after applying voltage before making accuracy measurements.
6. Under typical test conditions a minimum test time of 30 seconds is needed to reduce test uncertainty to a level compatible with the accuracy of the Libra meter. Check the meter calibration under three load conditions: full load, light load, and full load with lagging power factor. (Check the instruction book for your test board or standard to determine the actual minimum test time.)

4.2.3 VArhour Testing

Libra meters are digital sampling meters. All quantities are derived mathematically from the same set of voltage and current sampled data used to compute Watthours. Therefore, it is only necessary to check Watthour calibration to ensure that all revenue quantities are accurate. However, some utilities are required by their Public Utilities Commissions to verify the accuracy of VArhour data as well as Watthour data.

1. Use MPMS software to put the meter calibration LED into VArhour pulse output mode.
2. Set up the meter for testing as described above in Watthour Test Procedure. The test pulse value is now Kt VArhours per pulse.
3. Begin testing according to your standard VArhour test procedures. Allow 15 seconds of settling time after applying voltage before making accuracy measurements (20 seconds if modem installed).

NOTE: Test conditions with high power factors require very long VArh test times. Typically VArh testing is done at 120V and 0.5 PF.

4.3 Battery Replacement

Caution: donn't need to remove meter cover but should install battery with No power applied to the meter.

1. Remove power from the meter.
2. Turn up the battery port hatch on the meter cover.
3. Reach fingers into the battery port and disconnect the old battery.
4. Remove the old battery.
5. Connect the battery wire to the connector in the battery compartment of the bezel.
6. Slide new battery into battery compartment.

7. Turn down battery port hatch and replace seal.
8. Energize the meter.
9. Reset the Accumulated Outage Duration.

4.4 Service

The Libra meter is factory calibrated and requires no routine or scheduled service by the user.

4.5 Repair

Factory repair or replacement service is offered in the event an issue is not field servicable. If a problem can't be corrected, return the whole meter to Trilliant in the following paragraph.

4.6 Returning a Meter

If you wish to return a meter, call your Trilliant sales representative for a Return Authorization. The entire meter should be returned with the Trilliant supplied Return Authorization information form completed. Key information includes quantity, catalog number serial number(s) and a complete description of the problem. Your Trilliant sales representative will provide return instructions.

4.7 Cleaning

CAUTION	*Care must be taken during cleaning not to damage or contaminate any gold-plated contacts of the connectors.*
CAUTION	***Do not immerse the meter in any liquid.*** ***Do not use abrasive cleaners on the Polycarbonate covers.*** ***Do not use chlorinated hydrocarbon or ketone solvents on the covers.***

4.8 Storage

The Libra Meter is a durable device; however, it should be handled and stored with care. The temperature and humidity levels in storage are not critical; but extremes of either factor should be avoided.

4.9 Troubleshooting Guide

Table 3-1 Troubleshooting

Symptom	*Probable Cause*	*Remedy*
No display	a. Circuit de-energized. b. Test link(s) open. c. Meter internal wiring defective.	a. Rewire according to applicable diagram. b. Check that voltage and current connectors are seated properly. Check the leads for damage. c. Replace meter.
High/low demand registration	a. Socket wiring error. b. Meter interner wiring detective. c. Detective sensor.	a. Rewire according to applicable diagram b. Check that voltage and current connectors are seated properly. Check the leads of damage. c. Replace meter.
Meter runs slow	a. Socket wiring error. b. Meter internal wiring defective. c. Defective sensor.	a. Rewire according to applicable diagram. b. Check that voltage and current connectors are seated properly. Check the leads for damage. c. Replace meter.
Meter overheats	a. Meter socket has insufficient capacity or is not adequately wired. b. Meter is overloaded. c. Poor connection at socket terminal.	a. Replace meter socket with a heavy-duty model. b. Use transformer rated installation. c. Replace socket terminal.

5.0 Installation Instructions

5.1 General

CAUTION: Do not interchange power and meter module assemblies between meters. Calibration data stored in meter is particular to a matched power and meter module. Interchanging these components causes the meter to lose calibration. The meter should never be disassembled. Failure to observe this practice can result in serious injury or death.

This chapter of the guide give instructions for the proper handling and installation of the Libra meter.

5.2 Inspection

Perform the following inspections when you receive the meter:

- ✧ Inspect for obvious damage to the cover, base, and meter assembly.
- ✧ Be sure the optical connector is free of debris.
- ✧ Compare the meter and register nameplates to the record card and invoice. Verify the type, class, voltage, form number, and other pertinent data.
- ✧ Save the original packing materials.

5.3 Storage

Store the meter in a clean, dry (relative humidity < 50%) environment between -40℃ to +85℃ (-40℉ to +185℉). Avoid prolonged storage (more than one year) at temperatures above +70℃ (+158℉). Store the meter in the original packing material.

5.4 Unpackiing

As with all precision electronic instruments, the meter should be handled with care in an outdoor environment. Follow these precautions when handling the meter:

- o Avoid damaging the meter base, cover, reset mechanism (if supplied), and optical connector (if supplied).
- o When handling personality modules, grip the circuit board by its edges. Do not touch the liquid crystal display.

5.5 Selecting a site

The meter is designed and manufactured to be installed in an outdoor environment, at operating temperature ranges between -40℃ to +85℃ (-40℉ to +185℉). Operation in moderate temperatures increases reliability and product life.

5.6 Meter installation

The meter is plugged into a meter socket using standard meter installation practices. The meter base has current and terminals extending outside from the back of the meter. These terminals engage with the socket jaws, which are connected to the service lines. The socket jaws provide heavy contact force with the help of spring. In some heavy-duty sockets, contact force is provided by a handle or wrench.

On powering-up the meter, verify meter operations by observing the display:

- For the first 3 seconds, the LCD display All Segment Test (all display items shown). If this all segment display is continued after 3 seconds then there is possibly an error in the installation wiring.
- LCD display the software version of the meter for 1 second.
- After that, LCD displays the number of digits for Energy.
- Verify the expected direction of energy flow on the display Annunciator.

Appendix A: Product Specifications

Item	Specifications	Others
Power Requirements	Voltage Rating: 120V to 480V Current: 0 to class amperes Frequency: 60Hz,50Hz	Operating Voltage: 57V to 600V Operating Range: ±3Hz
Operating Environment	Temperature: -40° to +85°C Humidity:0%~95% non-condensing	Inside meter cover
Transient /Surge Suppression	ANSI C37.90.1-1989 IEC 61000-4-4 ANSI C62.41	2.5kV, 2500 strikes 4kV, 2.5 kHz repetitive burst for 1min 6kV at 1.2/50 us, 10 strikes
Accuracy	ANSI C12.20 - 0.2 Accuracy Class	
LCD Display	Six-digit Liquid Crystal Display Data Digit Height: 0.4”	Annunciator Height: 0.088” Electronic Load Indicator
Primary time base	Power line frequency (50 Hz or 60 Hz), with selectable crystal oscillator	
Secondary Time base	Meets the ANSI limit of 0.02 % using the 32.768 kHz crystal. Initial performance is expected to be equal to or better than ±55 seconds per month at room temperature	
Power supply burden	Less than 5W	Per phase current burden: 0.1 mOhm typical at 25°C Per phase voltage burden: 120V 0.008W 240V 0.03W 480V 0.04W
Starting current	5mA for Class 20 50mA for Class 200 80mA for Class 320	Creep 0.000A, no more than one pulse measured per quantity, conforming to ANSI C12.1 requirements
Outage carryover capacity	6 hours at 25 ° C. Super capacitor rated at 0.1 Farads, 3.3V	

Battery (optional)	Li-SOCl2 battery rated 1000 mAhr, 3.6 V and shelf life of 10+ years. 5 years continuous duty at 25 ° C
AMR rate	Optical port: 1200bps Remote port: 9600bps
Temperature Rise Specifications	Meets ANSI C12.1 Section 4.7.2.9