



**I-210+ Electronic Meter
User Manual**

132265-TUM
Revision 1
www.Aclara.com

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FCC COMPLIANCE



This product generates and uses radio frequency energy. It has been tested and verified that it complies with the limits for the Code of Federal Regulations (CFR) 47, Part 15 - Radio Frequency Devices, Subparts A - General and B -Unintentional Radiators issued by the Federal Communications Commission for Class B digital devices. If, however, the product causes radio or television interference, notify:

Manager - Technology
Aclara Technologies
130 Main Street
Somersworth, NH 03878-3194

Class A equipment is intended for use in an industrial environment. The equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with these instructions, may cause interference to other devices in the vicinity. If this equipment does cause interference with other devices, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving device.
- Increase the separation between the equipment.
- Connect the equipment into an outlet on a circuit different from the impacted device(s).
- Consult the manufacturer or field service technician for help.

Class B equipment is intended for use in a residential environment. The equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interferences to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from the receiver.
- Consult the dealer or an experienced ration/TV technician for help.
- All meters mentioned in this manual meet requirements for FCC Class B devices.
- All meters mentioned in this manual meet requirements for ICES-003 Class B devices.

WARNINGS AND CAUTIONS



 **DANGER**

Electrical equipment contains hazardous voltages. May cause death, serious personal injury or equipment damage.

Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Aclara reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawing or supplementary material or both, the latter shall take precedence.

The equipment in this manual must be operated only from the power source specified.

The successful operation of this equipment depends upon proper handling, installation, and operation. Neglecting fundamental installation requirements may lead to personal injury as well as damage to electrical equipment or other property.

All electronic components within the meter are susceptible to damage from electrostatic discharge. To prevent damage when handling this product use approved static control procedures.

Hazardous voltages can cause shock, burns or death. To prevent exposure to hazardous voltages, disconnect and lock out all power sources before servicing and removing components.

If the meter is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.

Unauthorized changes or modifications made to the unit could void the warranty.

QUALIFIED PERSON

For the purpose of this manual, a qualified person is one who is familiar with the installation, configuration, or operation of the equipment and the hazards involved. In addition, the person has the following qualifications and is trained:

- and authorized to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety procedures.
- in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc. in accordance with established safety practices.

in rendering first aid. Any work on or near energized meters, meter sockets, or other metering equipment presents the danger of 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 procedures.

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INTRODUCTION

The purpose of this document is to provide qualified metering personnel with product description; operating, maintenance, and upgrading instructions, site analysis guides, and diagrams for the I-210+ and I-210+n network meter family. 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 of 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 procedures.

Support

If you have a questions, an issue, or would like to speak with Aclara's Support personnel, please contact Aclara using one of the following methods.

Technical Support

Email support@aclara.com or call 1-800-892-9008 to speak with an Aclara representative.

Returning Product

To return product, email rma@aclara.com or call 1-800-892-9008.

PRODUCT DESCRIPTION

The I-210+ is a solid-state electricity meter designed to measure energy in residential and commercial applications that are wired for single-phase ANSI form 1S, 2S, 3S, and 4S services. The I-210+n meter, the functional equivalent of the I-210+, contains additional circuitry to support poly-phase residential (3-Wire Y Network) applications wired for ANSI 12S and 25S meter forms. The I-210+ and I-210+n are configured for single-voltage applications up to 240 V_{RMS}.

The I-210+ product family is designed to work with a broad range of third-party AMR / AMI systems encompassing all types of unidirectional and bi-directional communications media. The modular meter design allows utilities to integrate a range of AMR choices to suit each application's requirement inside a standard metering platform. The I-210+ and I-210+n are available with an internal connect-disconnect relay option within the same meter height and form factor.



The I-210+c meter provides a wide range of features, including the following:

- An extended range of software configurable features softswitches expand the functionality of the meter. (Please refer to *Softswitches* on page 25 for more information.)
- Alphanumeric display
- Standardized meter reading (ANSI C12.18) and programming (ANSI C12.19)
- Improved MeterMate™ support for the I-210+ expands shop configuration of the meter operating and display parameters.
- A Programmable Transformer factor display item
- Separate accumulators for each detenting mode supports net metering applications with different delivered and received energy pricing.

Physical Description

The I-210+ meter is furnished with a standard UV stabilized polycarbonate cover. The sides of the cover are designed to be reflective to minimize solar heating and obscure the internal components of the meter. Other cover options are available on request.

The meter base assembly contains current sensing CTs and the necessary potential connections to configure the meter for specific applications. The meter base configuration is set in the factory and not designed for field modification (except for 5th terminal location). The I-210+ is available with optional potential test links in forms 2S and 12S.

The Liquid Crystal Display (LCD) indicates energy consumption and optionally instantaneous demand or voltage on the lower three-digit informational display. The display is soldered directly to the meter circuit board for high reliability. The display features are covered in detail

AMR options may be installed on a supporting plastic bridge which mounts into the meter base, or they may be mounted in the Nameplate Carrier itself, depending on the size and construction details of the specific option.

A configuration port is located at the 3 o'clock position of the meter face. The port is used in conjunction with a reset adapter that mounts over the cover and MeterMate software (version 5.41 or greater) to reset accumulated energy to zero. The port is intended for factory or shop use and is not designed for use in direct sunlight. (Please see *Configuration Port* on page 19 for more information.)

Operating Range and Ratings

The operating attributes along with their values are listed in the following table:

Attribute	Value
Voltage	120/240V (±20%)
Operating Temperature (under the cover)	-40°C to +85°C
LCD Operating Temperature	-30°C to +80°C
Storage Temperature	-40°C to +85°C
Relative Humidity	95% non-condensing
Frequency	50 or 60Hz
Power Consumption (excluding modules)	<0.7 watts
Accuracy	Class 0.5 per ANSI C12.20, but typically
Current	Class 20, Class 100, Class 200, Class 320
Enclosure	Durable UV stabilized polycarbonate

Meter Forms

The I-210+ meter is available in several variant forms, which can be selected depending upon the application. The ANSI Standard S Base (socketed) Meter Forms are shown in the table below.

Form	Wires	Circuit	Elements	SC/TR	Class	Voltage
1S	2	1Ø	1	SC	100	120
1S	2	1Ø	1	SC	100	240
2S	3	1Ø	1	SC	100	240
2S	3	1Ø	1	SC	200	240
2S	3	1Ø	1	SC	320	240
3S	2	1Ø	1	TR	20	120
3S	2	1Ø	1	TR	20	240
4S	3	1Ø	1	TR	20	240
12S	3	Network	2	SC	200 or 320	120/208
12S	3	3Ø	2	SC	200 or 320	240
25S	3	Network	2	SC	200 or 320	120/208

ANSI Standards

The performance of the I-210+ meter meets or exceeds the following industry standards: ANSI C12.1, C12.10, C12.20, and all standards incorporated by reference.

Physical Variants Available

The table below provides information regarding the test constants and starting watts for each configuration.

Form	Class	Volt	Kt	Kh	TA	Starting Watts
2S	320	240	2	20	50	5.184
2S	200*	240	1	10	30	3.24
2S	100*	240	0.5	5	15	1.62
1S	100*	240	0.5	5	15	1.62
1S	100	120	0.25	2.5	15	0.81
3S	20	240	0.1	1	2.5	0.324
3S	20	120	0.05	0.5	2.5	0.162
4S	20	240	0.1	1	2.5	0.324
12S	320	120/208	2	20	50	1.62
12S	200*	120/208	1	10	30	1.62
12S	200*	100/200	1	10	30	1.62
12S	200	240	1	10	30	1.62
12S	320	240	2	20	50	1.62
25S	320	120/208	2	20	50	1.62
25S	200*	120/208	1	10	30	1.62

Self-contained forms are available with disconnect switch as a factory option.

Metering Mode

The I-210+ meter accumulates and displays kWh. The I-210+ meter provides various features, some of which are configurable at the factory.

- kWh energy measurement is accumulated in four ways. One of the accumulation types must be selected for display. The other accumulators are available to be read optically or via a suitable AMR/AMI system.

Received Only	Only the received energy is accumulated as a positive quantity
Delivered Only	Only the delivered energy is accumulated
Delivered + Received	The received and delivered energy are added together
Delivered - Received	The net energy is accumulated

- Display of Energy, configurable for four or five digits
- Disk Analog functionality on LCD - The disk analog is simulated on the display as explained in Chapter 3, *Operating Instructions* on page 11.
- Delivered and Received indicators on LCD
- Factory settable option of Instantaneous Power or AMR demand may appear on the LCD. The S₂ softswitch must be enabled and an appropriate AMR module must be used for the AMR demand feature.
- Factory settable option of Instantaneous RMS voltage may appear on the LCD. The V₂ softswitch must be enabled.
- I-210+™ Electronic Meter – User Manual 13
- Optional segment check in display scroll (in addition to the segment check that is performed on power up and every 24 hours)
- Reset energy to zero in field - The customer can reset the energy accumulation to zero on site with MeterMate Software and a reset adapter.

On-Site User Features

The I-210+ meter has many features intended for ease of use on site.

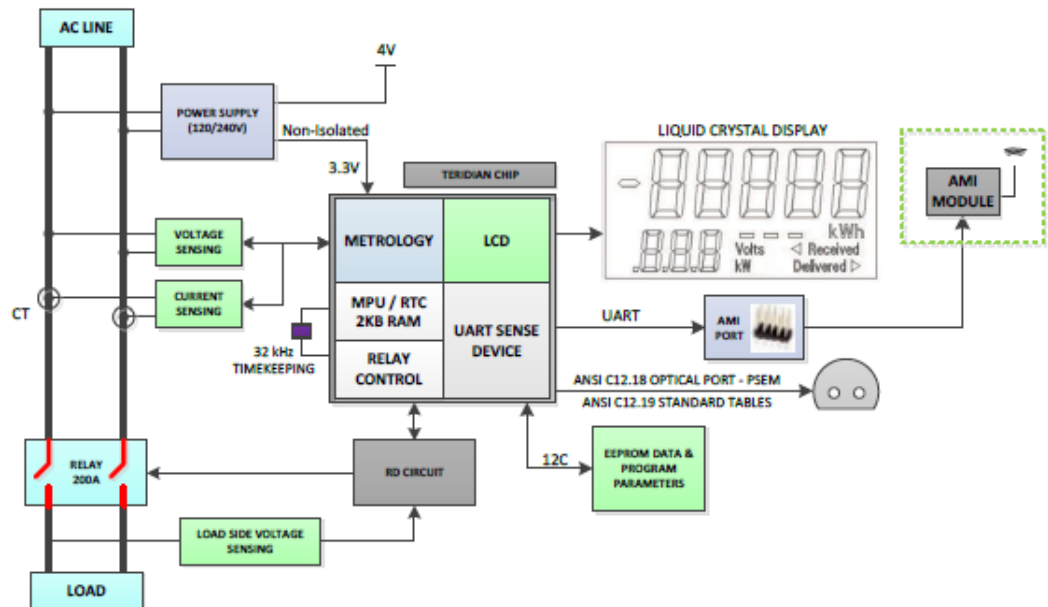
Operation

- Nameplate and label information
- Five digit alphanumeric display with key annunciators
- Instantaneous RMS voltage
- Instantaneous demand
- Service error caution

These features are described in detail in Chapter 3, *Operating Instructions* on page 11.

Theory of Operation

This section contains the general circuit configuration of the I-210+ meter. The theory of operation is described in conjunction with the following block diagram.



Sensing Devices

Voltage is measured through a high impedance resistive voltage divider network. Load current is converted to a scaled voltage signal by precision Current Transformers. The scaled signals are inputs for the analog front-end of the metering circuitry.

Metering and Reading of Data

The Meter chip contains a fully integrated analog-to-digital converter that samples the scaled-down current and voltage signals. The meter chip integrates the product of voltage and current over small intervals and accumulates the energy value in a register.

The meter chip also contains an 8-bit microcontroller. It reads the accumulated energy at defined momentary intervals from the meter chip and calculates the energy consumption to be displayed. It uses non-volatile memory to store the metered data and critical metering parameters.

Nonvolatile Memory

The I-210+ meter is equipped with 256 bytes of nonvolatile EEPROM memory device. It is used to store the metered data, calibration parameters, and configuration constants. Meter data quantities are updated at each power fail event. Stored data includes error-detection provisions. The non-volatile memory does not require a battery to retain information when line power is not present.

Power Supply

The I-210+ meter is powered from the AC main voltage of 120 V or 240 V for single phase ANSI forms 1S, 2S, 3S, and 4S and 100 V, 120 V, or 240 Volt for polyphase ANSI 12S meter forms. It has an operating range of $\pm 20\%$ of nominal rating. It is a wide range solid-state switching type power supply; however, the meter is configured for use at a specific nominal voltage rating.

AMR Interface

The meter has a ten-pin header (2x5 pin connector) that can be used to interface with various AMR modules. Power and data signals allow an AMR device to operate and retrieve metering data through this interface. The interface scheme supports four different data communication methods and must be configured to match the installed AMR device requirement.

Use of unlisted AMR/AMI modules shall result in voided warranty as Aclara can no longer guarantee the safety and integrity of the product.

Disconnect Switch

The meter can be equipped with an optional under the cover 200A disconnect switch in the same form factor.

Remote Disconnect Features

The Remote Connect/Disconnect (RCDC) feature provides the means to disconnect the load side terminals from the line side terminals by activating a switch that is controlled by the meter. This can be used for applications such as Pre-Payment Metering (PPM), Emergency Conservation Periods (ECP), Demand Limiting Periods (DLP), and Outage Management. The RCDC feature provides the means to connect or disconnect service with direct switch commands. Presence of load side voltage will be detected, and service will not be reconnected (the RCDC switch will not be closed) while load side voltage is present.

The load control modes and direct switch commands share control of the RCDC switch. The RCDC function can be in one of the following states (listed from highest to lowest priority):

- Locked open,
- Locked closed,
- Armed for manual closure,
- Opened and held open,
- Open due to outage management,
- Open due to load control service disconnect,
- Closed with service connected.

If the meter detects load-side voltage, the actual switch state will remain open until load side voltage is no longer detected.

The softswitches associated with the RCDC feature, which provide additional load limiting features, are reference in *Softswitches* on page 25.

Outage Management and Restoration

The outage management function enables meter to open the closed switch in an event of outage. Note that the meter does not enter into outage open mode, if the switch was already open, before the outage occurred. The meter can be programmed to reconnect the switch, after restoration of power.

Enabling Outage Management and Restoration in I-210+

The meter supports two programmable options to restore the connection by turning the switch on:

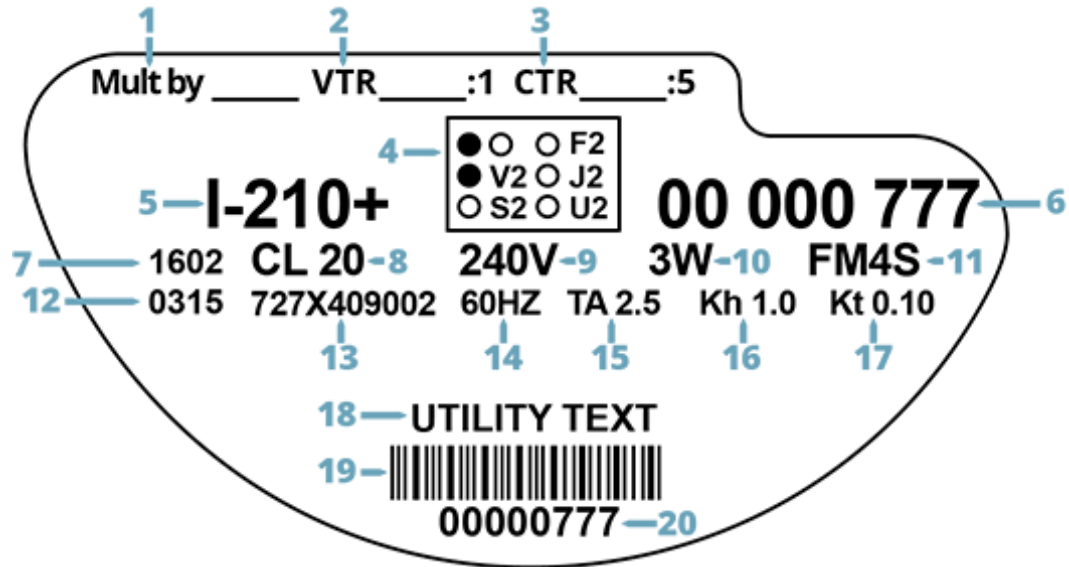
- Immediately after the power is restored.
- Wait for a predefined time before turning the switch on.

OPERATING INSTRUCTIONS

This section provides operational information.

Nameplate Label Information

The meter nameplate is found on the front of the meter.



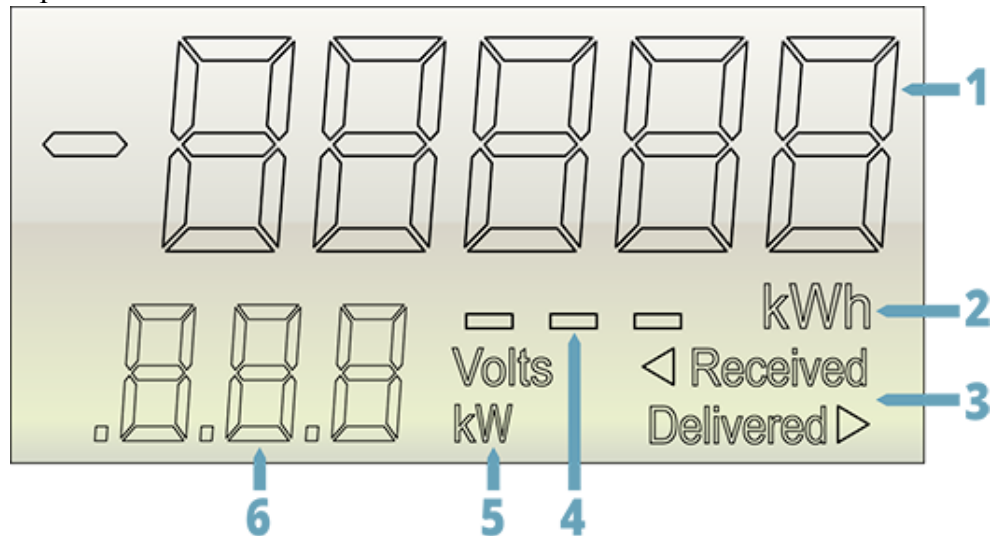
The following numbered list coincides with the numbers in the figure above:

- | | |
|--------------------------------|---------------------------------|
| 1. Multiply by Constant* | 11. ANSI C12.10 Form Number |
| 2. Voltage Transformer Ratio* | 12. Month & Year of Manufacture |
| 3. Current Transformer Ratio* | 13. Catalog Number |
| 4. Softswitch Selection Box | 14. Nominal Frequency |
| 5. Meter Model | 15. Test Amperage |
| 6. Meter Serial Number | 16. Watt-hour Constant |
| 7. Hardware & Firmware Version | 17. Watt-hour Test Constant |
| 8. Current Class | 18. Utility Text |
| 9. Nominal Voltage | 19. AMR Barcode |
| 10. Wires for Meter Service | 20. AMR Identifier |

* For Forms 3S and 4S only.

LCD Information

The LCD indicates not only the energy consumption but also a host of parameters that make on-site inspection of meters simple and fast. The LCD is shown below. Each indicator on the display is named in the list below followed by detailed explanations.



- 1 Billing Data Display
- 2 kWh Annunciator
- 3 Received / Delivered Annunciator
- 4 Disk Analog Blocks
- 5 Volts/kW Annunciator
- 6 Three-Character Display

Billing Data Display

The kWh energy value along with the kWh annunciator is displayed during normal operation.

Error is displayed if the meter detects an error that could affect the metering data.

The kWh will show an 8 for all characters, along with the kWh annunciator and the minus sign to the left of the kWh display when the optional segment check is enabled.

dnLod is displayed if the meter is in firmware download mode.

UnCFG is displayed if the meter is unconfigured. Meters in this state should be returned to the factory for replacement.

kWh Annunciator

This appears when the Billing Data Display is showing kWh.

Received / Delivered Annunciator

These indicators show whether the energy is being delivered to or received from the premise.

Disk Analog Blocks

The indicators show the percentage of energy accumulated in comparison to the Kh value.

Volts/kW Annunciator

These indicators show whether the three-character display in the lower left of the LCD is Volts or kilowatts.

Three-Character Display

This area shows the following informational and diagnostic information:

If enabled, instantaneous power is displayed during the normal operation.

If the V_2 softswitch is selected, then the instantaneous voltage can also be displayed.

The decimal point indicator is active when values of instantaneous power are displayed. The auto-ranging kW value will be scaled to show the maximum available precision in one of the following formats:

	.XXX	X.XX	XX.X
<i>Err</i>	This indicates that there was an error detected during the self-test operation.		
<i>SEr</i>	This indicates that a service application error was detected.		
<i>OPt</i>	This is displayed during optical communication.		
<i>AdI</i>	This is displayed while AMI NIC is communicating with the meter.		
<i>oN</i>	This is displayed when the disconnect switch is on.		
<i>oFF</i>	This is displayed when the disconnect switch is off.		
<i>LoU</i>	Indicates that load-side voltage is detected.		
<i>dC</i>	Indicates that DC voltage is detected.		

NOTE: The DC Detect feature is not recommended, and therefore it should be disabled.

Normal LCD Characteristics

In Normal Display mode, the meter display is always visible. Normal Display items are selected by the customer at the time of ordering the meter and are loaded into the meter at the factory.

The display segments are illuminated when the meter powers up and every 24 hours when the meter stores information to NVRAM. All of the annunciators are illuminated and eight is displayed in each of the kWh display positions.

Energy (kWh)

The I-210+ displays the energy accumulated in the top row of the LCD. The customer has an option, at the time of ordering, to select four or five digit display of the accumulated energy. This option can only be set at the factory. The LCD also has an annunciator, kWh, (under the kWh display and to the right) which is displayed whenever energy is indicated. The energy display is refreshed every five seconds.

Transformer Factor

The I-210+ meter can also store and utilize a transformer factor (TF). The default value for TF is 1. The TF value impacts the energy and demand values that are displayed on the LCD. For example, the energy displayed on the LCD is the product of the energy accumulated by the meter times the TF. This is frequently referred to as a primary reading. The TF is calculated by multiplying the current transformer ratio (CTR) by the potential transformer ratio (PTR).

Accumulation Mode

The meter accumulates energy in four detenting modes. Only one of these accumulators may be selected for the displayed energy quantity at a time. The displayed accumulation depends on the energy direction and the accumulation mode that is selected.

Delivered + Received Energy:

The magnitude of the delivered energy and received energy are added together. This mode of operation is known as unidirectional because the meter registration will always be positive, regardless of the direction of energy flow. This accumulation mode may deter tampering by meter inversion. This mode is enabled by default if the accumulation mode is not specified when the meter is ordered.

Delivered Only Energy:

Only delivered energy is accumulated. Received energy is not accumulated.

Received Only Energy:

Only received energy is accumulated as a positive quantity. Delivered energy is not accumulated.

Delivered - Received Energy:

The received energy is subtracted from the delivered energy. This mode of operation is often referred to as net energy.

NOTE: The first three modes of operation always have a positive accumulation. The displayed kWh never decrements and it cannot underflow zero.

Instantaneous Power

The I-210+ can be configured to display instantaneous power in the lower row of the LCD. This value is refreshed every second. The customer has an option of whether the meter should display instantaneous power or not. The Instantaneous Power has a real time indicator, kW, which is displayed whenever the instantaneous power value is displayed. The instantaneous power display is auto-ranging to display the most appropriate precision for the current load conditions.

Instantaneous Voltage

The I-210+ can be configured to display instantaneous voltage in the lower row of the LCD. This value is refreshed every second. The Instantaneous Voltage has a real time indicator, Volts, which is displayed whenever the instantaneous voltage value is displayed. The customer has an option of whether the meter should display instantaneous voltage or not. The V₂ softswitch must be enabled in order to display this item.

Segment Check

The I-210+ can also be configured to display a segment check. When configured to do so, the kWh value and the segment check alternate on the top row of the LCD. Each of these items is displayed for a fixed number of seconds (4 seconds in US and 6 seconds for customers in Canada). The display is blank for 0.5 seconds in between these two items. The following display items are illuminated for the segment check:

- eights in the kWh display
- the minus sign (-) in front of the kWh display
- and the kWh annunciator

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 arrows combined with the textual indicators Received and Delivered indicate whether the energy accumulated is delivered to the load or received from the load. The right pointing arrow will illuminate when energy accumulation is positive (delivered) along with Delivered text. The left pointing arrow will illuminate when the energy is negative (received) along with Received text. If the energy is not above the anti-creep threshold, both indicators will be displayed without any text.

MAINTENANCE

The I-210+ meter is designed for unattended operation over a long life. When the meter or the site requires attention, the meter has features to facilitate the following tasks:

- Enabling various modes of operation and enhanced functions already built into the meter software.
- Displayable disk analog, instantaneous power, and RMS voltage capabilities, for field calibration and testing.
- Application verification through limited site diagnostics.

This section provides information to aid qualified personnel when testing or troubleshooting a meter.

Meter Accuracy Testing

The I-210+ meter includes provisions to verify the accuracy of calibration.

Test Mode

The I-210+ meter does not provide an independent test mode. Energy measured during meter tests is accumulated normally.

Configuration Port

The optical configuration port is intended primarily for use in a controlled indoor environment and is not shielded from ambient light. Bright light conditions may interfere with field operation of the port. If field operation is required, a cover with a shielded optical port is recommended.

Calibration

The meter is equipped with an infra-red light-emitting diode (IR- LED) for calibration and a LCD with disk analog and test displays. The calibration IR-LED is part of the configuration port as shown in the figure below.

The Configuration Port LED emits calibration pulses of infrared light unless the meter detects the presence of OPTOCOM communications. Each calibration pulse is equal to the value assigned to Kt (watt-hours). The duration of each output pulse is approximately 25 milliseconds. The pulses are intended to be compatible with the optical pickups provided by most watt-hour meter test equipment manufacturers.

Disk Analog Testing

The disk analog provides a manual 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 accurately time the switching of the standard.

Refer to *Real Time Watt Hour Disk Emulator* on page 17 for detailed understanding of the disk analog operation feature.

For this test you need a portable standard with a start/stop switch. Field testing using the disk analog allows you to check the calibration of the meter without having to install a phantom load.

1. Confirm the correct form of meter is used for a given socket.
2. Connect the portable standard to the meter.
3. Reset the standard.
4. Observe the disk analog. Each cycle of the disk analog represents Kh Watt hours of accumulation. (The Kh value is printed on the meter nameplate.)
5. When the disk analog transitions from all segments on to all segments off, start the standard.
6. Let the disk analog scroll a predetermined number of times (two, for example).
7. Stop the standard when the disk analog transitions from all segments on to all segments off for the desired number of times.
8. Calculate the accumulated watt-hours as shown in the following equation.
Accumulated Energy = (Kh) × (the number of complete disk analog cycles)
E.g. If: Kh equals 10 and 2 complete cycles were counted
Then: (10 Wh) × (2 complete scroll cycles) = 20 Wh.
9. Compare the results of the calculation to the reading on the standard.

Meter Instantaneous Power Testing

When enabled, the I-210+ displays instantaneous power with the kW indicator in the lower row of 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 reasonably knowing the applied load and upon the displayed precision of the result. Because the display is auto-ranging, at low loads the displayed precision can differentiate a load variation of a few watts of power. The instantaneous power value may be useful in resolving customer questions about meter performance since no computation is necessary to obtain meaningful data. The value is also useful to service personnel for providing immediate data on the applied load.

Shop Testing

Shop testing consists of verifying the meter's accuracy.

Meter Shop Equipment

The meter loading equipment must be capable of maintaining accuracy while supplying energy to the meter's broad range switching power supply. Otherwise, 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.

Test Constant

The meter test constant (Kt) is the number of watt-hours per optical calibration pulse.

Watt-Hour Test Procedure

To test the meter, proceed as follows:

1. Note the meter Kt value listed on the nameplate.
2. Select the desired voltage and current level(s) on the test equipment.
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 settling time after applying voltage before making accuracy measurements (20 seconds if modem installed).
6. Check the meter calibration under three load conditions: full load, light load, and full load with lagging power factor. A minimum test time of 30 seconds is needed to reduce test uncertainty to a level compatible with the accuracy of the I-210+ meter. (Check the instruction book for your test board or standard to determine the actual minimum test time.)

Service

The I-210+ meter is factory calibrated and requires no routine or scheduled service by the user.

Repair

Factory repair or replacement service is offered when you cannot fix a problem. Because of the high density and integrated design, the repair of on-board components is not recommended. Instead, return the whole meter as described in *Returning Product* on page 1.

Cleaning

- During cleaning, take care to avoid damaging or contaminating any gold-plated contacts of the connectors.
- 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

Storage

The I-210+ Meter is a durable device; however, temperature extremes (below -40C or above +85C inside the meter cover) should be avoided.

Errors and Cautions

The meter performs self-tests periodically. These self-tests are performed when the meter powers up, and once every 24 hours thereafter. The current metering data is stored to non-volatile memory (NVRAM) prior to performing the periodic self-test. If the meter detects an error it will repeat the self-test every minute in order to attempt to recover from the condition causing the error. If the conditions causing the error clear, the meter will resume metering.

If an error occurs, the meter will display *Error* in the primary display along with the kWh value at the time the error occurred. The kWh value and *Error* will alternate on the display with a three second display time. The alternate display will also indicate *Error* continuously.

The disk analog display and the energy direction display will not be operational and the meter will not accumulate energy when an error is present.

An error display indicates a fault in an electronic subsystem of the meter and indicates a condition that is not user serviceable. The meter must be returned to the factory for service.

Caution	Description
Received kWh	This flag is set when energy flows from load to line for two minutes (120 consecutive seconds). It will be cleared when energy flow is from line to load or below creep for 2 consecutive minutes.
Meter Inversion	If the direction of energy flow is stable for two minutes, then the meter stores the direction of energy flow in NVRAM during power fail. If the direction of energy flow changes from the time a meter powers down to the time it powers up, the inversion caution flag is set.
DC detection	If enabled this flag is set when Meter detects the DC presence. NOTE: Use of the DC Detection feature is not recommended, and therefore it should be disabled.
Error	Description
Service Error	Set if a 12S is installed in a 1S or 2S socket or if a 1S or 2S meter is installed in a 12S socket.
Meter Error	Meter chip error
NVRAM CRC	The CRC for ST85, ST86, MT20, or MT21 is wrong, indicating that data is corrupted.
NVRAM I2C	EEPROM interface not functioning. No data can be read from or written to NVRAM.

Troubleshooting

Symptom	Probable Cause	Remedy
High/low Momentary kW display	Socket wiring error.	Rewire according to applicable diagram.
	Meter internal wiring defective.	Check the voltage and current connectors are seated properly. Check the leads for damage.
	Defective sensor.	Replace meter.
Meter overheats	Meter socket has insufficient capacity or is not adequately wired.	Replace meter socket with a heavy-duty model.
	Meter is overloaded.	Change to transformer rated installation with correctly sized CTs.
	Poor connection at socket terminal.	Replace socket terminal.
Meter runs slow	Socket wiring error.	Rewire according to applicable diagram.
	Meter internal wiring defective.	Check that voltage and current connectors are seated properly. Check the leads for damage.
	Defective sensor.	Replace meter.
No display	Circuit de-energized.	Check circuit voltages
	Test link(s) open	Close test links.
	Meter internal wiring defective	Check the voltage leads are properly connected. Also check the wires for damage
Error message on display	Meter detected an internal condition that may affect the meter data.	Replace the meter and return to factory for service.

CHAPTER

5

UPGRADING

This section covers the internal features available for an I-210+ meter, along the AMI modules that are available for the I-210+.

Softswitches

The I-210+ meter offers a set of features which are disabled by default. The I-210+ upgrade features can be individually enabled, either in the factory before shipment or after receipt by a customer, through a mechanism referred to as a softswitch. A softswitch feature may subsequently be disabled, for example to allow the customer to reuse the softswitch when a meter is replaced or moved.

MeterMate is required to upgrade or downgrade the softswitch. If any unsupported softswitches are set, the meter shall clear all of the softswitches. The softswitch features supported in the I-210+ are:

Softswitch	Description
O	AMR Communication
V ₂	Voltage Event Monitoring
S ₂	AMR Demand
F ₂ *	Emergency Conservation Demand Limiting Function
J ₂ *	Demand Limiting Function
U ₂ *	Prepayment

*Available only when the internal disconnect switch is installed (unavailable in Meter forms 12S/25S).

O: Communication

The O softswitch enables AMR communication. After installing the O softswitch, the meter will support one of the following communication types: PSEM, SPI-1, SPI-2 or quadrature pulse. Default AMR communication type is AMR PSEM.

V₂: Voltage Event Monitoring

Sags and swells are the most common types of power quality disturbances. The I-210+ meter counts both sag and swell events. A swell is the presence of line voltage above the nominal voltage for a defined period of time. A sag event is the presence of line voltage below the nominal voltage for a defined period of time. The I-210+ meter has two programmable thresholds for Swell and Sag voltage and one programmable threshold for the duration. When enabled, the user can also elect to display V_{RMS} on the three segment display on the bottom left of the LCD (see *LCD Information* on page 12).

S₂: AMR Demand

This softswitch enables an AMR module that calculates demand and uses PSEM communication to write that demand value to the display of the I-210+ meter. If this feature is enabled, the instantaneous demand that is available from the I-210+ meter will not be available.

F₂: Emergency Conservation Demand Limiting

The Emergency Conservation Demand Limiting function provides a means to enforce an emergency conservation policy for all residential customers. This establishes a maximum demand that customers will be allowed during the conservation period.

J₂: Demand Limiting Function

In the event of non-payment during a period of time when government restrictions prevent termination of service, the Demand Limiting function switch may be implemented to limit the customer demand to the minimum level necessary to maintain basic heating or cooling and other safety needs. The Demand Limiting function enforces such a limit remotely.

U₂: Pre-Payment Management (PPM)

With a remote connect/disconnect switch and a two-way AMR system, it is possible to implement a prepayment metering system using online services or call centers, with no direct interaction with the meter required.

AMI Modules

The supported AMI communications modules for the I-210 + meter are listed in the table below:

AMI Technologies	Type
Aclara TWACS® (UMT-R)	PLC
Aclara Synergize® RF	RF P2MP
Itron (54ESS ERT®)	RF (AMR), 900 MHz
Itron (55ESS ERT®)	RF (AMR), 900 MHz
Itron (56ESS ERT® High Power)	High Power RF (AMR) 900 MHz
Silver Spring Networks® (NIC 310)	RF Mesh, 900MHz
Trilliant (SecureMesh™)	RF Mesh, 2.4 GHz
Trilliant (RPMA)	RF P2MP

CAUTION Do not interchange base and electronics module assemblies between meters. Calibration data stored in the meter is particular to a set of current sensors and electronics module. Interchanging these components causes the meter to lose calibration and revert to an unconfigured mode which is indicated by **UncFG** on the LCD.

Dominican Republic Models

The following models with integrated communication modules are available only in the Dominican Republic.

Aclara

I-210+ models with integrated Aclara communication modules:

Standard Meter Form	Backhaul Technology	Internal Connect/Disconnect	Model
1S	TWACS	No	1SATDR
1S	TWACS	Yes	1SDTDR
1S	Synergize RF	No	1SARDR
1S	Synergize RF	Yes	1SDRDR
2S	TWACS	No	2SATDR
2S	TWACS	Yes	2SDTDR
2S	Synergize RF	No	2SARDR
2S	Synergize RF	Yes	2SDRDR
4S	TWACS	No	4SATDR
4S	Synergize RF	No	4SARDR
12S	TWACS	No	12SATDR
12S	TWACS	Yes	12SDTDR
12S	Synergize RF	No	12SARDR
12S	Synergize RF	Yes	12SDRDR

Trilliant

I-210+ models with integrated Trilliant RPMA communication modules:

Standard Meter Form	Backhaul Technology	Internal Connect/Disconnect	Model
1S	RPMA	No	1SNPMDR
1S	RPMA	Yes	1SPMDR
2S	RPMA	No	2SNPMDR
2S	RPMA	Yes	2SPMDR
4S	RPMA	No	4SNPMDR
12S	RPMA	No	12SNPMDR
12S	RPMA	Yes	12SPMDR

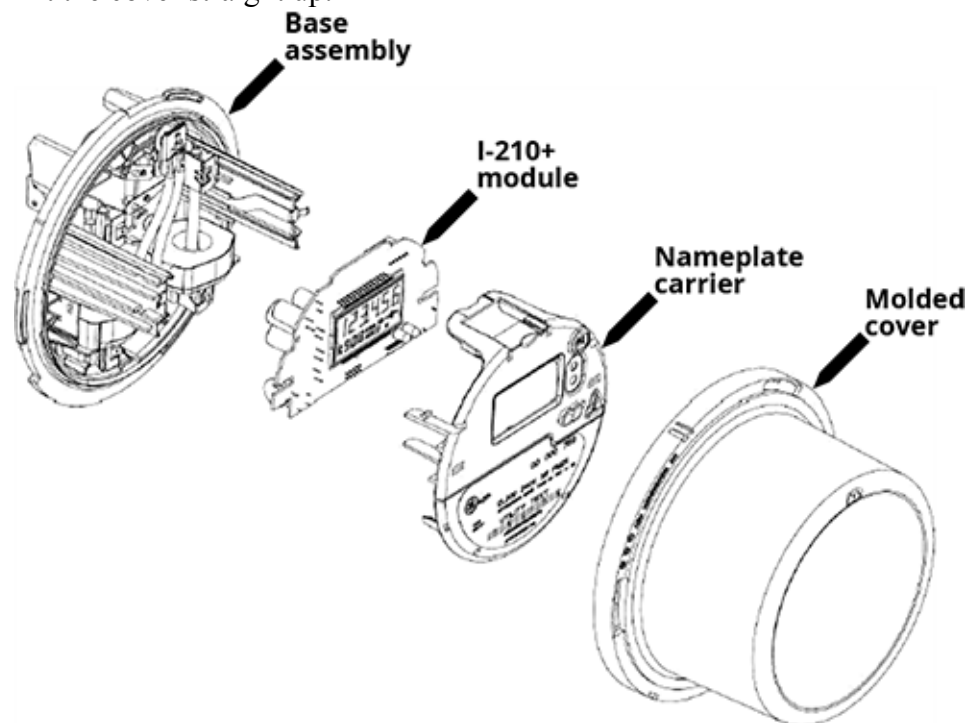
Meter Disassembly

Use the procedures in the following sections to disassemble and reassemble the meter.

Meter Cover Removal

Remove the meter cover as follows:

1. Remove the security seals from the side of the meter, if present.
2. Turn the cover counterclockwise approximately 30 degrees.
3. Lift the cover straight up.



I-210+ Module Removal

1. Disconnect the CT connector from the socket on the electronics module.
2. Grasp the snaps on either side of the nameplate carrier between the thumb and index finger and press them together to release them from the notches on the base posts. It may be easier to unclip one side at a time. Ensure all four snaps are disengaged and lift the module assembly off the base.
3. Place the module on a flat, clean, cloth-covered surface with meter face down.

CAUTION Do not pull on the wires to disengage the connectors. Pull only on the connectors.

AMI Module Installation

To learn more about the various modules compatible with the I-210+ and I-210+n meter and how to install those modules, please contact the module supplier for the appropriate integration documentation.

CAUTION Do not interchange base and electronics module assemblies between meters. Calibration data stored in the meter is particular to a set of current sensors and electronics module. Interchanging these components causes the meter to lose calibration and revert to an unconfigured mode which is indicated by **UnCFG** on the LCD.

Meter Reassembly

1. Carefully align the module over base assembly posts and push down firmly to engage all four snaps on the post undercuts.
2. Connect the CT sensor connector to the socket on the electronics module.
3. Replace the cover by aligning it with the openings in the base and rotating it clockwise approximately 30 degrees.
4. Install security seals as required.

CHAPTER**6****INSTALLATION INSTRUCTIONS**

The meter is plugged into a meter socket using standard meter installation practices. The meter base has current and potential 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. It is the installer's responsibility to verify the meter and socket are installed according to local and national codes.

Upon applying power to the meter, verify meter operations by observing the display:

- For the first 5 seconds, the register will display an All Segment Test (all display items shown). If this all segment display is continued after 5 seconds, it is possible that there is an error in the installation wiring.
- If a Form 2S meter displays 5E- in the lower left display section, it indicates that the meter has been connected in a 12S/25S socket. Please confirm that the meter is connected to the same socket form that is stated on the meter label.
- The LCD will show the correct number of digits (4 or 5) for energy along with kWh annunciator.
- Verify the expected direction of energy flow on the display annunciators.

SITE ANALYSIS GUIDES

NOTE: These site analyses include rudimentary connection diagrams for identification of metering installation. These diagrams are not metering installation guides.

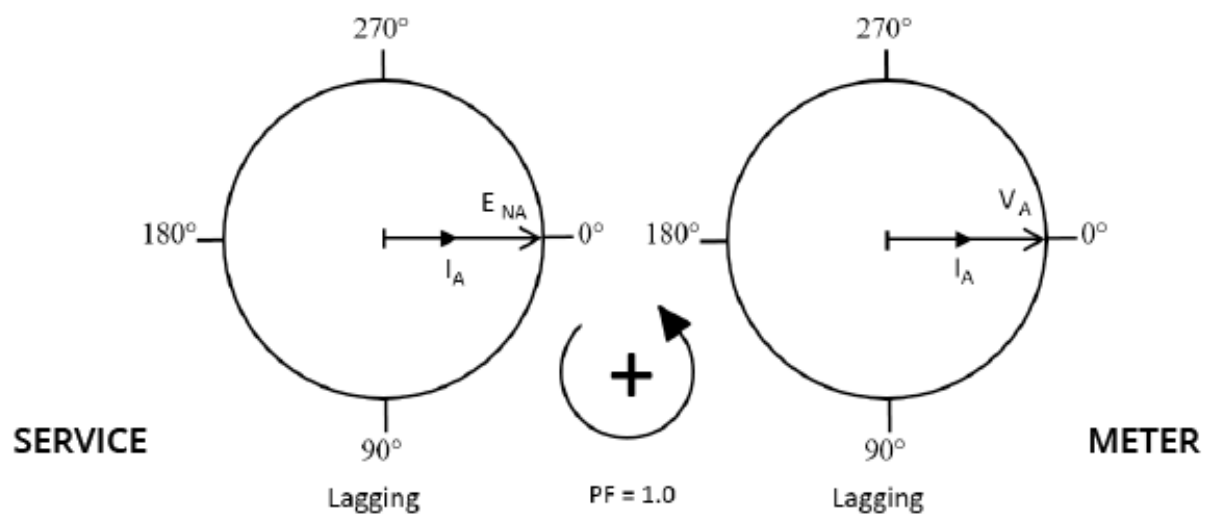
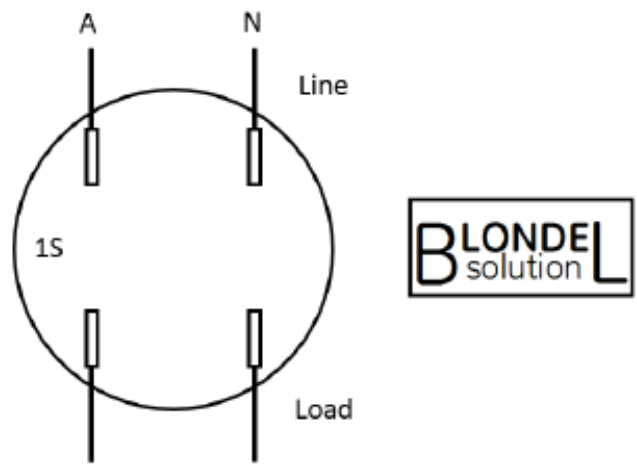
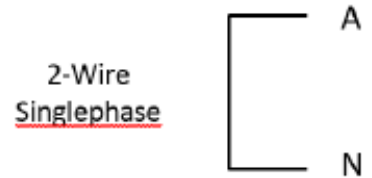
The phasor diagrams are shown for informational purposes only. The meter does not provide the information necessary to determine the phase relationships between voltages and currents.

Form	2W-1 ϕ	3W-1 ϕ	3W-N
1S	32	-	-
2S	-	33	-
3S	34	35	-
4S	-	36	-
12S	-	37	38
25S	-	-	39

IMPORTANT Actual installation procedures, materials, equipment, and connections must conform to applicable codes and standards.

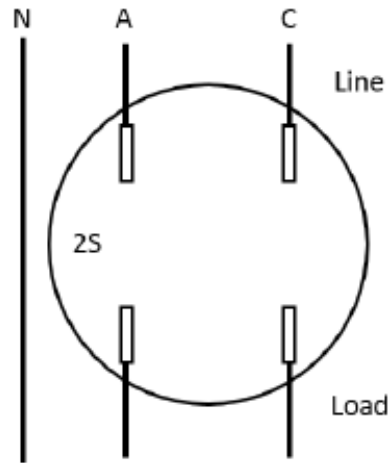
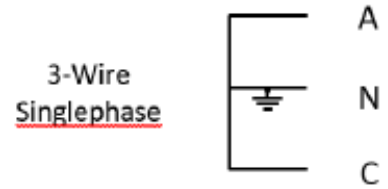
Form 1S (2W-1 ϕ)

Self-contained, 2-wire, 1-phase, 1-element

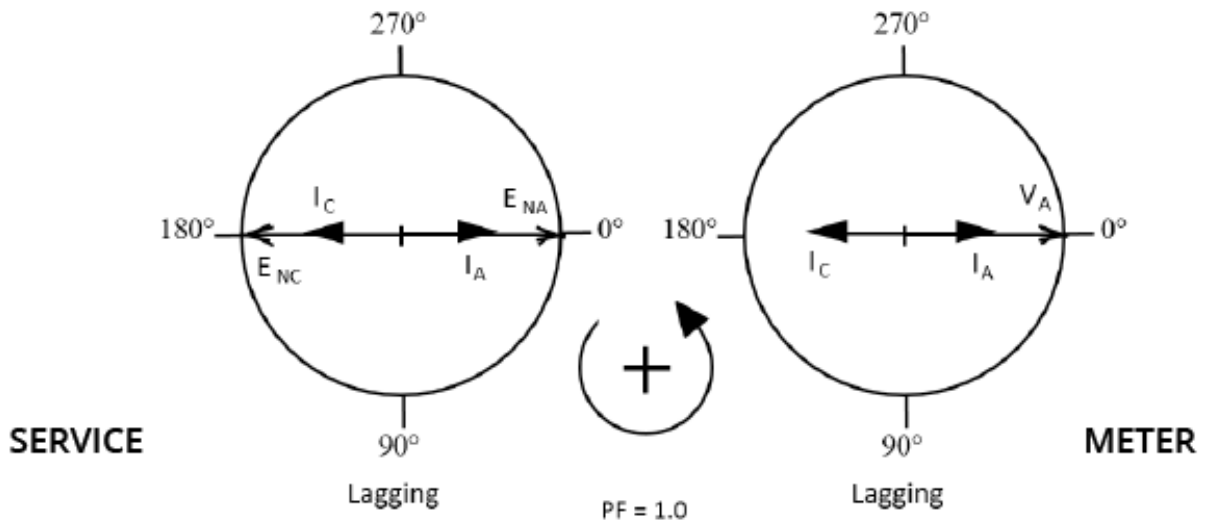


Form 2S (3W-1 ϕ)

Self-contained, 3-wire, 1-phase, 1-element

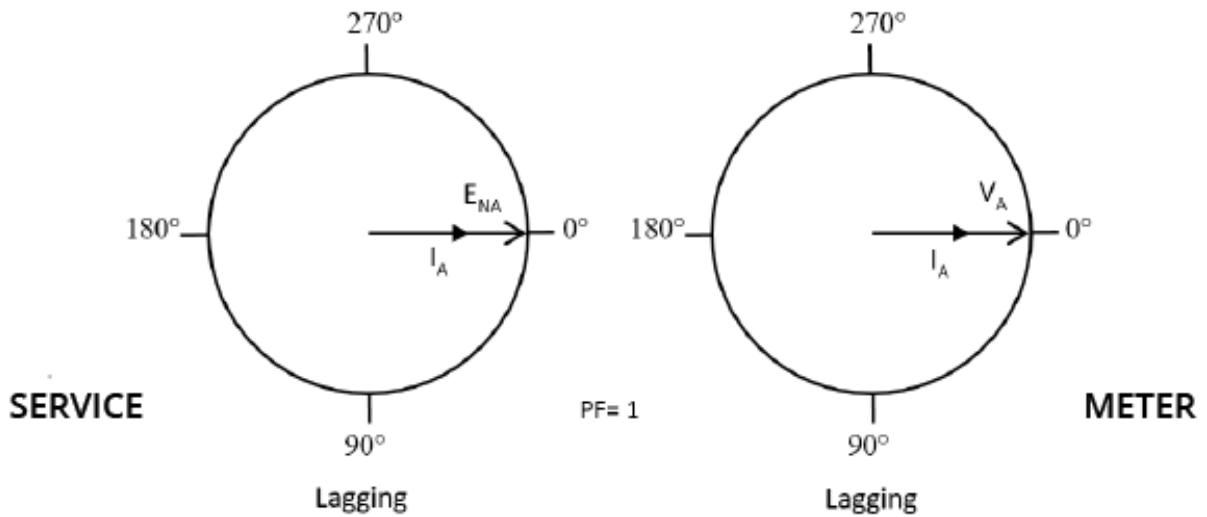
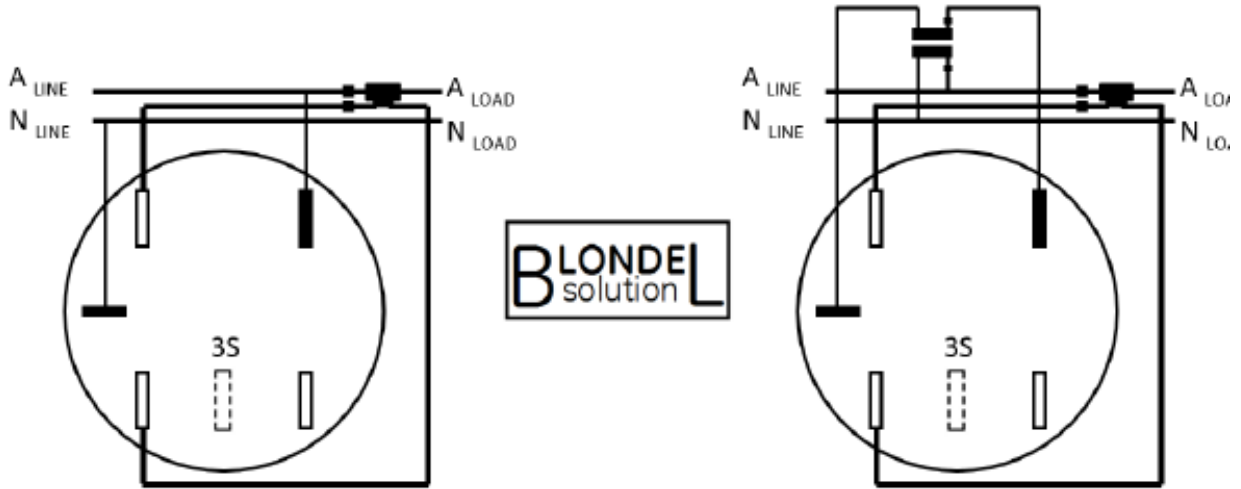
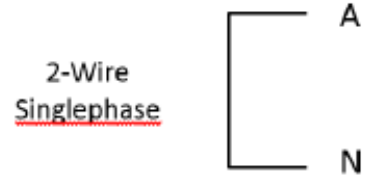


Accuracy is based on assumptions which, if not fulfilled, may result in systematic errors unrelated to meter calibration.



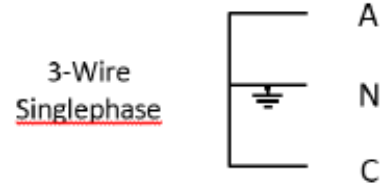
Form 3S (2W-1φ)

Transformer rated, 2-wire, 1-phase, 1-element



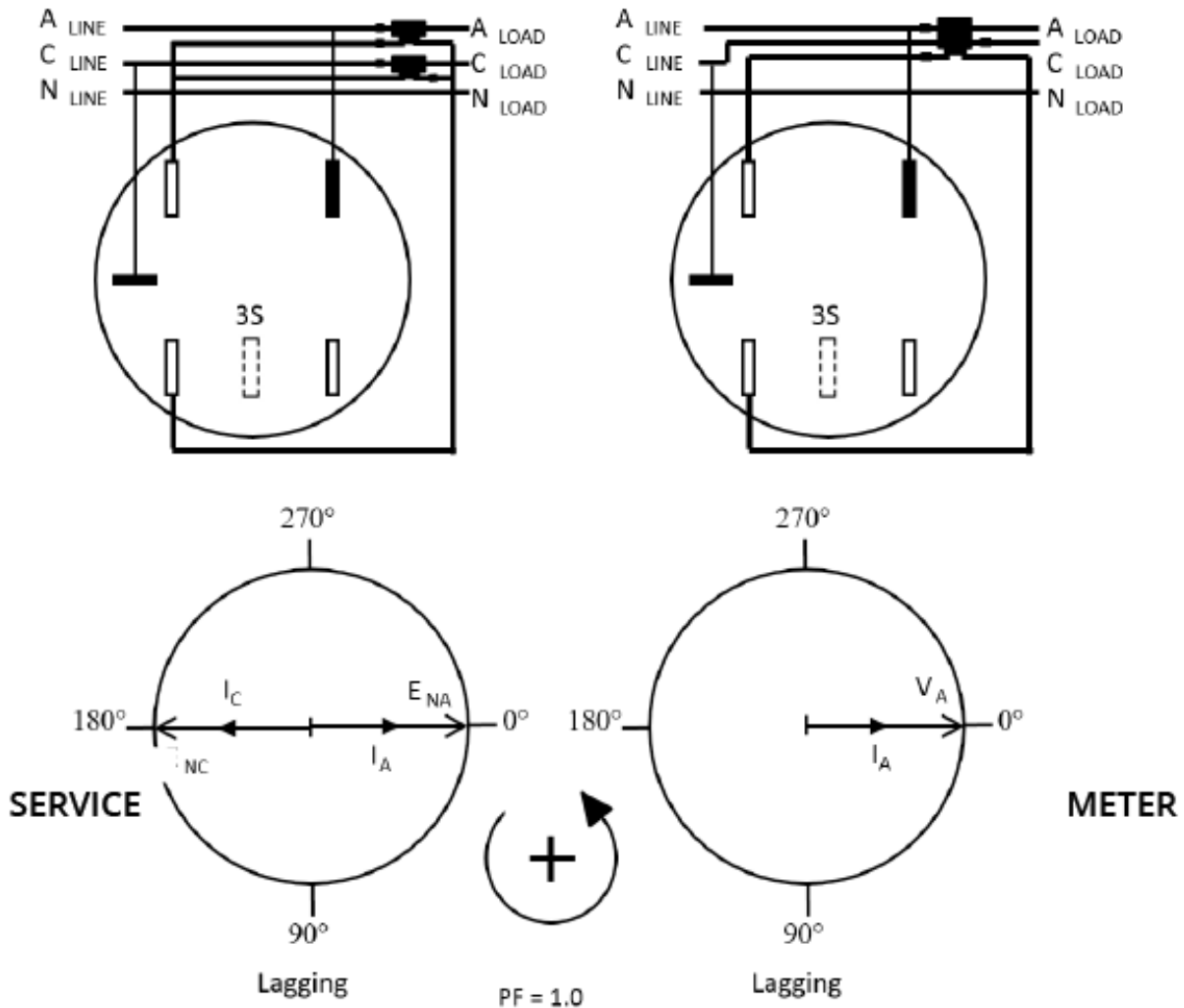
Form 3S (3W-1 ϕ)

Transformer rated, 3-wire, 1-phase, 1-element



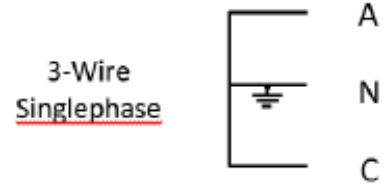
Accuracy is based on assumptions which, if not fulfilled, may result in systematic errors unrelated to meter calibration.

NOTE: Use half the CTs ratio as transformer factor in determining meter multiplier, except for three Wire CTs.

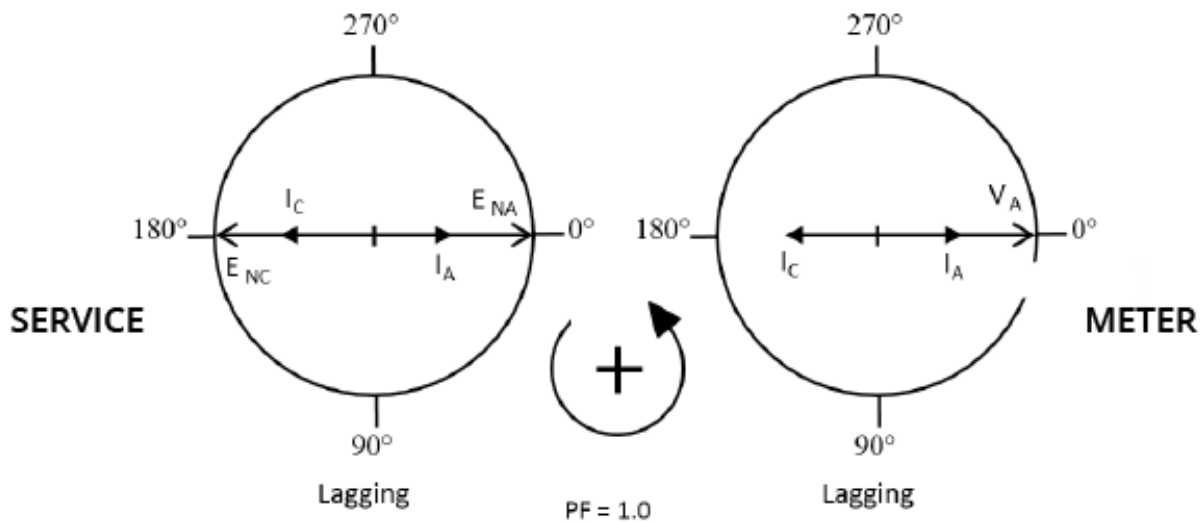
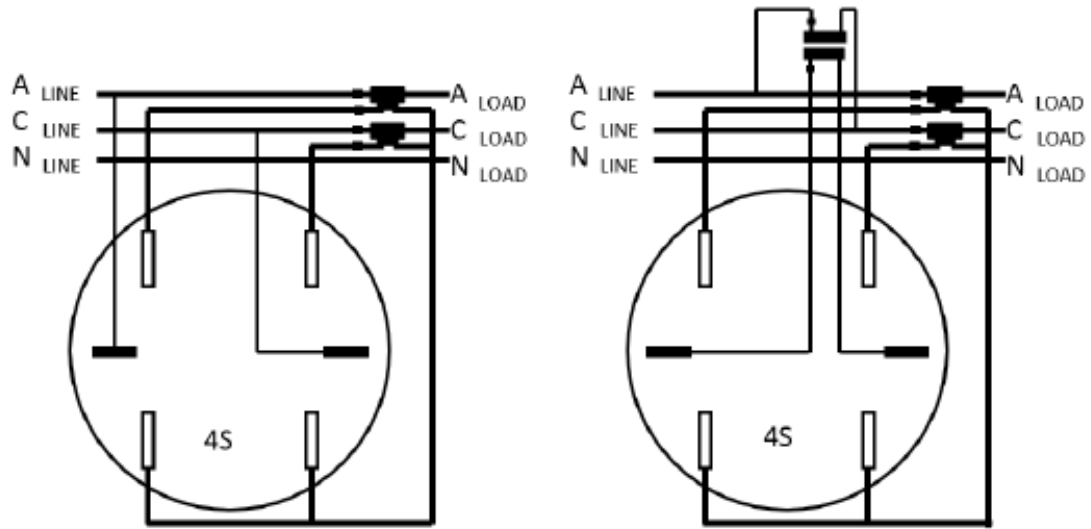


Form 4S (3W-1φ)

Transformer rated, 3-wire, 1-phase, 1-element

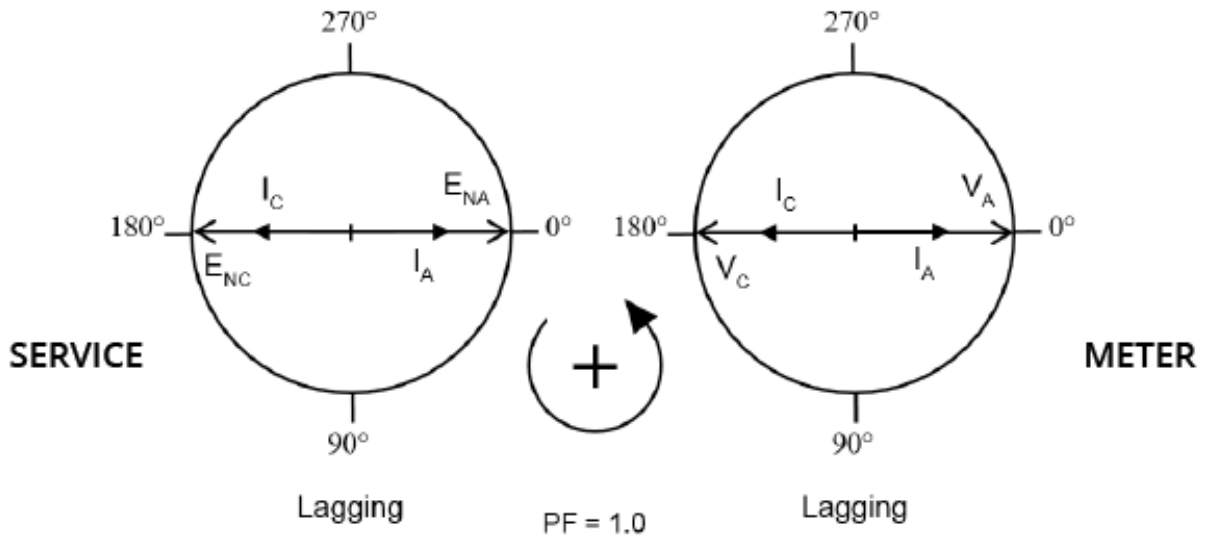
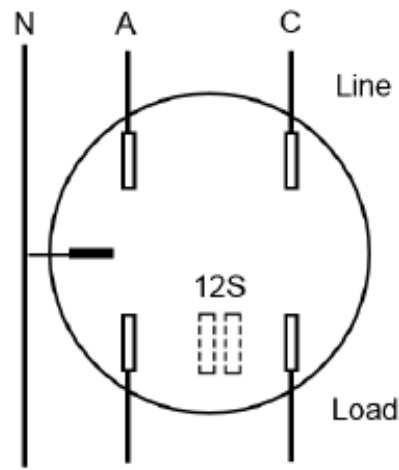
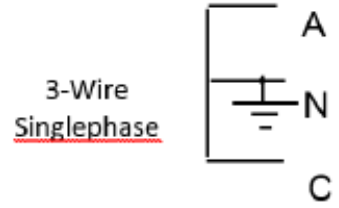


Accuracy is based on assumptions which, if not fulfilled, may result in systematic errors unrelated to meter calibration.



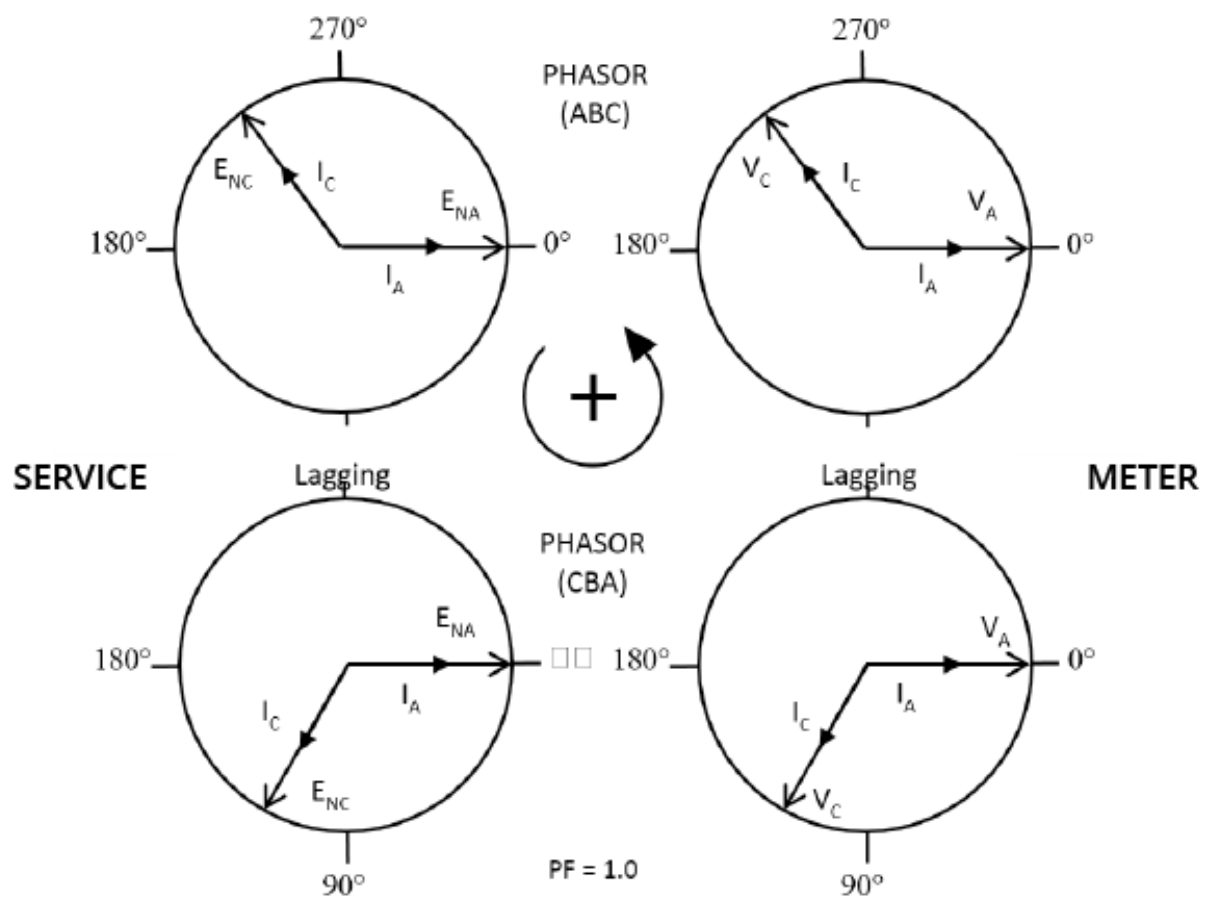
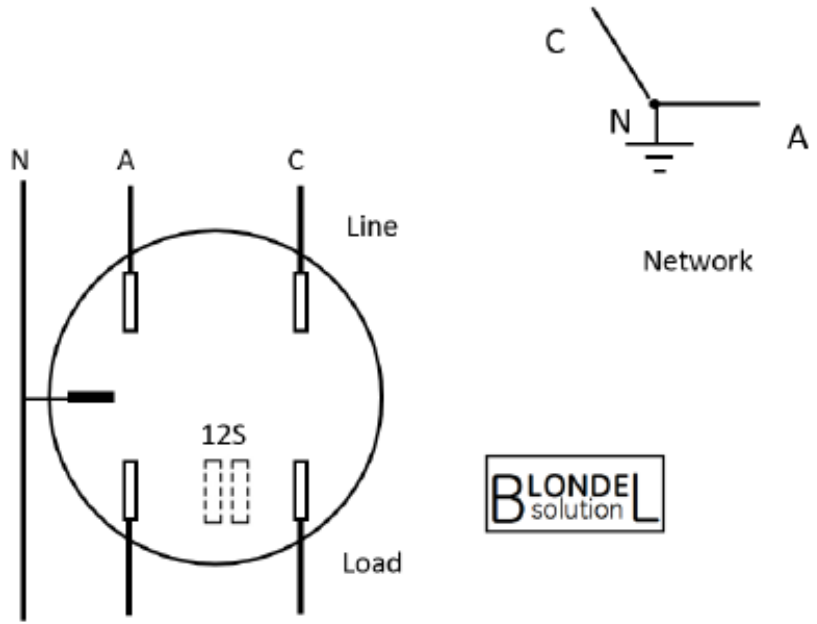
Form 12S (3W-1 ϕ)

Self-contained, 3-wire, 1-phase, 2-element



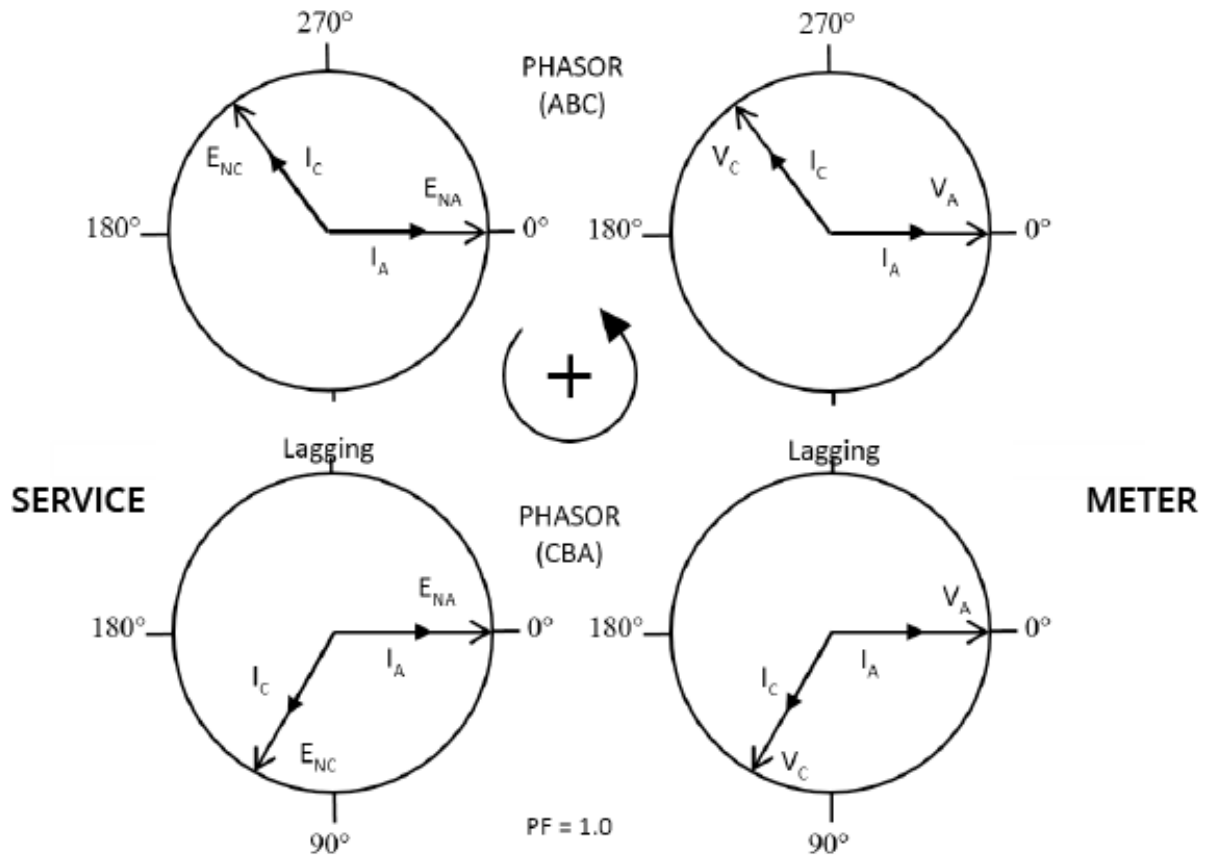
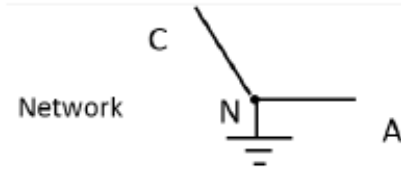
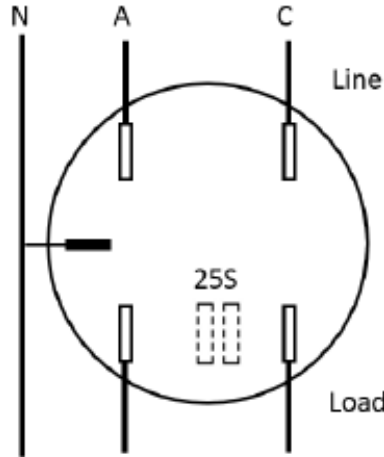
Form 12S (3W-N)

Self-contained, 3-wire, network, 2-element



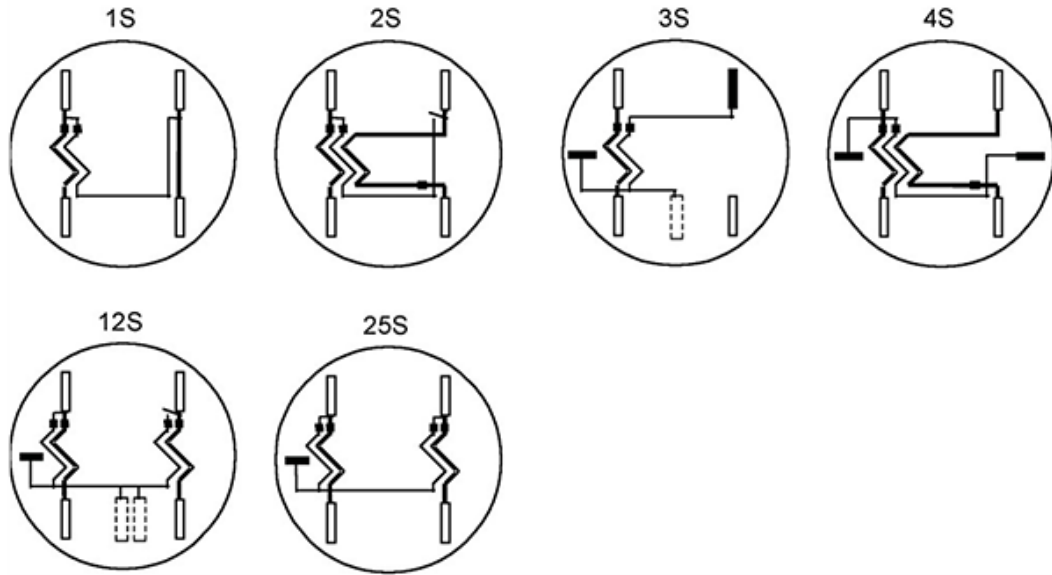
Form 25S (3W-N)

Self-contained, 3-wire, network, 1-element

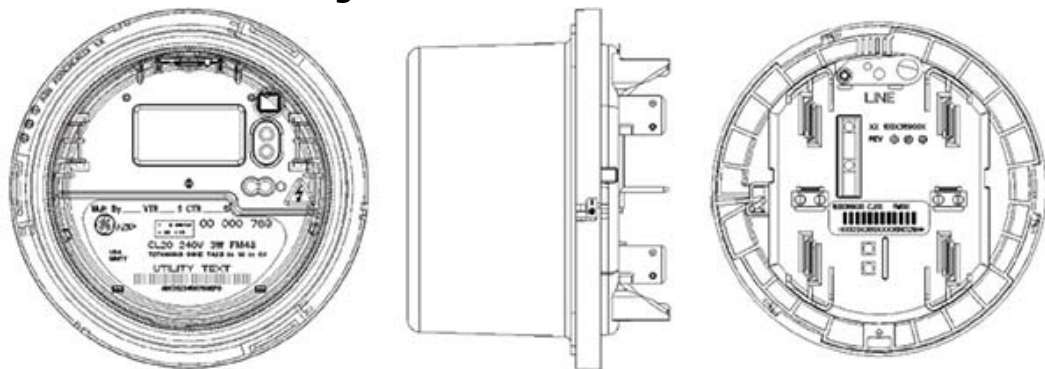


DIAGRAMS

ANSI Meter Diagrams.



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