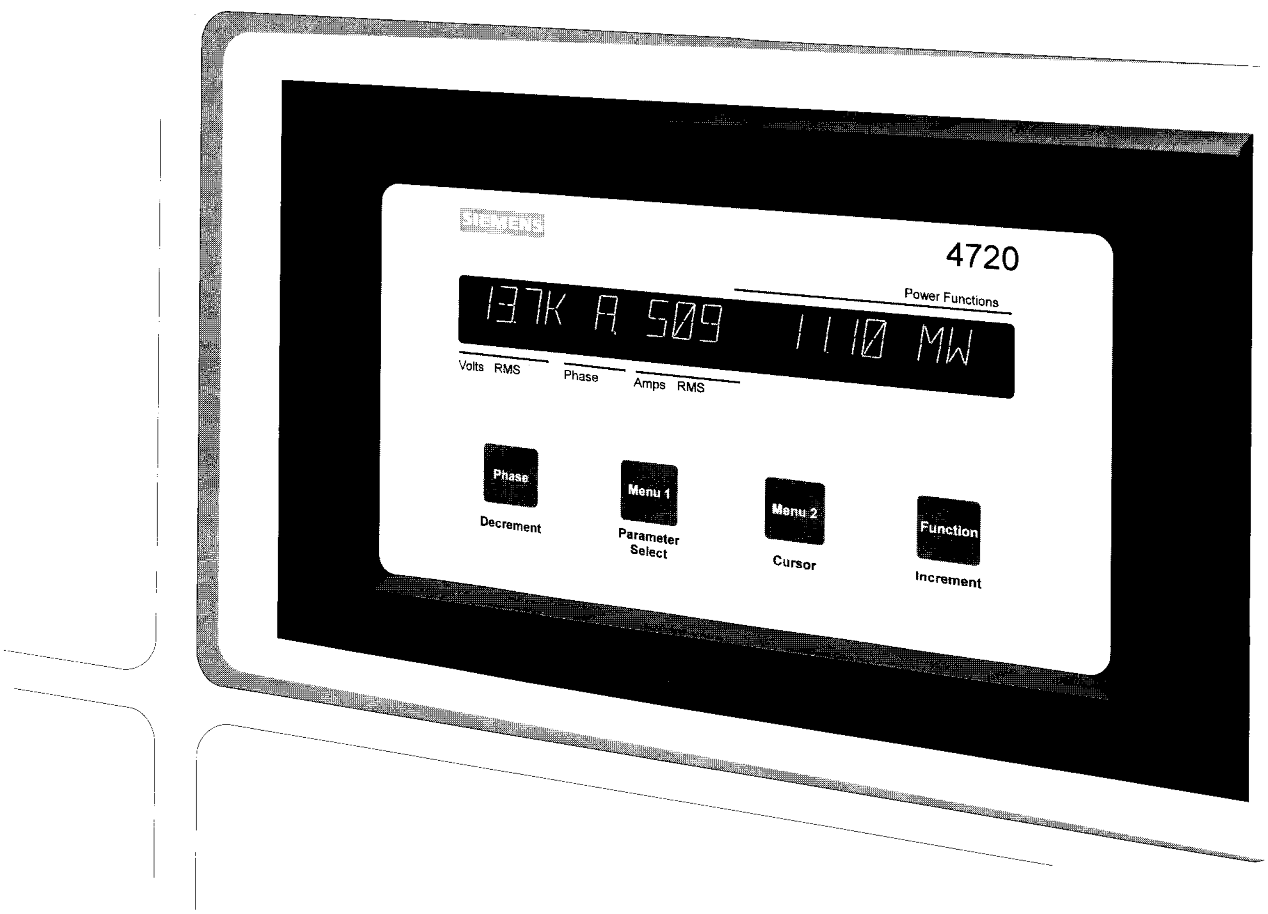
SIEMENS

4720 Power Meter

Operator's Manual



Manual No. SG6068-01

⚠ DANGER

Electrical equipment contains hazardous voltages and high speed moving parts.

Will 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 in nature 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. Siemens reserves the right to make changes at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material, or both, the latter shall take precedence.

QUALIFIED PERSON

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

(a) **is trained and authorized** to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

(b) **is trained** 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 procedures.

(c) **is trained** in rendering first aid.

SUMMARY

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

The contents of the instruction manual shall not become part of or modify any prior or existing aggreement, commitment or relationship. The sales contract contains the entire obligation of Siemens Energy & Automation, Inc. The warranty contained in the contract between parties is the sole warranty of Siemens Energy & Automation, Inc. Any statements contained herein do not create new warranties or modify the existing warranty.

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1 Introduction

1.1 About the Power Meter

The 4720 power meter is a microprocessor-based, digital three-phase "smart" power meter designed for use in industrial, commercial, and utility power distribution switchboards and substations. The 4720 power meter answers the ever-increasing concern for "clean," reliable power by integrating the many critical aspects of power metering, analysis, and control into one simple and economical instrument. It is a state-of-the-art alternative to traditional analog electromechanical metering devices, replacing numerous individual transducers and meters, and offering many features previously unavailable in power instrumentation.

The 4720 power meter offers the high accuracy, reliability, and ruggedness of its companion products, the 4700 and 4300 power meters, while adding many new measurements and advanced features. The 4720 power meter also matches the 4700 power meter in its mounting dimensions and installation requirements, and in its straightforward, flexible user interface. **Figure 1.1** shows the 4720 power meter front and rear views.

The unit is based on a 13.5 MHz, 16-bit microcontroller chip. This provides very high computational throughput, allowing the unit's sophisticated software to process information in real time. The meter's readings and setup parameters are maintained in nonvolatile memory.

The 4720 power meter is panel-mountable and provides rear-mounted, utility approved terminal strips rated at 600 V. The 4720 power meter is exceptionally rugged, with a high tolerance to electrical disturbances and temperature extremes. Many special design features guarantee performance in electrically harsh environments. The voltage, current, status (digital), relay, supply power, and communications inputs are designed to withstand hipot, C37.90A SWC, and fast transient tests. The 4720 power meter transformer-coupled current inputs are fully isolated with respect to the chassis of the unit, and provide 300 A surge protection.

1.2 Inputs and Outputs

The 4720 power meter supports a variety of power distribution configurations, including 4-wire wye, 3-wire delta, and single phase systems. Three-phase voltage and three-phase current inputs are provided, as well as an additional current input. In installations with non-linear loads, where odd harmonics can fail to cancel, significant currents in the neutral conductor can be produced. The 4720 power meter fourth current input can be used optionally for monitoring current in the neutral conductor, or for ground current monitoring. Used in conjunction with its high-speed setpoint system, the 4720 power meter can provide reliable ground fault protection.

Intermediate transducers are not required on phase voltage and current inputs. When equipped with the appropriate voltage input option, no voltage transformers (VTs) are required for wye systems up to 347 VAC line-to-neutral/600 VAC line-to-line. For higher voltage wye systems, and all delta systems, VTs can be used. The transformer-coupled current inputs accept current transformers (CTs) with 5 A full scale outputs. Additionally, a 1 A input version is available. Overrange measurement options include 125% to 500%.

An auxiliary voltage input can be used to measure an external variable such as transformer temperature or battery voltage. Input range is 0 to 1 V (AC or DC). An auxiliary analog current output can provide 0-20 or 4-20 mA proportional to any measured parameter.

Four digital inputs can be used to monitor breaker status, ground fault relay status, or any other external dry contact. These can also be used as pulse counters to measure device cycles, running hours, and so on. An internal 30 VDC supply provides self-excitation for "volts free" contact sensing.

Outputs include three relays that can be automatically controlled by an extensive user-programmable setpoint system, or manually operated by commands made via the communications port. Relays can perform operations ranging from simple alarm activations to fully automated demand, power factor, or load control. Relays can operate in a latched or pulsed mode, and can also be programmed to provide kWH (import/export), kVARH (import/export), or kVAH output pulsing. The basic 4720 power meter provides 10 A, Form C electromechanical relays.

1.3 Displays and Measurements

The 4720 power meter offers many high accuracy, real-time, three-phase measured parameters and status parameters. All parameters are quickly accessible via the front panel display or through the meter's communications port.

Real-time measurements include: Volts, Amps, Neutral/Ground Current, kW, kVA, kVAR, Power Factor (PF), and Frequency. Power quality analysis capability offers total harmonic distortion, individual harmonic levels, and K-factor for all eight voltage and current inputs (to the 15th harmonic).

Thermal, sliding window, and predicted sliding demands are provided on all measurements. Minimum/maximum values are also provided on all measurements.

Energy values include kWH, kVAH, and kVARH. All energy readings provide bidirectional (import/export) indication. All voltage, current, power and energy readings are true rms, including harmonics.

Status information includes real-time conditions for the three relays, four status/counter inputs, and seventeen user-programmable setpoints. The scaling for each pulse counter reading is user-definable. Also included is internal self-diagnostic information.

1.4 User Interface

The 4720 power meter front panel features a large, high-visibility, 20-character vacuum fluorescent display. Voltage, current, and power functions can all be displayed together for the selected phase. Very large measured values with up to nine significant digits (for example, kWH) are presented using the entire display. Concurrent display of all three phases of voltage and current readings is also possible.

The 4720 power meter uses four long-life, stainless steel membrane switches to access all measured parameters and status information, and to program functions. Using the Menu buttons, you can define convenient custom groupings of important parameters for quick viewing.

You can program the basic setup parameters of the 4720 power meter quickly and easily from the front panel. Basic parameters include voltage and current scales, voltage mode such as wye or delta, baud rate, and so on.

Programming for many of the advanced features of the 4720 power meter must be performed via the communications port using a portable or remotely located computer running supervisory software such as Siemens WinPM™ software. These parameters include setup for waveform, data logging, and setpoint functions.

Setup and other critical information is saved when the 4720 power meter power is turned off. All programming is password protected.

1.5 High-Speed Setpoint System

The comprehensive setpoint system of the 4720 power meter provides extensive control over the three relay outputs, as well as triggering capabilities for the waveform capture, waveform recorder, and snapshot logging features. Setpoints can also be used to automatically clear status input counters, or to reset Min/Max Logs.

Seventeen user-programmable setpoints are provided, six of which offer high-speed (67 milliseconds/4 cycle) capabilities. Setpoints can be activated by a wide variety of conditions, including:

- A user-defined level on any measured parameter (for example, voltage, current, power, harmonic distortion (HD), demand, and so on)
- Time-overcurrent characteristics
- External equipment status (via the status inputs)
- New hour, day, week, month, or year

An active setpoint condition can be used to trigger simultaneously up to two separate functions. For example, you may wish to operate a relay and perform a waveform recording when an overcurrent condition occurs. Using predicted demand, you can apply setpoint control of the relays in effective demand management strategies.

All setpoint activity is recorded automatically in the Event Log.

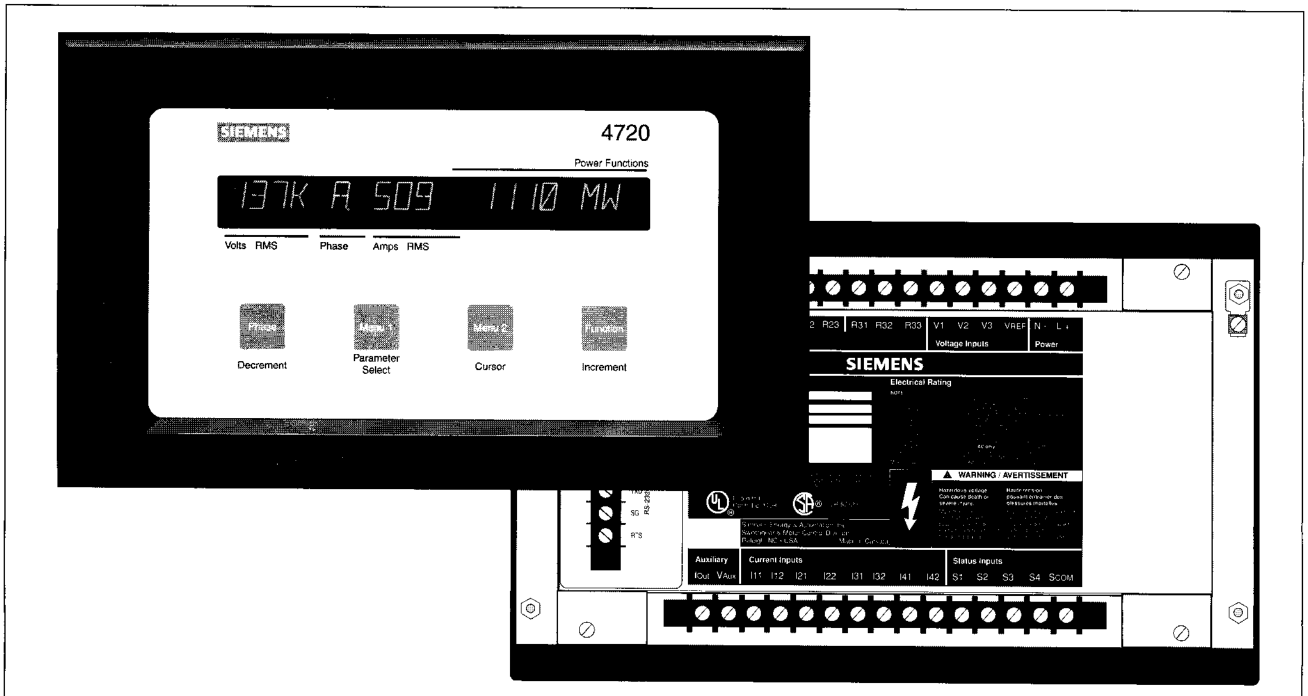


Figure 1.1 Siemens 4720 Power Meter (Front and Rear View)

1.6 Power Quality Monitoring and Fault Recording

In addition to harmonic distortion and K-factor measurements, the 4720 power meter is equipped with digital waveform sampling capabilities for power quality monitoring and fault analysis. The 4720 power meter provides two powerful methods for acquiring waveform data: waveform capture and waveform recording.

1.6.1 Waveform Capture

Waveform capture allows you to perform high-speed (128 samples/cycle) sampling with any one of the eight voltage and current inputs, providing high-resolution data which can be used for detailed power quality analysis. Capture can be triggered either through user-defined setpoint conditions or commands via the meter's communications port. Sampled waveform data is stored in memory and can be read via the communications port. WinPM software can be used to view and display captured waveform data. WinPM software calculates total harmonic distortion for each waveform and a breakdown of individual harmonic components (to the 63rd harmonic) in graphical form.

1.6.2 Waveform Recording

Waveform recording allows you to analyze the conditions occurring before, during, and after a power fluctuation or failure and is ideal for fault and surge analysis, and to aid in fault location.

Waveform recording runs continuously at 16 samples/cycle on all eight voltage and current inputs. A trigger by a user-specified setpoint condition or a command made via the meter's communications port freezes multiple cycles of each waveform in memory along with a time stamp.

The user can configure the 4720 power meter to concurrently store up to three 12-cycle events, two 18-cycle events, or one 36-cycle event for each input. A programmable trigger delay allows pre-event or post-event data to be recorded.

The recorded data is saved until uploaded to a master station for analysis. WinPM software can be used to display the waveforms together on the computer screen, presenting a comprehensive picture of the power line conditions surrounding the disturbance.

1.7 Logging Capability

The 4720 power meter supports three types of data logs: the Event Log, the Min/Max Log, and the Historical Log. Logged data can be extremely useful in the study of growth patterns, for scheduling loads, for cost allocation, for isolating problem sources, or for analyzing a variety of power system operating conditions.

1.7.1 Event Logging

The Event Log provides 100 date and time-stamped records. Digital input changes are recorded with a resolution of 1 millisecond typical and 10 milliseconds maximum, ideal for sequence-of-event recording. The log also records all relay operations, setpoint/alarm conditions, setup changes, and self-diagnostic events (1 millisecond typical, 10 milliseconds maximum).

1.7.2 Min/Max Logging

A preset Min/Max Log records the extreme minimum and maximum (min/max) values for all parameters measured by the 4720 power meter, including all voltage, current, power, frequency, power factor, harmonic distortion, and demand values. Min/max values for each parameter are logged independently with date and time stamp with 1 second resolution.

You can also define up to 16 separate Min/Max Logs, each containing up to 16 time-stamped parameters. Each log is triggered by the first parameter in its list. When a new minimum or maximum value for the trigger parameter is recorded, coincident real-time values for all other parameters in the list are simultaneously stored. For example, you could program a log to record all per-phase kW, kVAR, and PF demand values when total kW demand peaks.

Reset functions for the preset and programmable Min/Max Logs are performed either from the front panel or via communications.

1.7.3 Historical Logging

The 4720 power meter Snapshot Logs are historical or trend logs. Up to 8 logs may be defined, each recording up to 12 channels of time-stamped data. The measured parameters recorded by each log are user-programmable. Trigger functions are assigned independently for each log.

Each Snapshot Log can be triggered in one of three possible ways, each described below:

- User-defined time interval
- One-shot method
- Gated method

A user-defined time interval basis provides an interval range from 1 second to 400 days. One log can be configured for high-speed operation, recording at intervals as short as 2 cycles. The high-speed log can be useful for logging short duration conditions such as motor start-ups.

One-shot method allows any standard setpoint to automatically trigger a snapshot recording when an active condition occurs. Setpoint conditions can include harmonic distortion levels, status input changes, and more.

A gated method allows readings to be recorded on a time interval basis only during the time that a setpoint remains active. This method is ideal for logging voltage and current extremes following a breaker trip, for example.

1.7.4 Access to Logged Data

Alarm conditions, events, min/max levels, and snapshot interval readings are all automatically time-stamped and logged into nonvolatile memory and are accessible via the communications port. Preset Min/Max Log readings can also be viewed via the front panel display by assigning them to either Menu button.

WinPM software can be used to program all log setup parameters and to display all logged data. Historical snapshot data can be displayed graphically.

1.8 Network Communications

For integration into an energy management system, the 4720 power meter is equipped with a communications port selectable as either RS-232 or RS-485. As part of the ACCESS™ system, the 4720 power meter uses the open SEAbus™ protocol for communications.

1.9 System Applications

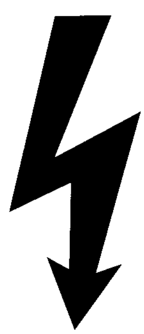
The unique features of the 4720 power meter, including measurement, storage, setpoint (load shedding) and display characteristics, make it suitable for use in:

- Utility Installations
- Industrial Buildings
- Office Buildings
- Commercial Buildings
- Hospitals
- Airports
- Telephone Exchanges
- Factories
- Pulp Mills
- Saw Mills
- Shopping Centers
- Large Stores
- Hotels
- Substation Metering
- Co-Generation Systems
- Chemical Process Plants
- Multi-user sites where allocation of electrical costs is desirable
- Any installation that uses significant amounts of electrical energy
- Any installation that is experiencing power quality problems
- Any location where remote power monitoring, control, or analysis is needed

2 Installation

The 4720 power meter model type is determined from the phase voltage, phase current, power supply, and relay input ratings. The rear panel of the 4720 power meter lists all equipped options. **Appendix A** of this manual defines all options and their associated ratings. This chapter provides detailed installation instructions applicable to each hardware option.

⚠ WARNING



Electrical equipment contains hazardous voltages.

Can cause death, serious personal injury, or equipment damage.

Installation and maintenance should be performed only by qualified personnel.

2.1 Location and Mounting

The 4720 power meter should be mounted in a dry, dirt-free location away from heat sources and very high electric fields. To operate properly and effectively, environmental conditions should fall within the guidelines listed in **Appendix A**.

The enclosure in which the 4720 power meter is mounted (typically a switchgear cabinet) should protect the device from atmospheric contaminants such as oil, moisture, dust, corrosive vapors, or other harmful airborne substances.

When choosing the enclosure size for the 4720 power meter, allow extra space for all wiring, intermediate terminal strips, shorting blocks, or any other required components. Position the enclosure so the doors will open fully for convenient troubleshooting of wiring or related components.

Figure 2.1 provides the mounting dimensions for the 4720 power meter. A five inch clearance behind the front panel is required for access to wiring.

> **Note:** Most electrical codes prohibit extending voltages greater than 240 VAC to the door of the switchgear cabinet. If this is the case, use a basic model (120 VAC input) 4720 power meter with VTs that are connected to provide 120 VAC line-to-neutral input to the power meter (see **section 2.5.1**).

Refer to **section 2.4** for information about chassis ground connection.

2.2 Power Wiring

Connections to the 4720 power meter are made to three terminal strips located on the rear of the unit. **Figure 2.1** provides 4720 power meter terminal block dimensions. Either 12 AWG or 14 AWG wire is recommended for all connections except for communications connections. Ring or spade terminals may be used to simplify connection.

> **Note:** All wiring must conform to applicable local electrical codes.

2.3 Power Supply Connections

The basic model 4720 power meter can be powered by 85 to 264 VAC or 110 to 300 VDC at 0.2 A. An optional power supply of 20 to 60 VDC at 10 W is also available. This option is indicated by the catalog number 4720DRMC-3x-xx on the rear of the unit.

The basic model can be powered from a dedicated fused feed or from the voltage source which it is monitoring, as long as it is within the supply range. The 20 to 60 VDC option must be powered from a dedicated fused feed.

If an AC power supply is being used, connect the line supply wire to the 4720 power meter L/+ terminal and the neutral supply wire to the N/- terminal. If a DC power supply is being used, connect the positive supply wire to the 4720 power meter L/+ terminal and the negative (ground) supply wire to the N/- terminal.

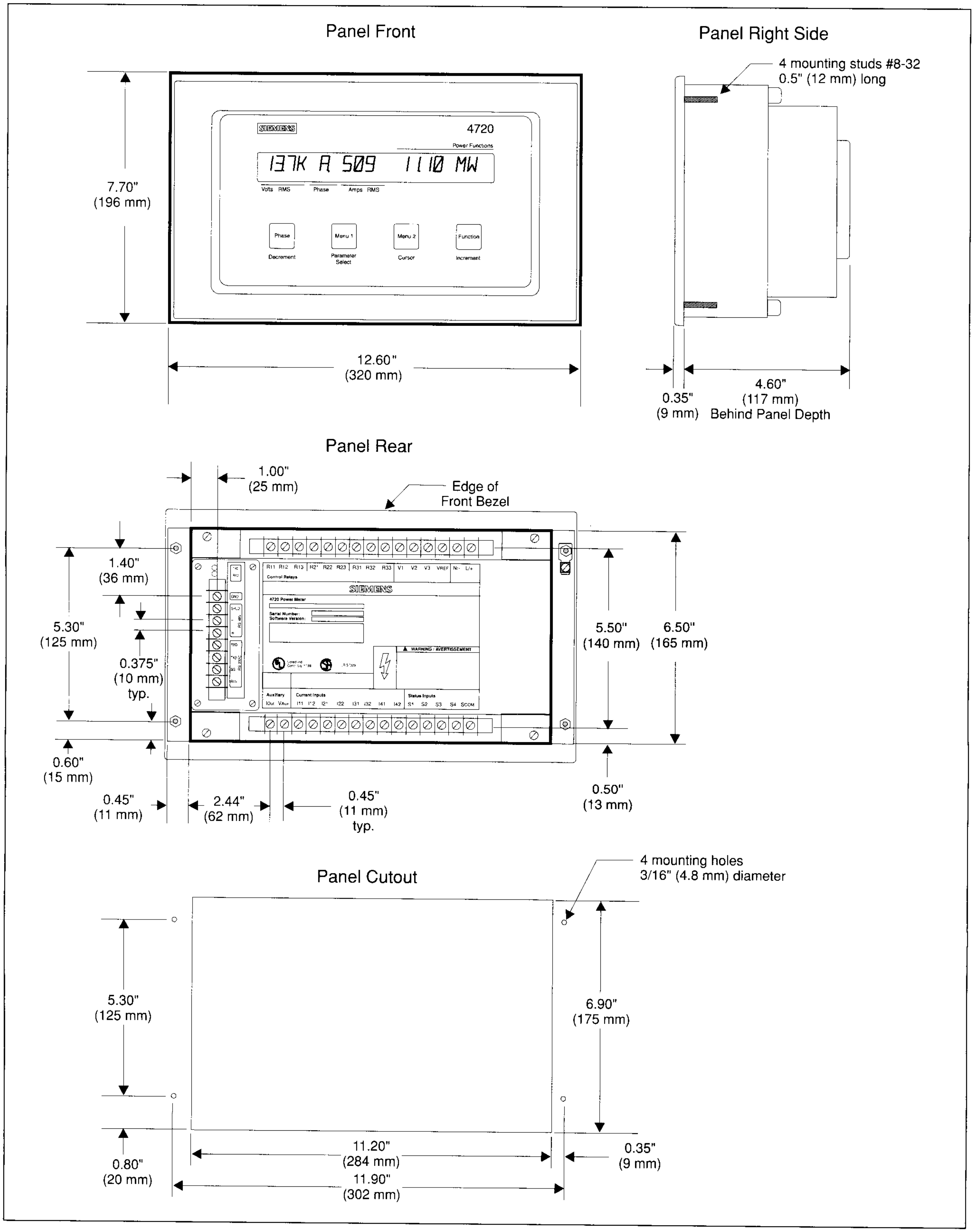


Figure 2.1 Mounting Dimensions

2.4 Chassis Ground Connection

The chassis of the 4720 power meter must be connected to earth ground. A good, low impedance chassis ground connection is essential for the 4720 power meter surge and transient protection circuitry to function effectively. It should be connected to the switchgear earth ground using a dedicated 14 AWG (or larger) wire to a point where there will be no voltage error due to distribution voltage drops. Do not rely on metal door hinges as a ground path.

Ground wire connection to the chassis is made using the ground lug supplied with the unit. For the basic model, this is attached to one of the four mounting studs. Ensure that the ground lug screw is tightened down securely onto the ground wire and that the nut has been tightened down securely onto the lug.

Note: For the noise and surge protection circuitry to function correctly, the 4720 power meter chassis ground lug must be connected to the switchgear earth ground using a dedicated 14 AWG (or larger) wire. Failure to do so will void the warranty.

2.5 Phase Voltage and Current Input Connections

The following sections describe the requirements for connecting the 4720 power meter to the system being monitored. This includes selection and location of current and voltage transformers.

2.5.1 Phase Voltage Inputs: Direct Connection

The 4720 power meter uses the V1 input as the reference for maintaining phase relationships for all power and energy related measurements. For any system configuration, the V1 input must be connected to ensure accurate readings and correct operation of the 4720 power meter.

Whether or not voltage transformers (VTs) are required depends on the nature of the system being monitored, the voltage levels to be monitored, and the input option of the 4720 power meter.

Note: Most electrical codes prohibit extending voltages greater than 240 VAC to the door of the switchgear cabinet. If this is the case, use a basic model (120 VAC input) 4720 power meter with VTs that are connected to provide 120 VAC line-to-neutral input to the power meter.

Basic Model (120 VAC)

The basic model can be used for direct connection to wye systems up to 120 VAC line-to-neutral/208 VAC line-to-line or single phase systems up to 120 VAC line-to-neutral/240 VAC line-to-line.

277 VAC Option

This option provides 277 VAC full scale inputs that can be used for direct connection (using fuses) to wye systems up to 277 VAC line-to-neutral/480 VAC line-to-line or 277 VAC line-to-neutral/554 VAC line-to-line single phase systems.

347 VAC Option

Models supplied with the 347 VAC option provide 347 VAC full scale inputs that can be used for direct connection (using fuses) to 347 VAC line-to-neutral/600 VAC line-to-line wye or single phase systems up to 347 VAC line-to-neutral/694 VAC line-to-line.

2.5.2 Phase Voltage Inputs: Using Voltage Transformers

If wye system voltages are over 347 VAC line-to-neutral/600 VAC line-to-line or single phase system voltages are over 347 VAC line-to-neutral/694 VAC line-to-line, voltage transformers (VTs) are required.

Note: VTs are always required for delta systems.

VTs are used to scale down the line-to-neutral voltage of a wye or single phase system, or the line-to-line voltage of a delta system to the rated input scale of the 4720 power meter. The inputs of the basic model can be used with VTs that have secondaries rated at 120 VAC or less. This can include $100/\sqrt{3}$, $110/\sqrt{3}$, 100, 110, or 120 VAC secondaries. Devices equipped with the 277 option can be used with VTs that have secondaries rated to 277 VAC such as 220 VAC.

For proper monitoring, correct selection of VTs is critical. For wye systems, the VT primary rating should equal the system line-to-neutral voltage or nearest higher standard size. For delta systems, the VT primary rating should equal the system line-to-line voltage. For all system configurations, the VT secondary rating must be within the rated full scale range of the 4720 power meter voltage inputs.

VT quality directly affects system accuracy. The VTs must provide good linearity and maintain the proper phase relationship between voltage and current in order for the voltage and power readings to be valid.

2.5.3 Phase Current Inputs: Options

The 4720 power meter requires external CTs to sense the current in each phase of the power feed and (optionally) in the neutral or ground conductor. The selection of the CTs is important because it directly affects accuracy.

The 4720 power meter offers various phase current input options to match the type of CTs being used and the desired overrange capability. The current input ratings of the three phase inputs and the fourth current input (I4) are equivalent.

The fourth current input is typically used to measure the current flow in the neutral or ground conductor. The use of this input is optional.

The basic model 4720 power meter is compatible with CTs with 5 A secondaries. The 1AMP option provides compatibility with 1 A CT secondaries.

The basic model 4720 power meter provides 125% overrange capability which allows current readings to be accurately displayed up to 125% of full scale. For example, if the AMPS SCALE has been set at 2000 A full scale, the 4720 power meter allows for readings up to 2500 A.

The 4720 power meter provides two additional current input overrange options which include 200% and 500% of full scale. Each overrange option also affects all current-related measurement accuracies such as amperage (A) and kilowatt (kW). Refer to **Appendix A** for detailed specifications on each current input option.

Note: Refer to the rear panel catalog number to determine the equipped current input option(s). Applying current levels incompatible with the current input configuration will permanently damage the device.

2.5.4 Phase Current Inputs: Current Transformer Ratings

The CT secondary should have a burden capacity greater than 3 VA.

The CT primary rating is normally selected to be equal to the current rating of the power feed protection device. However, if the peak anticipated load is much less than the rated system capacity, you can improve accuracy and resolution by selecting a lower rated CT. In this case, the CT size should be the maximum expected peak current +25% rounded up to the nearest standard CT size.

Other factors may affect CT accuracy. The length of the CT cabling should be minimized because long cabling contributes to inaccuracy. Also, the CT burden rating must exceed the combined burden of the 4720 power meter plus cabling plus any other connected devices. The burden is the amount of load being fed by the CT measured in Volt-Amps. The 4720 power meter burden rating is given in **Appendix A**.

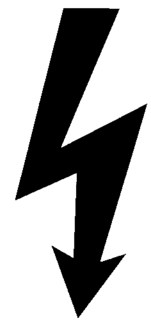
Overall accuracy is dependent on the combined accuracies of the 4720 power meter, the CTs, and the VTs (if used).

2.5.5 VT and CT Connections

Figure 2.2 to **Figure 2.8** illustrate all required phase voltage and phase current connections for various circuit configurations to ensure correct installation. Phasing and polarity of the AC current and voltage inputs and their relationship is critical to the correct operation of the unit.

All phase voltage sense leads should have overcurrent protection at their source. In cases where VTs are required, the secondaries should be fused.

⚠ WARNING



Hazardous voltages and currents exist at VT secondary circuits which have their primary circuits energized.

Can cause death, serious personal injury, or equipment damage.

Installation and maintenance should be performed only by qualified personnel.

CT circuits that include a shorting block or test block to facilitate the safe connection and disconnection of the CTs are desirable.

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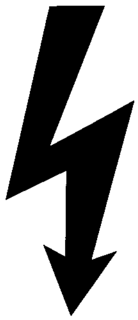


Hazardous voltages and currents exist at open circuited CT secondary circuits which have their primary circuits connected.

Can cause death, serious personal injury, or equipment damage.

Installation and maintenance should be performed only by qualified personnel.

The secondary rating of the CT connected to the I4 input must be identical to that of the three phase current inputs. This rating depends on the current input option installed in the 4720 power meter.

The primary rating for the CT connected to the I4 input can be different than for the three phase inputs, since the I4 input scaling can be programmed independently.

2.5.6 Voltage Reference Connection

The voltage reference terminal (VREF) of the 4720 power meter serves as the zero voltage reference for voltage readings. A good, low impedance VREF connection is essential for accurate measurement. It should be made using a dedicated 14 AWG wire to a point where there will be no voltage error due to distribution voltage drops.

The connection point for VREF is dependent on the system configuration. Each of the following configurations is illustrated in **Figure 2.2** through **Figure 2.8**:

- If the system being monitored is 4-wire wye or single phase, VREF must be connected to the neutral conductor
- If the system is 3-wire grounded (delta), VREF must be connected to the line transformer neutral
- For 3-wire ungrounded (open delta) systems, and for systems where VTs are being used, VREF must be connected to the VT common leads

2.5.7 Waveform Capture Connections

The 4720 power meter waveform capture feature allows signals at each of its voltage inputs (V1, V2, V3, VAux) and current inputs (I1, I2, I3, I4) to be digitally sampled. The 4720 power meter uses the V1 input as the triggering reference for waveform capture, and to maintain phase relationships between all sampled signals. The V1 input must be connected for waveform capture to work. No other special wiring considerations are necessary. The operation of the waveform capture feature is described in detail in **Chapter 9, Using Waveforms**.

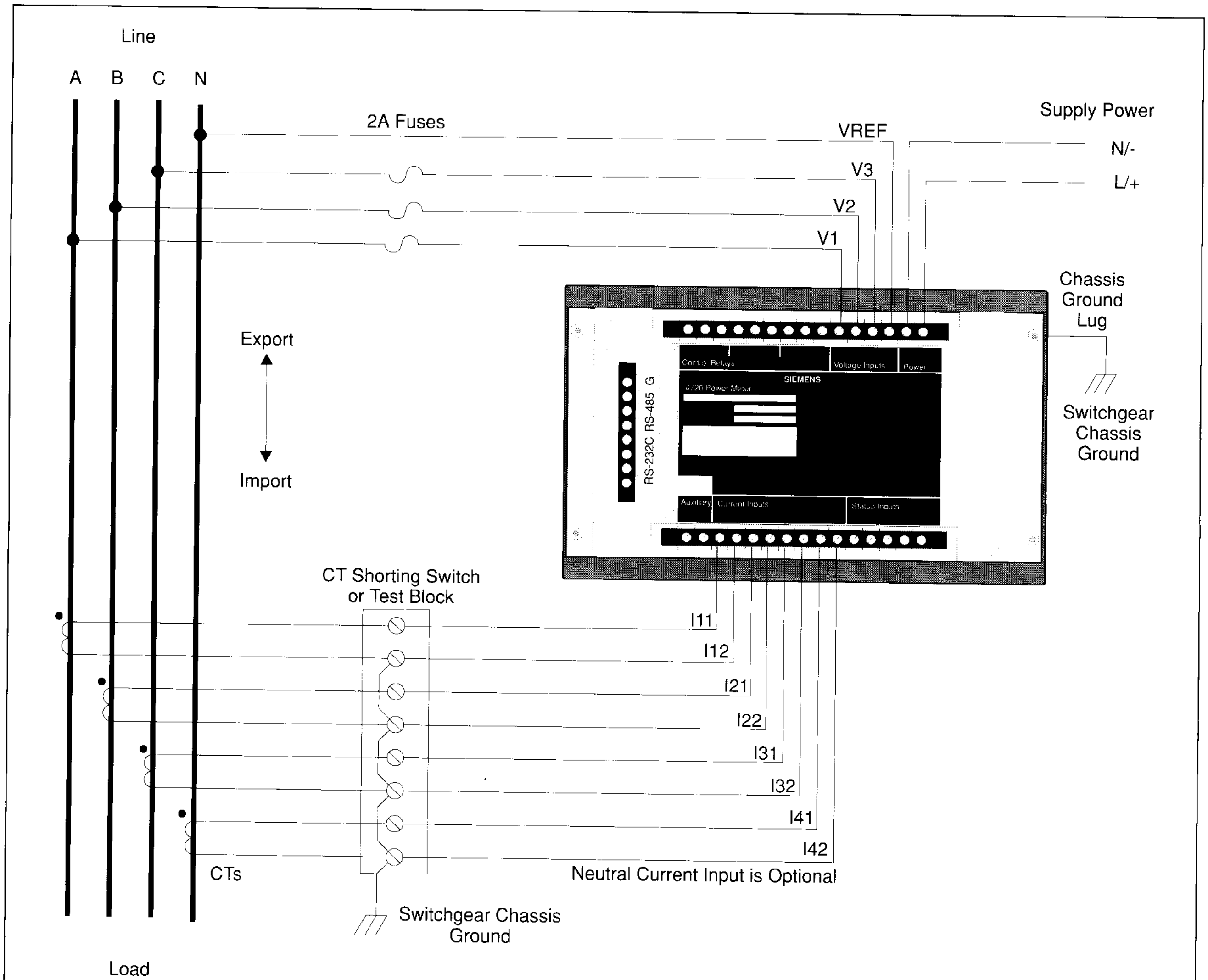
2.5.8 Three-Phase WYE (Star) Connection

Figure 2.2 through **Figure 2.5** provide wiring diagrams for 4- and 3-wire wye system configurations.

For a 4-wire wye system, the 4720 power meter senses the line-to-neutral (or ground) voltage of each phase and current of each phase, making for an equivalent three-element metering configuration.

If the power system to be monitored is a 120 VAC line-to-neutral/208 VAC line-to-line system, the basic model with 120 VAC inputs can be used with direct sensing of each phase, without the need for VTs. If the system is a 277 VAC line-to-neutral/480 VAC line-to-line or 347 VAC line-to-neutral/600 VAC line-to-line system, models with the 277 or 347 input options (respectively) may be connected directly (using fuses).

The wiring diagram for these voltage ranges is shown in **Figure 2.2** below. VOLTS MODE should be set to 4W-WYE as explained in **Chapter 6, Programming**.



Volts mode is four wire wye. **VOLTSMODE:** WYE<4W>

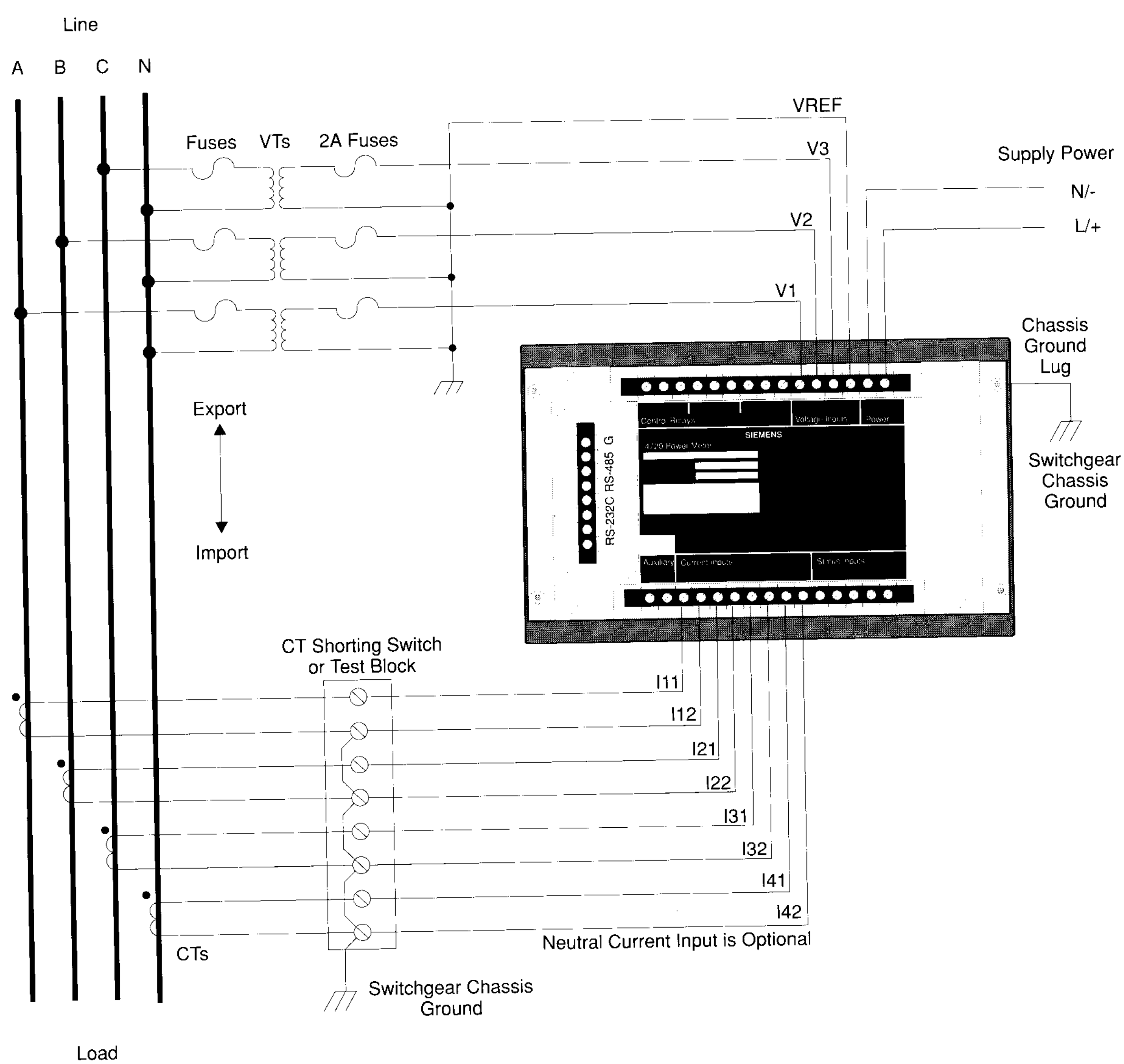
Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model
≤277VAC Line-to-Neutral/480VAC Line-to-Line Systems: 277 Option
≤347VAC Line-to-Neutral/600VAC Line-to-Line Systems: 347 Option

Figure 2.2 Four-Wire Wye, Three-Element Direct Connection

For wye system voltages over 347 VAC line-to-neutral/600 VAC line-to-line, VTs must be used. When VTs are used, both the VT primary and secondary must be wired in a wye (star). Voltage sense leads should have overcurrent protection at their source. Wiring must be exactly as shown for correct operation.

This configuration is shown in **Figure 2.3** below. VOLTS MODE should be set to 4W-WYE as explained in **Chapter 6, Programming**.



Volts mode is four wire wye. **VOLTSMODE:** WYE<4W>

Supported Models:

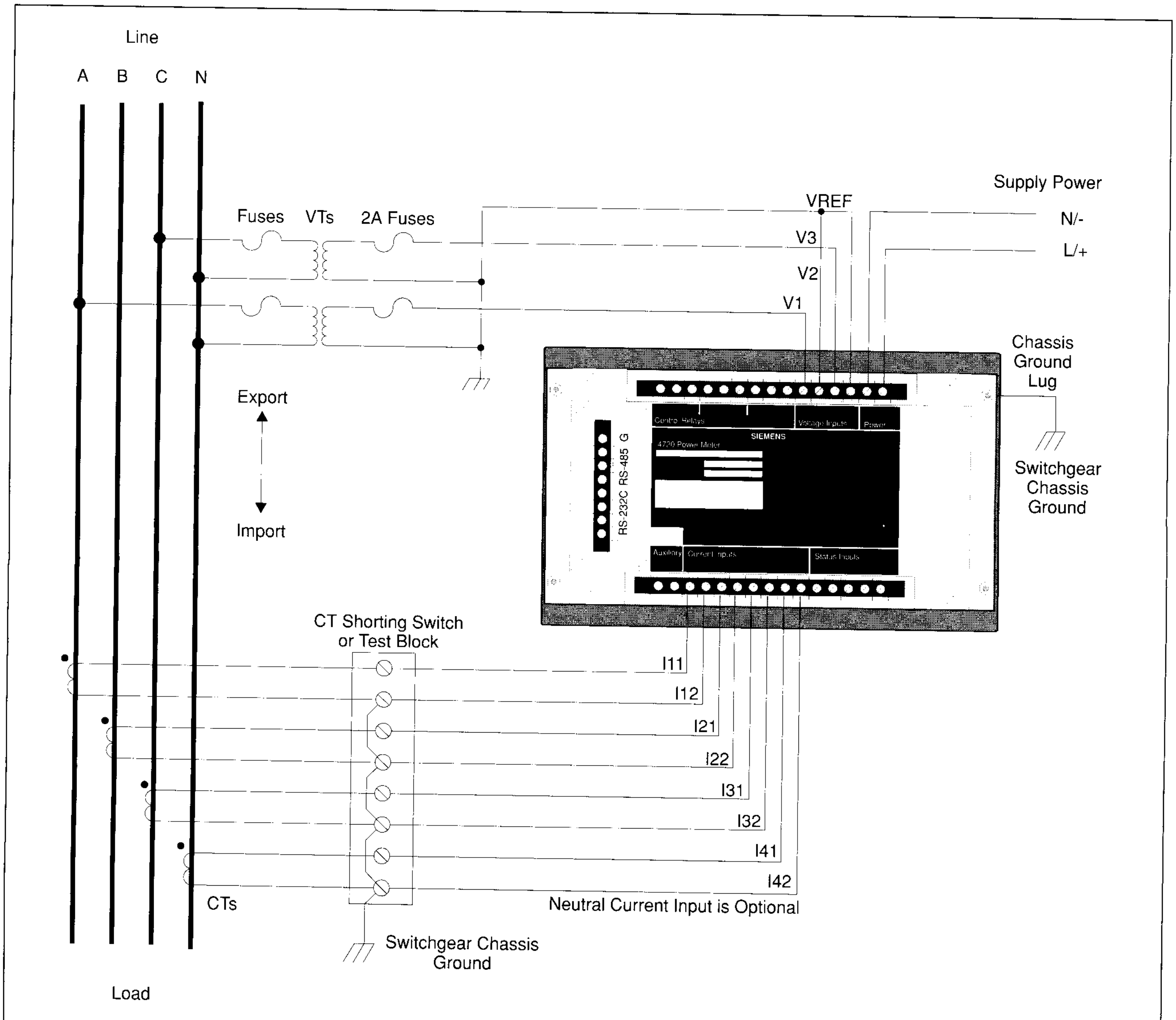
≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model

Figure 2.3 Four-Wire Wye, Three-Element Connection Using Three Voltage Transformers

The 4720 power meter also supports a 2½-element connection scheme which requires only two VTs. In this mode, the phase B voltage displayed on the front panel is derived from the available voltages.

This configuration is shown in **Figure 2.4**. VOLTS MODE should be set to 3W-WYE as explained in **Chapter 6, Programming**.

Note: VOLTS MODE = 3W-WYE only provides accurate power measurement if the voltages are balanced. If the phase B voltage is not equal to the phase A and C voltages, the power readings may not meet the 4720 power meter accuracy specifications.



Volts mode is three wire wye. **VOLTSMODE:** WYE<3W>

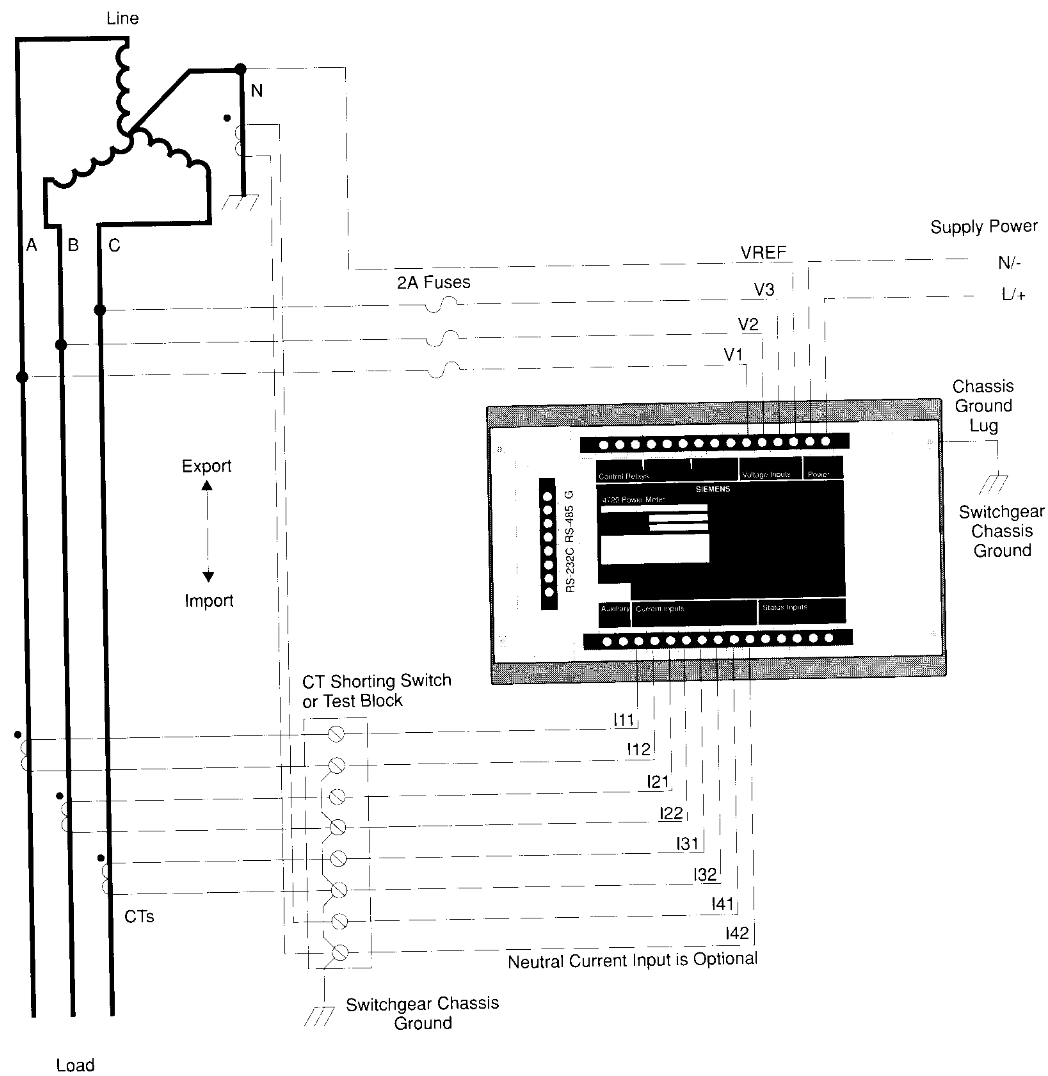
Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model

Figure 2.4 Four-Wire Wye, 2½-Element Connection Using Two Voltage Transformers

When the common or star point of a 3-wire wye system is grounded, the 4720 power meter may be connected directly without the use of VTs (provided the voltages are within the input range of the unit).

This configuration is shown in **Figure 2.5**. The VOLTS MODE should be set to 4W-WYE as explained in **Chapter 6, Programming**.



Volts mode is four wire wye. **VOLTSMODE:** WYE<4W>

Supported Models:

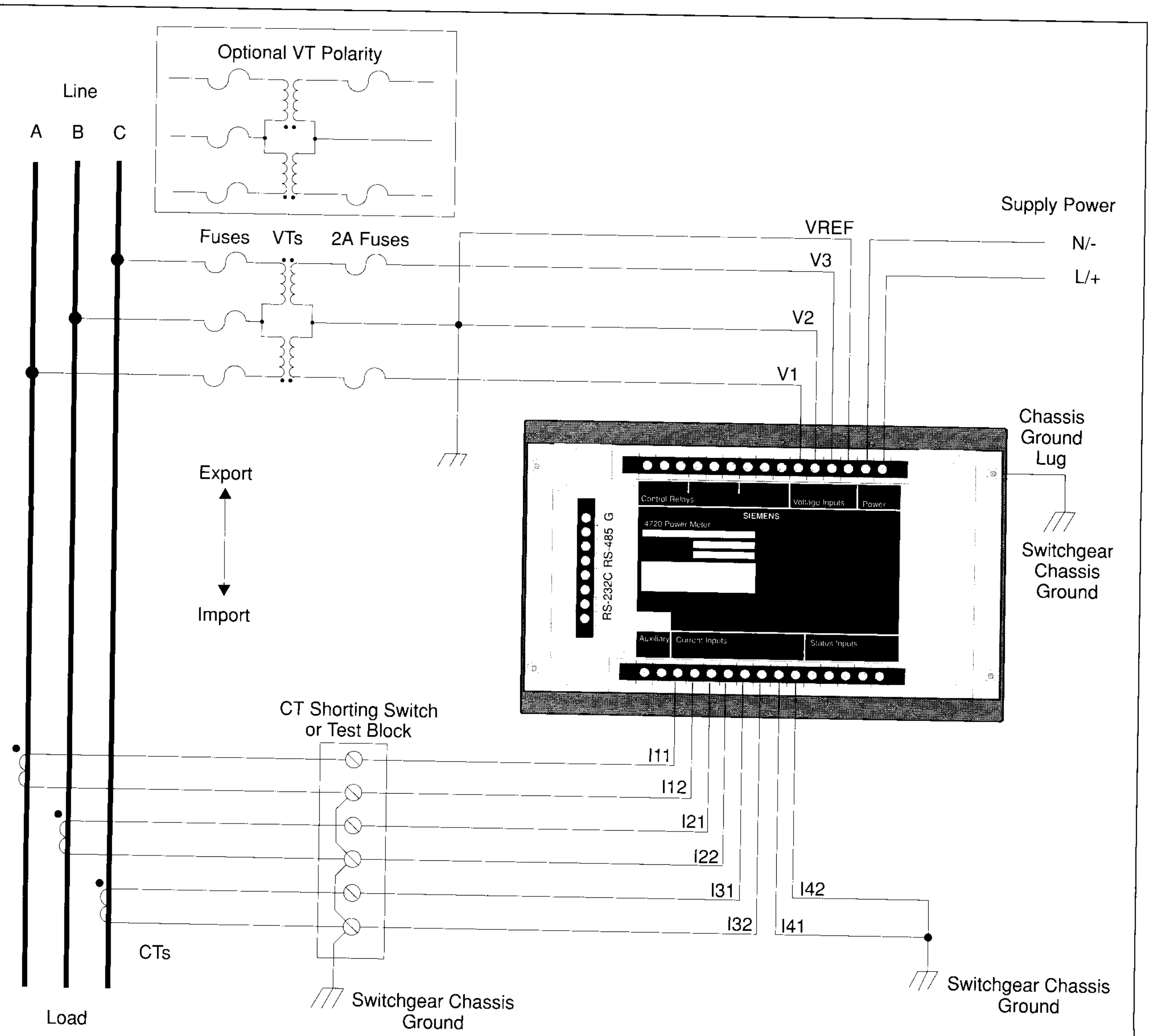
≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model
≤277VAC Line-to-Neutral/480VAC Line-to-Line Systems: 277 Option
≤347VAC Line-to-Neutral/600VAC Line-to-Line Systems: 347 Option

Figure 2.5 Three-Wire Wye, Three-Element Direct Connection

2.5.9 Three-Phase Delta Connection

For ungrounded (floating) 3-wire delta systems, the 4720 power meter always requires VTs and senses the line-to-line voltages between each of the phases.

The 4720 power meter may be connected in either of two ways: using two or three CTs. **Figure 2.6** below shows ungrounded delta connection using three CTs. VOLTS MODE should be set to DELTA as explained in **Chapter 6, Programming**.



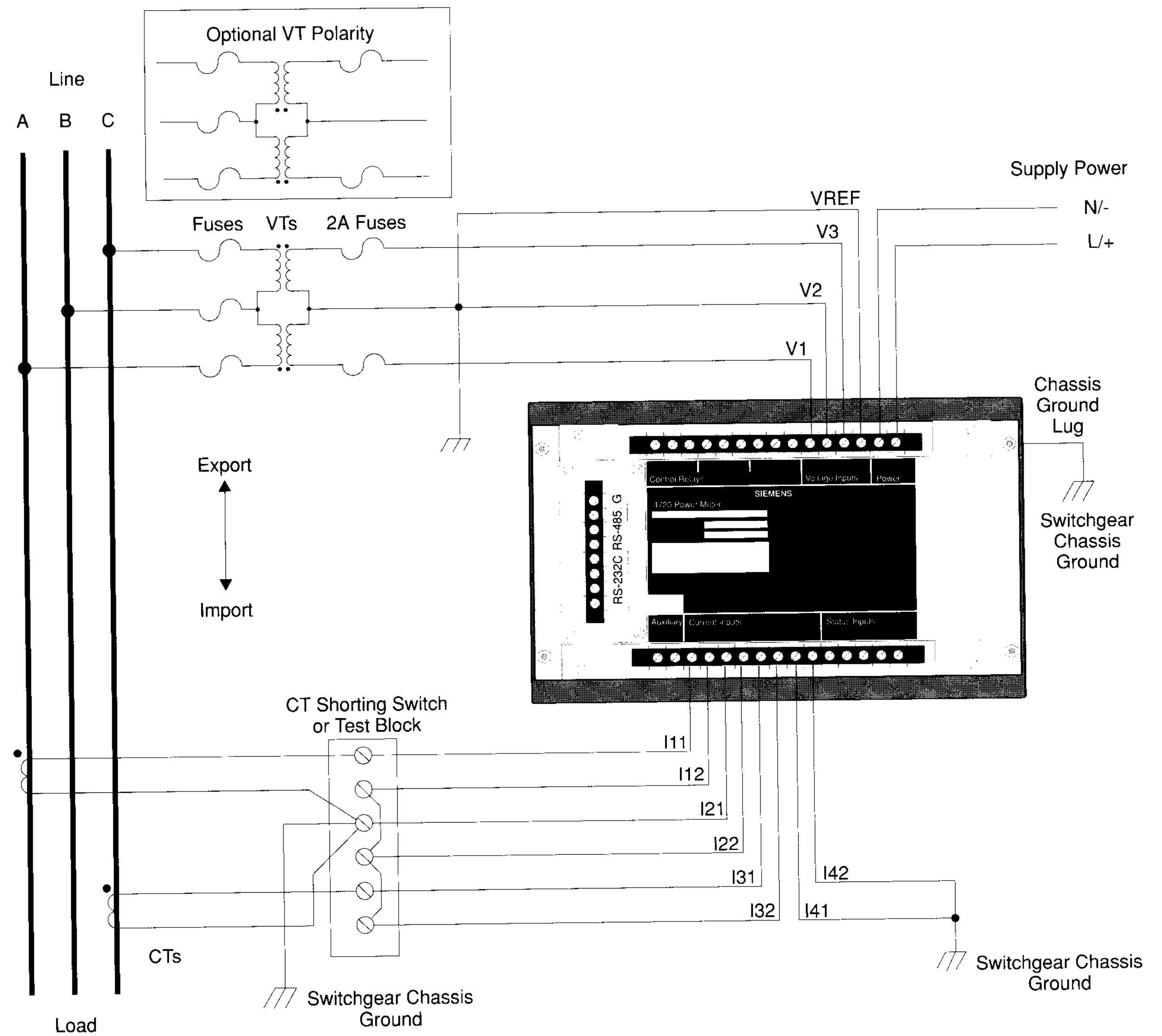
Volts mode is delta. **VOLTSMODE:** DELTA

Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model

Figure 2.6 Three-Wire Delta, 2½-Element Connection Using Two Voltage Transformers and Three Current Transformers

Figure 2.7 below shows ungrounded delta connection using two CTs. The VOLTS MODE parameter should be set to DELTA as explained in **Chapter 6, Programming**.



Volts mode is delta. **VOLTSMODE:** DELTA

Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model

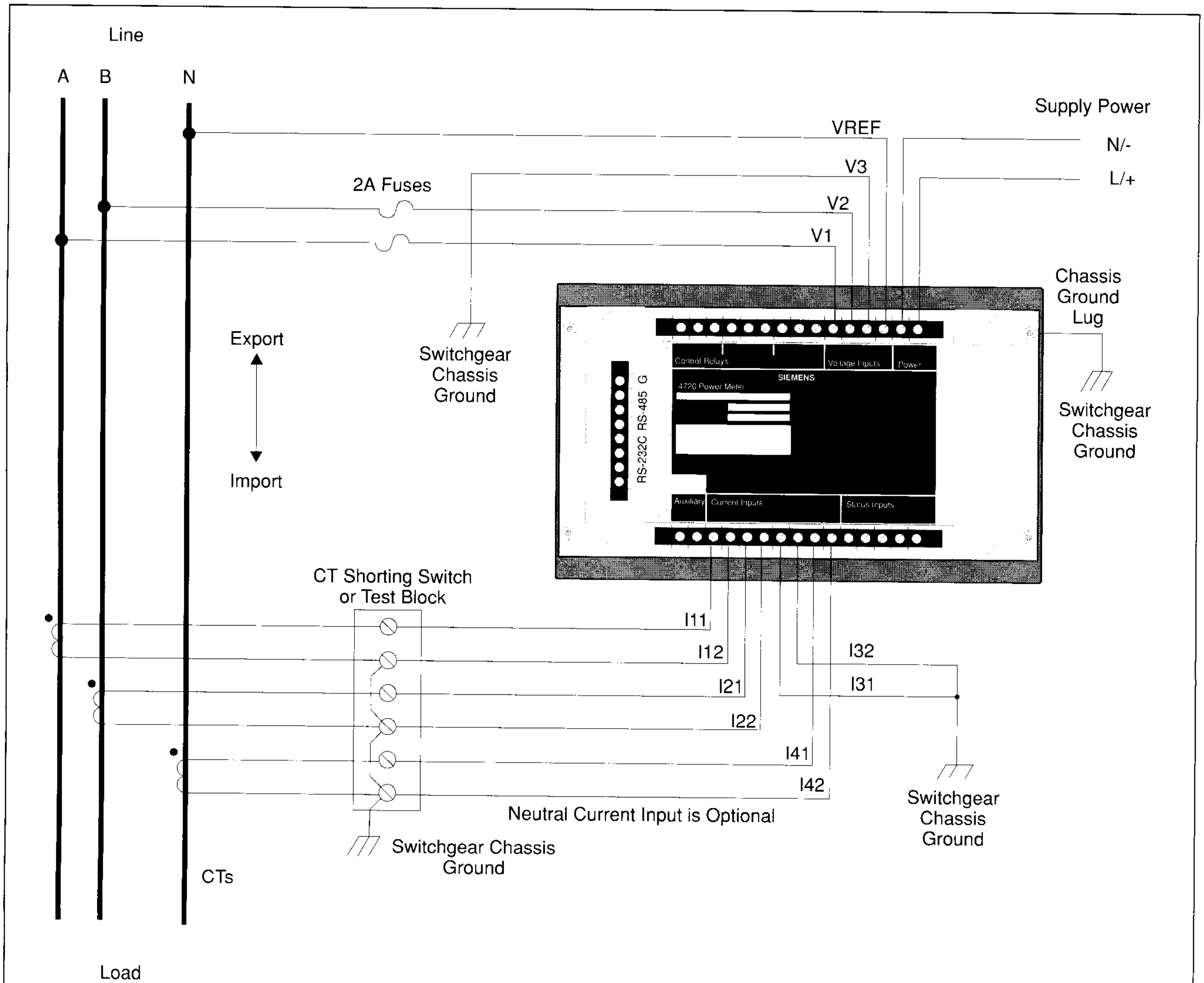
Figure 2.7 Three-Wire Delta, Two-Element Connection Using Two Voltage Transformers and Two Current Transformers

2.5.10 Single-Phase Connection

Wiring for single-phase systems is performed by connecting the two voltage phases (each 180 degrees with respect to the other) to the V1 and V2 inputs of the 4720 power meter, and the outputs of the two corresponding current transformers to the I1 input pair and I2 input pair.

This is illustrated in **Figure 2.8** below. Note that the V3 input and I3 input pairs are unused and should all be grounded.

For single phase systems, the VOLTS MODE of the 4720 power meter should be set to SINGLE as explained in **Chapter 6, Programming**.



Volts mode is sngle phase. **VOLTSMODE:** SINGLE

Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model
≤277VAC Line-to-Neutral/480VAC Line-to-Line Systems: 277 Option
≤347VAC Line-to-Neutral/600VAC Line-to-Line Systems: 347 Option

Figure 2.8 Three-Wire Single Phase, Two-Element Direct Connection

3 Communications Wiring

The 4720 power meter is equipped with a communications card. The card is field configurable to allow the 4720 power meter to communicate using either the EIA/TIA-232 (RS-232) or EIA/TIA-485 (RS-485) standard. Optical coupling provides full isolation between the RS-232 or RS-485 communication lines and the metering equipment. Protection circuitry provides protection from common mode voltages and incorrect connection. All inputs pass the ANSI/IEEE C37.90A-1989 surge withstand and fast transient tests.

Refer to **Chapter 11** for information regarding communication setup parameters.

The communications card is shipped with a label affixed to the mounting plate indicating the communications mode (RS-485 or RS-232) set at the factory. If the mode is incorrect for your application, refer to the following section for changing the configuration.

3.1 Configuring the Communications Card

This section describes how to change the communications mode of the 4720 communications card. You can select RS-232 or RS-485 lines by switching a jumper block on the card. The currently selected communications mode may be viewed from the power meter front panel, or by removing the card and examining the position of the jumper block. (See **section 6.2** for instructions on how to use the power meter front panel to display the communications mode.)

To remove the card for configuration:

1. Turn off the power to the 4720 power meter.
2. Remove the four machine screws holding the rectangular communications card mounting plate to the 4720 power meter case back cover.
3. Carefully pull the plate away from the main chassis to remove the card.

To configure the card:

The circuit board of the communications card has a jumper labelled J1. This jumper has two positions, labelled "RS485" and "RS232," which determine the communications mode. **Figure 3.1** illustrates the jumper position required for RS-485 or RS-232 mode. Move the jumper to the correct position.

To re-install the card:

1. Make sure that the power to the 4720 power meter is off.
2. Insert the communications card into the 4720 power meter, ensuring that the circuit card is oriented such that it will mate properly with the edge connector on the main board inside the 4720 power meter.

   Note: The card is polarized (keyed) to ensure it may only be installed in the correct orientation.

3. Align the holes in the mounting plate of the card with the mounting holes in the rear cover of the main chassis while lowering the card toward its seating. A correct alignment will allow the card edge to mate with the edge connector inside the main chassis.
4. Once the board is resting in proper alignment on the edge connector, carefully press down to plug the card into the edge connector.
5. Install the four mounting screws into the mounting plate to secure the card.

The card is now ready for use.

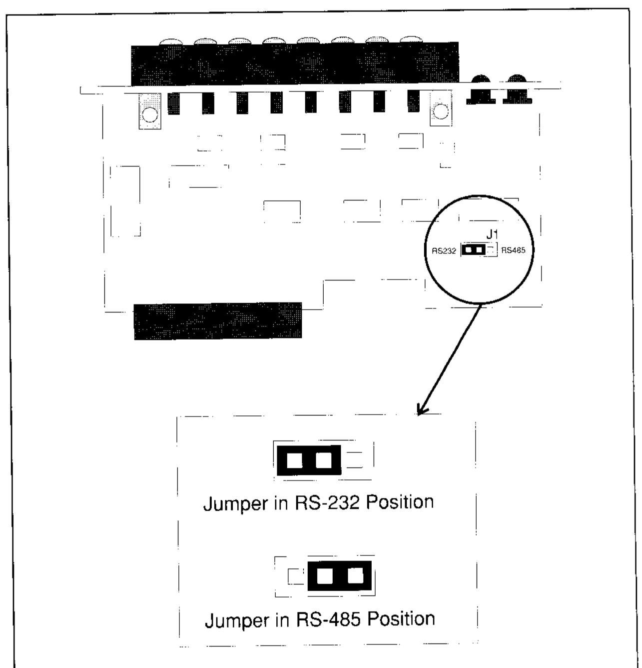


Figure 3.1 Communications Card Jumper Configuration

3.2 Terminal and LED Functions

The communications card provides a barrier-style terminal strip as shown in **Figure 3.2**. Terminal functions include:

Ground	GND	Chassis Ground
RS-485	SHLD	RS-485 Shield (electrically connected to chassis ground)
	-	RS-485 Data Minus
	+	RS-485 Data Plus
RS-232	RXD	RS-232 Receive Data (that is, receive data into device)
	TXD	RS-232 Transmit Data (that is, transmit data out of device)
	SG	RS-232 Signal Ground (isolated)
	RTS	RS-232 Request To Send (optional, see **Chapter 11**)

Two LED indicators, TXD and RXD, show activity on the RS-485 or RS-232 communication lines and can be used to verify correct communications operation. The TXD indicator flashes when data is being sent out by the device. The RXD indicator flashes when data is being received by the device.

3.3 RS-232 Connections

Figure 3.3 illustrates the wiring requirements for connection of the 4720 power meter using RS-232 communication. This can include a local direct connection to a computer or other device, or a remote connection via modem.

> **Note:** For information on remote connections via modem (telephone, fiber optic, radio, and so on), contact Siemens for a detailed application note.

The RS-232 standard allows only a single point-to-point communication connection. Using this method, only one RS-232 equipped device may be connected to the serial port of the computer, modem, or other device.

The cable used between the computer and the modem (if used) is a standard RS-232 communications cable with a maximum length of 50 feet (15.2 meters). Refer to the installation manuals for each device for cable requirements.

The cable used between the computer or modem and the 4720 power meter is a custom RS-232 cable. One end is equipped with a DB-25 or DB-9 plug (male) or socket (female) connector. The connector required depends on the mating computer or modem serial port connector. The other end of the cable consists of discrete wires which connect to the RS-232 terminals of the communications card of the 4720 power meter. Cable length is 50 feet (15.2 meters) maximum.

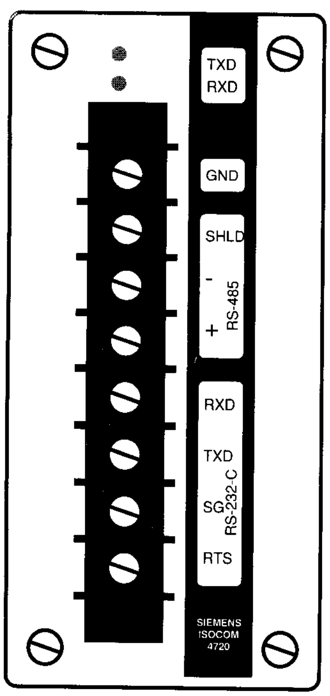


Figure 3.2 Communications Card Terminal Block

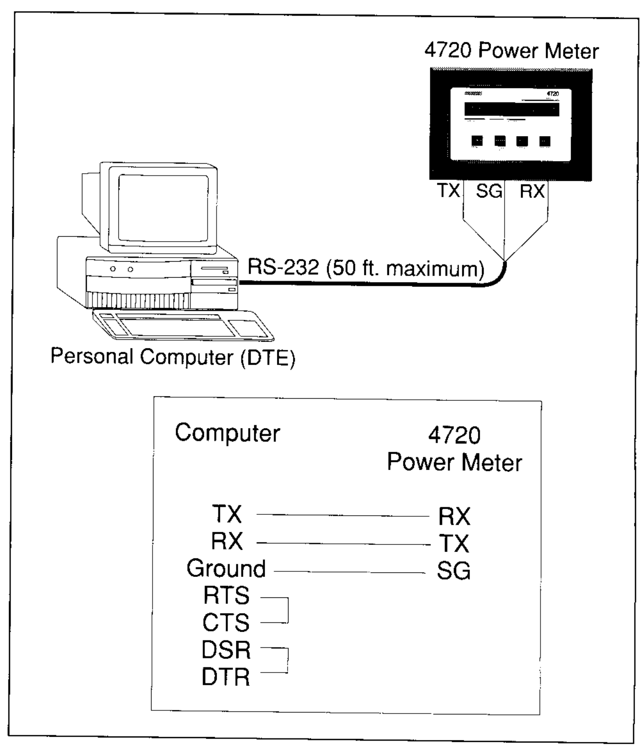
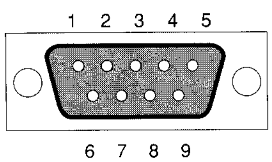
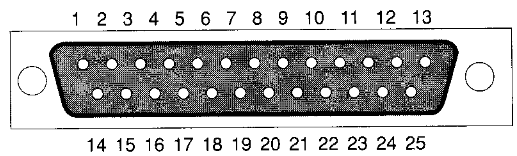


Figure 3.3 RS-232 Communications Connections



(Seen From Computer)

Pin	Computer (DTE)
1	RLSD
2	RX
3	TX
4	DTR
5	Ground
6	DSR
7	RTS
8	CTS
9	RI



(Seen From Computer)

Pin	Computer (DTE)	Isolated Multi-Drop Converter
1	Ground	Ground
2	TX	RX
3	RX	TX
4	RTS	RTS
5	CTS	CTS
6	DSR	DSR
7	Ground	Ground
8	RLSD	RLSD
20	DTR	DTR
22	RI	RI

Figure 3.4 RS-232 Cable Wiring Specifications

Figure 3.3 and **Figure 3.4** illustrate the RS-232 cable configurations and wiring connections.

If connected directly to a computer's RS-232 port, the TXD and RXD leads may need to be reversed at the remote device, depending on whether the PC RS-232 port is configured as DCE or DTE.

Refer to **Chapter 11** for information regarding the use of the RTS line of the 4720 power meter.

3.4 RS-485 Connections

RS-485 communications allow multiple devices to be connected on the same bus (see **Figure 3.5**). Up to 32 devices can be connected on a single RS-485 bus which consists of a shielded twisted pair cable. The overall length of the RS-485 cable connecting all devices cannot exceed 4000 feet (1219 meters).

To connect an RS-485 communications bus to a computer or other RS-232 equipped device, an RS-232 to RS-485 converter is required, such as the Siemens Isolated Multi-Drop™ converter. The Isolated Multi-Drop converter offers four RS-485 ports that can each support up to 32 devices.

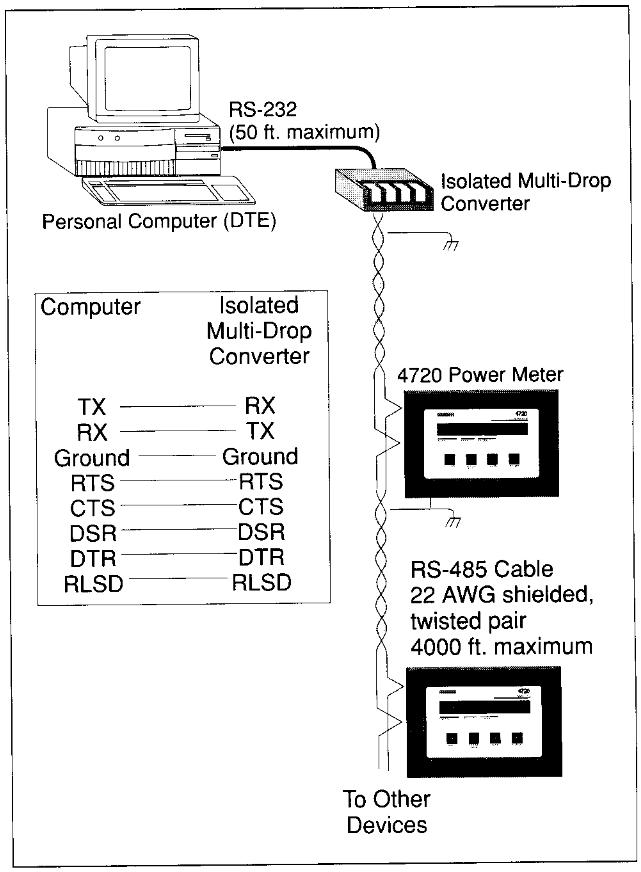


Figure 3.5 RS-485 Communications Connections

Devices connected on the bus, including the 4720 power meter converter(s), and other instrumentation, must be wired as follows:

1. Use a good quality shielded twisted pair cable for each RS-485 bus. It is recommended that 22 AWG (0.6 mm) or larger conductor size be used.
2. Ensure that the polarity is correct when connecting to the RS-485 port (+) and (-) terminals of each device.
3. The shield of each segment of the RS-485 cable must be connected to ground at one end only.

   Note: Do not connect ground to the shield at both ends of a segment. Doing so allows ground loop currents to flow in the shield, inducing noise in the communications cable.

4. It is recommended that an intermediate terminal strip be used to connect each device to the bus. This allows the easy removal of a device for servicing if necessary.
5. Cables should be isolated as much as possible from sources of electrical noise.

Devices on an RS-485 bus are connected in a point-to-point configuration with the (+) and (-) terminals of each device connected to the associated terminals on the next device.

3.4.1 Topologies

While there are many topologies that can be used to connect devices on an RS-485 communications bus, the two recommended methods are the straight-line and the loop topologies.

Straight-Line Topology

The straight-line wiring method is illustrated in **Figure 3.5**. Note that connections are shown for one RS-485 port only. The Isolated Multi-Drop converter supports four RS-485 buses simultaneously. The Isolated Multi-Drop converter can exist at any position on the RS-485 bus, including an end point.

Each end point of the straight-line bus must be terminated with a 1/4 W resistor. These termination resistors reduce signal reflections that may corrupt data on the bus.

Termination resistors are connected between the (+) and (-) terminals of the device at each end of the bus. This device can include either a converter or any other instrument. The value of the resistor should match the line impedance of the cable being used. For 22 AWG shielded twisted pair cable, values between 150 and 300 Ω are typical. Consult the cable manufacturer's documentation for the exact impedance of your cable.

Loop Topology

The Isolated Multi-Drop converter can exist at any position on the RS-485 bus when using a loop topology. The loop topology does not require termination resistors at any point on the bus.

One advantage of the loop topology is that a single open circuit fault condition anywhere on the loop will not result in the loss of communication between the computer station and any of the remote devices.

3.4.2 Calculating Overall Cable Length

When determining the overall length of an RS-485 communication straight-line or loop connection, it is important to account for all cable segments. For example, when RS-485 connections to the device are made via an intermediate terminal block, the length of the cable between the device and the terminal block must be added to the total cable distance.

Refer to the *ACCESS Installation System* (Manual No. SG-6028-01) for detailed information on calculating the cable length.

4 Optional Wiring

4.1 Control Relay Connections

This section describes the wiring connection requirements and applications of the 4720 power meter control relays. **Section 6.6** in **Chapter 6** describes the operation of the relays.

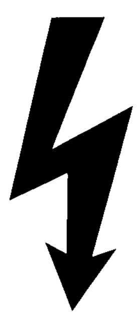
The basic 4720 power meter provides three Form C electro-mechanical control relays. **Figure 4.1** illustrates the wiring connection requirements for these relays. These relays are rated for 277 VAC or 30 VDC at 10 A resistive load.

4.1.1 Relay Application Precautions

In applications where the relays are used to perform critical equipment control operations (for example, breaker trip), the important precautions described below should be followed.

1. Connection to the external equipment should be made via an intermediate mechanism such as a local/remote switch allowing relay control to be completely disabled for commissioning and servicing (see **Figure 4.1**).
2. Following initial power up, the 4720 power meter should be programmed (see **Chapter 6**), including all required setpoints for setpoint controlled relay operations (see **Chapter 8**).
3. The relay outputs of the 4720 power meter should be tested to ensure that setpoint or manual control condi-tion(s) are occurring as expected.
4. Once correct relay operation has been verified, relay control of the external equipment can be enabled.

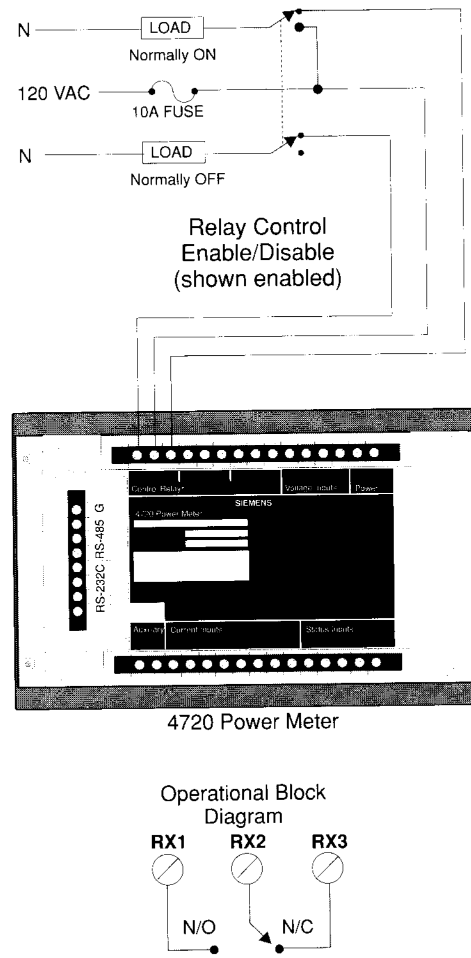
⚠ WARNING



Hazardous voltages and currents are present.

Can cause death, serious personal injury, or equipment damage.

Do not use the power meter as a primary protection device.



State:	Rx1/Rx2	Rx2/Rx3
Inactive	Open	Closed
Active	Closed	Open
Pulse	Closed for Duration of Pulse	Open for Duration of Pulse

Notes:

1. Relays are Form C dry contact rated at 277 VAC or 24 VDC at 10 Amps.
2. Only relevant 4720 power meter terminal block connections are illustrated.

Figure 4.1 Control Relay Connections

Primary Protection

The relays of the 4720 power meter should not be used for primary protection functions. These include applications where the device would be providing:

- Overcurrent protection on circuit breakers.
- Protection of people from injury. If failure of the device can cause injury or death, the 4720 power meter should not be used.
- Energy limiting. If failure of the device will cause sufficient energy to be released that a fire is likely, the 4720 power meter should not be used. In electrical systems, energy limiting is normally provided by circuit breakers or fuses.

Secondary Protection

The 4720 power meter can be used for secondary (that is, backup) protection functions. Secondary protection includes:

- Situations where the 4720 power meter is backing up a primary protection device (shadow protection), such as an overcurrent relay.
- Situations where the 4720 power meter is protecting equipment, not people. This typically includes applications such as over/under voltage, reverse power flow, and so on.

4.2 Status Input Connections

This section illustrates wiring connection methods and applications for the status inputs. **Section 6.7** in **Chapter 6** describes the operation of the status inputs.

The 4720 power meter uses a current sensing technique to monitor the status of an external dry contact. The 4720 power meter provides an internal 30 VDC supply for self-excitation of the status inputs (see **Figure 4.2**). These can be used for dry contact sensing applications, but not for voltage sensing applications. Note that no ground or external voltage connections are required.

> **Note:** The 4720 power meter status inputs can only be used for dry contact sensing applications. Connection of an external voltage source to any of the status inputs of a standard equipped 4720 power meter can cause permanent damage to the 4720 power meter.

An open contact registers as inactive; a closed contact registers as active.

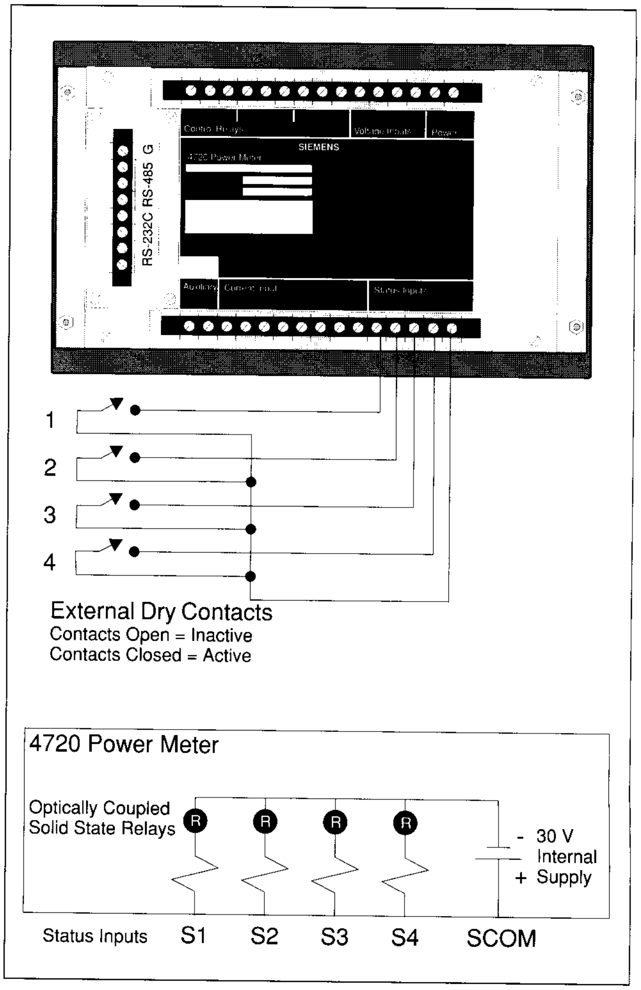


Figure 4.2 Status Input Connections

4.3 Auxiliary Voltage Input

Figure 4.3 illustrates several possible wiring connection methods and applications for the VAux input. **Section 6.8** in **Chapter 6** describes the operation of this input.

Note: VAux is a non-isolated input. If full isolation is required, use an intermediate isolation transducer.

4.4 Auxiliary Current Output

Figure 4.4 illustrates several possible wiring connection methods and applications for the IOut output. **Section 6.9** in **Chapter 6** describes the operation of this output.

Note: IOut is a non-isolated output. If full isolation is required, use an intermediate isolation transducer.

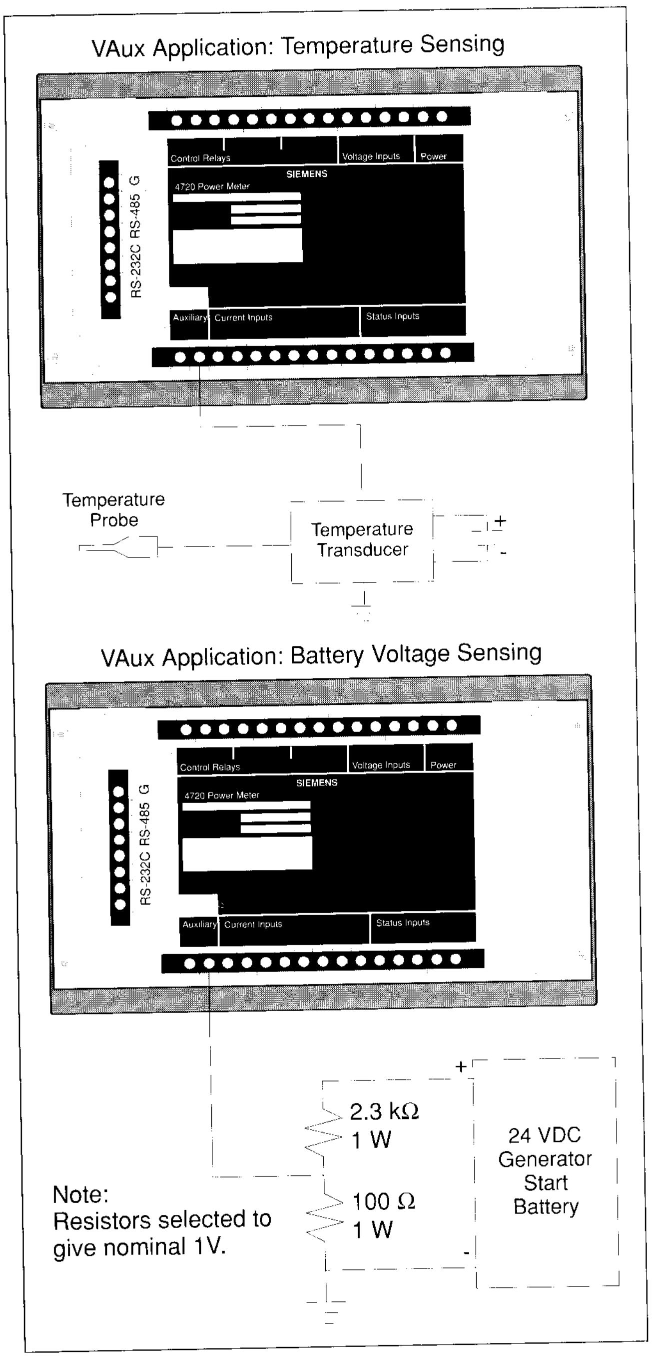


Figure 4.3 Auxiliary Voltage Input Connections

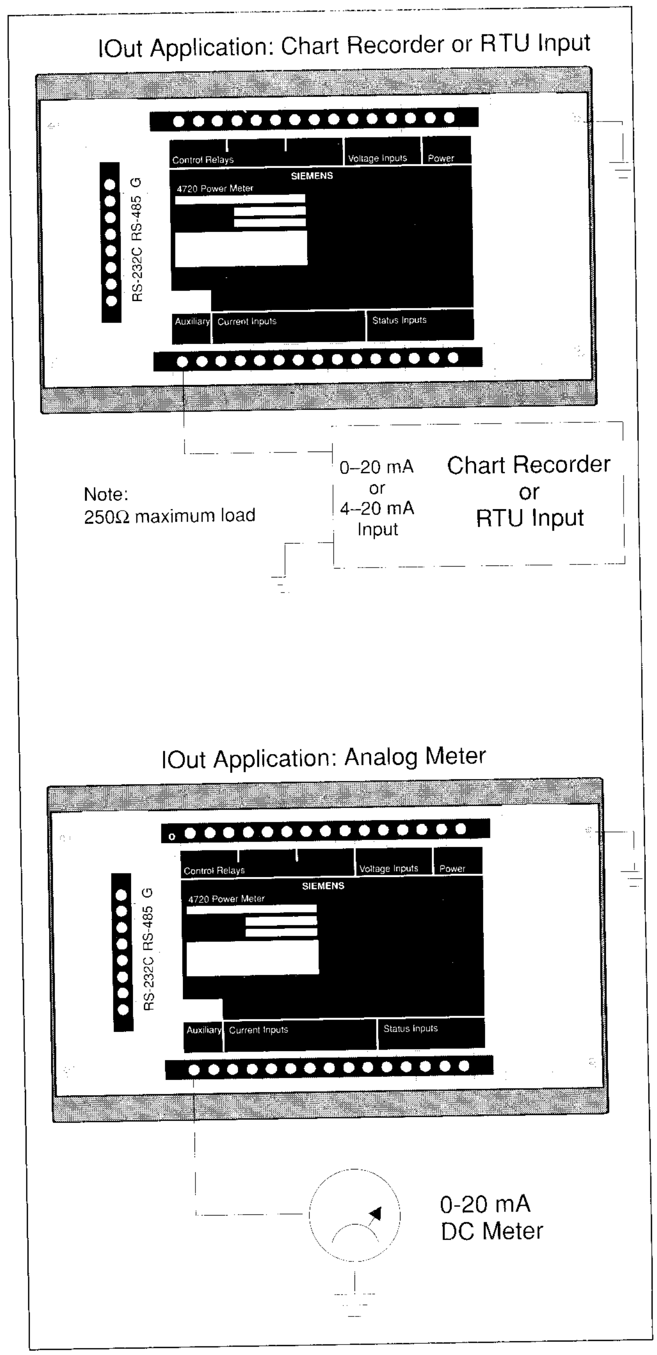


Figure 4.4 Auxiliary Current Output Connections

5 Operator Interface

This chapter describes the following:

- Power-up procedure
- Front panel operation

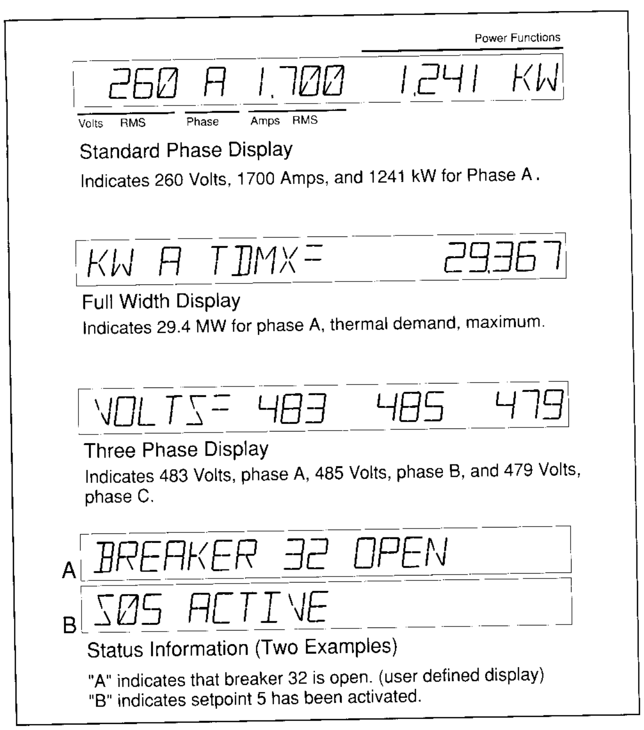
For a description of the 4720 power meter display mode and a complete list of the meter's measured parameters and status information available, refer to **Chapter 7, Displaying Information**. Refer to **Chapter 6, Programming**, for a description of programming mode and instructions on how to program the meter.

Chapter 8 through **Chapter 10** describe the setup and operation of the advanced features of the 4720 power meter including setpoint, waveform, and logging functions. Remote communications setup and operation are described in **Chapter 11**.

5.1 Start Up

After all installation wiring is complete and has been double checked, the unit may be powered up by applying the appropriate voltage to the power input terminals.

The 4720 power meter first enters its display mode, presenting Volts-Phase-Amps-Power Function. The power function displayed on power up is kW average, totalled for all phases (see **Figure 5.1**). The values initially appearing may not be correct, since the unit has not been properly programmed with the correct information. Refer to **Chapter 6, Programming**, for instructions on how to program the meter.



Standard Phase Display
Indicates 260 Volts, 1700 Amps, and 1241 kW for Phase A.

Full Width Display
Indicates 29.4 MW for phase A, thermal demand, maximum.

Three Phase Display
Indicates 483 Volts, phase A, 485 Volts, phase B, and 479 Volts, phase C.

Status Information (Two Examples)
"A" indicates that breaker 32 is open. (user defined display)
"B" indicates setpoint 5 has been activated.

Figure 5.1 Front Panel Display Modes

5.2 Front Panel Operation

The 4720 power meter provides a unique and very flexible user interface. One of its front panel features is the large, high-visibility, 20-character vacuum fluorescent display. The other feature is the row of four long-life, stainless steel membrane buttons for parameter selection and local programming functions. See **Figure 5.2** for an illustration of the front panel of the 4720 power meter.

The display can present a wide variety of information in many different formats. The user can customize the display by defining which measured parameters can be accessed and in what format they are displayed. The 4720 power meter front panel can display readings of up to nine digits including any floating point decimals. The type of information and formats that can be displayed are described below.

5.2.1 Standard Phase Display

The front panel display (on power up) presents volts, amps and power functions for the selected phase. The Phase button is used to advance through each phase in sequence, while a selection of power functions can be accessed using the Function button. The format of the phase labels and numeric readings can be programmed to conform to international conventions (see **section 6.4**).

5.2.2 Full Width Display

Very large measured values (for example, kW hr) and parameters with large display labels are presented using the entire display.

> **Note:** While viewing a full-width display, press the Phase button to return to the standard Volts-Phase-Amps display.

5.2.3 Three-Phase Displays

Concurrent display of readings for all three-phase voltages or currents is possible. The Menu buttons can be programmed to access these displays (see **section 5.2.9**).

5.2.4 Status Information

Status information includes the present condition of the three relays, four digital (status) inputs, and seventeen setpoints. The Menu buttons can be programmed to access all status information (see **section 5.2.9**). For example, the two possible conditions of a setpoint-controlled relay could be displayed as "breaker normal" and "overcurrent trip." Display labels for relay and status input conditions are user-definable via communications. Device programming is described in **Chapter 6**.

Figure 5.3 lists the display labels used by the 4720 power meter to identify various measurement modes and status information. These labels are further described in **Chapter 7**.

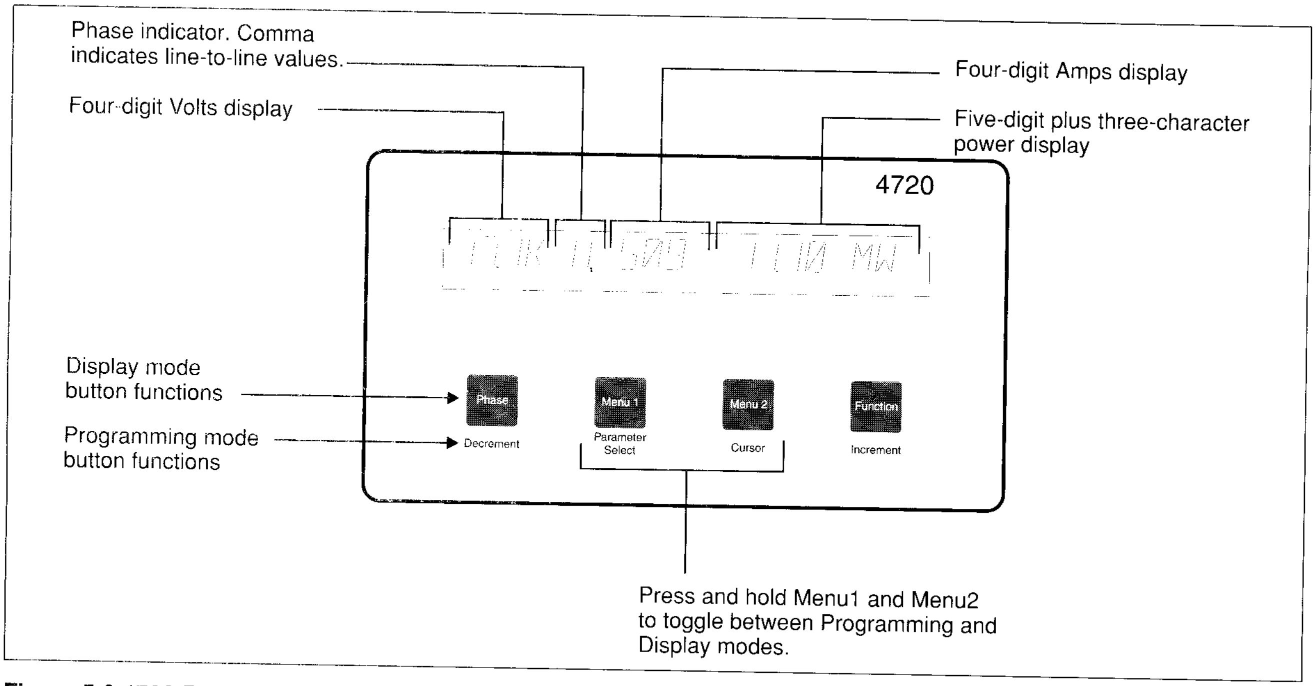


Figure 5.2 4720 Front Panel Buttons

5.2.5 Parameter Formats

Special parameter name formats are used on the front panel of the 4720 power meter. These labels are also used to identify parameter types selected by the user in programming mode.

Most measured parameter readings are displayed in integer format. The use of floating decimal points depends on the parameter type. Harmonic distortion readings are displayed with one decimal place. Frequency readings are presented with two decimal places. Status Input Counter totals can be displayed with between 0 and 3 decimal places depending on the user-definable parameter setting (see **section 6.4**).

5.2.6 Timeout Feature

The life and brightness of the 4720 power meter vacuum fluorescent display can be significantly extended by reducing the "on" time. The 4720 power meter provides a DISPLAY TIMEOUT parameter that can be used to set a timeout interval of 1 to 999 minutes, after which the display automatically switches to display saver mode. This interval starts counting down from the last button press made on the front panel. A timeout interval of 180 minutes (3 hours) or less is recommended. Setting the parameter to zero causes the display to stay on indefinitely. While the display is in display saver mode, pressing any button on the front panel turns on the normal display again. Device programming is described in **Chapter 6**.

5.2.7 Phase Button

The 4720 power meter uses four long-life, stainless steel membrane buttons. The label above each button names a Display Mode operation while the label below the button refers to a Programming Mode operation (see **Figure 5.2**). The buttons are used for parameter selection and local programming functions.

If you are viewing the standard display, the Phase button advances through each phase. The sequence of phase readings depends on the device setup, including the volts mode and phase rotation selected (device setup is described in **Chapter 6**). The Phase field of the front panel display indicates the phase for which readings are being displayed. Phase indicators displayed without a comma indicate line-to-neutral values are being displayed for the indicated phase. Phase indicators displayed with a comma indicate line-to-line values are being displayed for the indicated phase. An asterisk (*) symbol indicates that the average for all line-to-neutral or line-to-line phases is being displayed.

RT	Real Time
THD	Total Harmonic Distortion
TEH	Total Even Harmonic Distortion
TOH	Total Odd Harmonic Distortion
HD3	Individual Harmonic Distortion (3rd)
TD	Thermal Demand
SD	Sliding Window Demand
PD	Predicted Sliding Window Demand
MN	Minimum
MX	Maximum
IM	Imported Energy
EX	Exported Energy
NT	Net Energy
TOT	Total Energy
R03	Relay Output (3)
S4	Status Input (4)
H06	High Speed Setpoint (6)
S09	Standard Setpoint (9)
TOC	Time Overcurrent Curve
HSS	High Speed Snapshot Log

Figure 5.3 4720 Display Labels for Measured Parameters and Status Information

The following phases of readings are available in each mode:

VOLTS MODE = 4W-WYE, 3W-WYE, or DEMO
For each of these modes, the Phase button advances through:

- line-to-neutral average of the three phases
- line-to-neutral values for each phase
- line-to-line average of the three phases
- line-to-line values for each phase

VOLTS MODE = DELTA
The Phase button advances through:

- line-to-line average of the three phases
- line-to-line values for each phase

VOLTS MODE = SINGLE
The Phase button advances through:

- line-to-neutral average of the two phases
- line-to-neutral values for each phase and the line-to-line value

The Phase button also advances the display through each relay (R1 to R3), digital status input (S1 to S4), or setpoint (S01 to S11, H01 to H06) when status conditions are being displayed.

You can make the 4720 power meter automatically cycle the display through each phase by holding down the Phase button for more than four seconds, then releasing. The display advances through each phase at four second intervals, displaying the volts and amps for each phase. Pressing any button returns the display to the regular non-cycling viewing mode.

5.2.8 Function Button

A preset list of useful power function parameters is available via the Function button. Press the Function button to advance through each measured parameter.

For per-phase values displayed using the Function button, the Phase button can be used to advance the display through each phase.

The following is the complete sequence of power function parameters accessible using the Function button:

- kW per phase
- kVAR per phase
- kVA per phase
- Power Factor per phase
- Current I4
- Frequency (phase A)
- Voltage VAux
- kWH Import (total for all 3 phases)
- kWH Export (total for all 3 phases)
- kVARH Import (total for all 3 phases)
- kVARH Export (total for all 3 phases)
- kVAH Net (total for all 3 phases)

A full description of each parameter is provided in **Chapter 7, Displaying Information**.

You can make the 4720 power meter automatically cycle the display through each power function on the front panel display. The power functions displayed are the group of parameters normally displayed using the Function button (kW, kVAR, and so on). To start the cycling mode, hold down the Function button for more than four seconds, then release. The display will advance through each power function at four second intervals. Pressing any button will return the display to the regular non-cycling viewing mode.

5.2.9 Menu Buttons

You can use the Menu 1 and Menu 2 buttons to display additional groups of measurements and status information. The parameters accessible using each Menu button are user-definable. Up to 18 parameters may be assigned to each button. Similar to the Function button, each press of a Menu button will advance the display through the list of items assigned to that button.

The Menu buttons are ideal for creating convenient custom groupings of important parameters for quick viewing. For example, the user might wish to assign the third and fifth harmonic distortion values for each input to the Menu 1 button and relay status information to the Menu 2 button. Any of the measured and status parameters can be assigned to either Menu button. Programming the Menu buttons must be performed via communications and WinPM software.

For per-phase parameters displayed using the Menu buttons, the Phase button can be used to advance the display through each phase. For relay, status input, and setpoint conditions, the Phase button can be used to advance through each relay, status input or setpoint number. The mode function can also be used to display additional related parameters, if applicable. This feature is described in **section 5.2.10**.

The following default parameters have been assigned to each Menu button.

Menu 1:

- Three-phase Voltage line-to-neutral (if applicable)
- Three-phase Voltage line-to-line
- Three-phase Current
- Voltage line-to-neutral Maximum per phase (if applicable)
- Voltage line-to-line Maximum per phase
- Current Maximum per phase
- kW Maximum per phase
- kVAR Maximum per phase
- Frequency Maximum (phase A)
- Power Factor Minimum per phase
- Power Factor Maximum per phase
- Frequency Minimum (phase A)
- Voltage line-to-neutral Minimum per phase
- Voltage line-to-line Minimum per phase
- Relay Condition (1 to 3)
- Status Input Condition (1 to 4)

Menu 2:

- Voltage THD (total harmonic distortion) per phase
- Current THD per phase
- Voltage THD Maximum per phase
- Current THD Maximum per phase
- Current 3rd HD (harmonic distortion) per phase
- Current 5th HD per phase
- Current 7th HD per phase

- Current Sliding Window Demand Maximum average of all phases
- kW Sliding Window Demand Maximum total of all phases
- kVAR Sliding Window Demand Maximum total of all phases
- kVA Sliding Window Demand Maximum total of all phases

A full description of each parameter is provided in **Chapter 7, Displaying Information**.

5.2.10 Mode Function

As an added convenience feature, a special mode function has been provided for use with parameters assigned to the Menu 1 or Menu 2 button. The mode function is enabled after the Menu buttons have been programmed (see **section 5.2.9**).

The mode function provides quick access to additional measurement modes for the parameter currently being displayed, if applicable. For power and harmonic distortion parameters, this can include demand and minimum/maximum values. For example, if the front panel display is presenting a kW measurement, the mode function can be used to advance the display through kW Min, kW Max, kW Thermal Demand, kW Thermal Demand Min, and kW Thermal Demand Max. The sequence of parameters displayed is definable by the user via communications.

The mode function can also be used to advance through all bi-directional modes of an energy parameter. This can include import, export, net, and total measurements.

The mode function is accessed using a special button combination on the front panel:

1. Press the Function button and the Menu button that includes the desired parameter at the same time.
2. Repeat pressing the Function and the Menu button simultaneously to scroll through the available modes.

   Note: If a particular parameter accessed using a Menu button has not been programmed to provide additional modes, the mode function has no effect.

3. To return the front panel buttons back to normal operation, press the Menu button only.

5 Operator Interface

6 Programming

Basic device programming can be performed quickly and easily from the front panel (called *local programming*) or via the communications port using a portable or remotely located computer. Basic setup parameters include scaling factors for the voltage and current inputs, voltage mode (wye, delta, and so on), and communications settings.

The customization of the front panel display and the programming of the Menu buttons are only possible via the communications port. The same applies to advanced features such as waveform capture, waveform recording, data logging, and setpoint and relay control functions. WinPM software fully supports 4720 power meter programming, providing a number of parameter screens which make setup quick and easy. (The open communications protocol of the 4720 power meter also allows free access to all programming parameters using any compatible third-party system.)

Setup and other critical information are stored in nonvolatile memory and are not lost if power to the unit is turned off. All programming is password protected.

A complete list of all programmable setup parameters is provided in **section 6.10**.

This manual describes procedures for programming the 4720 power meter from its front panel only. For information on programming via communications using WinPM software, refer to the documentation for WinPM.

6.1 Programming Mode

To program the setup parameters of the 4720 power meter from the front panel, you must first enter programming mode. To enter programming mode, press the two Menu buttons at the same time (see **Figure 6.1**). When programming mode is first entered, "PROGRAMMING MODE" is displayed.

You can return to display mode at any time by again pressing the two Menu buttons at the same time.

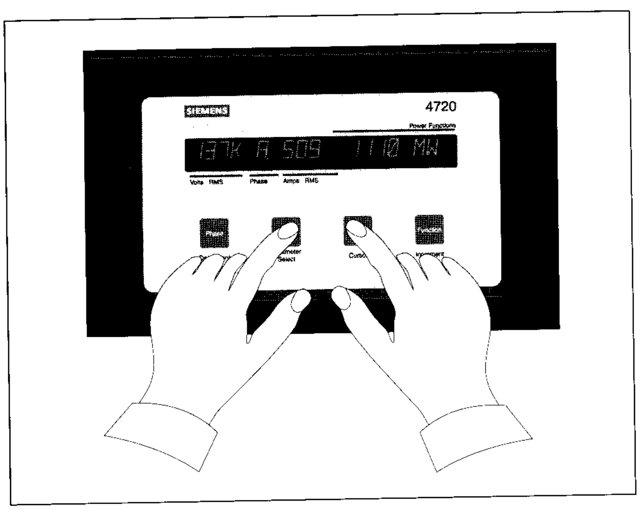


Figure 6.1 Entering Programming Mode

6.1.1 Programming Button Functions

In programming mode, the buttons of the front panel take on new programming functions. The label below each button indicates its alternate function.

Parameter Select
: Selects which parameter is displayed.

Cursor
: Moves the cursor left one digit. The cursor position wraps around to the right of the number if advanced past the left-most digit.

Increment
: Increments the digit at the cursor, advances through a number of preset values, or toggles a yes/no option.

Decrement
: Decrements the digit at the cursor, advances through a number of preset values in reverse order, or toggles a yes/no option.

6.1.2 Entering the Password

At shipping, the 4720 power meter password is set to zero (0). In programming mode, press the Parameter Select button until the PASSWORD parameter appears. Enter the password using the Cursor and Increment buttons. You must enter the password to change any parameter values, although you can view them on the front display panel at any time. You can also change the password as described in the next section. If the password is lost or forgotten, contact Siemens customer service.

6.1.3 Changing the Password

To change the password, use the following procedure:

1. Enter programming mode by pressing and holding simultaneously the Menu 1 and Menu 2 buttons (see **Figure 6.1**).
2. Press Parameter Select until the PASSWORD parameter appears. Enter the present password using the Cursor and Increment buttons.
3. Press the Parameter Select button repeatedly until the PASSWORD parameter appears again.
4. Enter the new password using the Cursor and Increment buttons.
5. Return to display mode. The new password is now in effect.

6.2 Accessing and Modifying Parameters

To support the extensive functionality and flexibility that the 4720 power meter offers, a large number of user-programmable parameters are provided. To make local programming as efficient as possible, the parameters accessible via the front panel have been organized into six groups:

- Basic System Setup
- Auxiliary Setup
- Clear Functions
- Communications
- Front Panel Display
- Diagnostics

Each parameter group has an access parameter with the default value NO. If the setting is not changed, the parameter group will be skipped when pressing the Parameter Select button. With the value set to YES, the Parameter Select button advances through each parameter within that group.

Advancing past all parameters within a group returns you to the access parameter for that group with its value set to NO. You can then skip to the next group by pressing Parameter Select or gain access once more to the same group by setting the parameter to YES.

The entire parameter list wraps around. If a parameter group is missed, the Parameter Select button may be pressed repeatedly to return to the desired group.

6.3 Defining New Parameter Values

If the correct password was entered, you can modify any setup parameter. As discussed in **section 6.1.1**, the Cursor, Increment, and Decrement buttons can be used to change individual digits or select from a preset list of options for that parameter value. **Section 6.10** lists all programmable parameters and their range of possible values.

If you attempt to set a parameter to a value outside of its allowed range, the display flashes the message "INVALID ENTRY." The message remains on the display until any button is pressed. The parameter is shown again with its previous value.

Parameter modifications are implemented immediately when you advance to the next parameter.

Once all parameters have been set to their desired values, pressing the two Menu buttons at the same time returns to display mode.

Figure 6.2 and **Figure 6.3** show a step-by-step example of how to program the operating parameters from the front panel. The example given shows how to set the VOLTS MODE to DELTA, the VOLTS SCALE to 277, and the AMPS SCALE to 2000.

6.4 Display Format

The 4720 power meter front panel display can present numeric information and phase labels in a number of different formats which reflect various world and industrial standards. Two programmable parameters are used to define the display format:

FORMAT

This parameter allows you to select formats for numeric information. The front panel display can present measured values using either of the two following numeric formats:

1,234.5 This is the default. A comma is used for the thousands delimiter (radix), and a decimal point is used for the decimal delimiter.

1234,5 No thousands delimiter is used, and a comma is used for the decimal delimiter.

PHASE LABELS

This parameter defines the three letters used for the phase labels. The possible choices are ABC (default), XYZ, RYB, and RST.

6.5 Basic Settings

This section details the minimum basic programming setup required for proper operation of the 4720 power meter.

6.5.1 Volts Scale

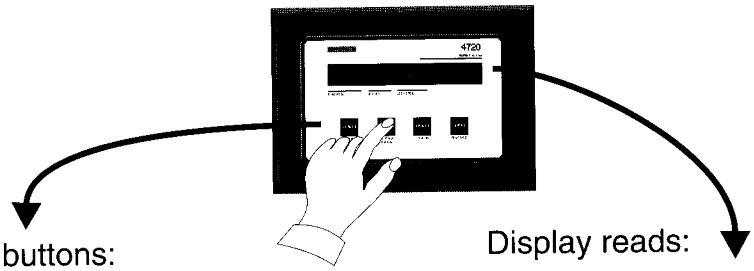
The setting of the VOLTS SCALE parameter depends on the voltage of the system being monitored and whether the 4720 power meter is connected directly to the lines, or if VTs are used.

Note: VTs are required for connection to all delta systems. Some electrical codes may prohibit extending voltages greater than 240 VAC to the door of the switchgear cabinet. If this is the case, use a basic model (120 VAC input) 4720 power meter with VTs that are connected to provide 120 VAC line-to-neutral input to the power meter (see **section 2.5.1** in **Chapter 2**).

The various phase voltage input options of the 4720 power meter support direct connection (using fuses) to wye systems up to 347 VAC line-to-neutral/600 VAC line-to-line and single phase systems up to 347 VAC line-to-neutral/694 VAC line-to-line without the need for VTs.

For direct connection, the VOLTS SCALE parameter of the 4720 power meter must be set to the full scale rating of its phase voltage inputs. The basic model provides 120 VAC voltage inputs, which allow for direct connection (using fuses) to wye systems up to 120 VAC line-to-neutral/208 VAC line-to-line and single phase systems up to 120 VAC line-to-neutral/240 VAC line-to-line. For the basic model, VOLTS SCALE must be set to 120.

Programming the 4720 Power Meter



Press these buttons: | **Display reads:**

1 Menu 1 (Parameter Select) + Menu 2 (Cursor) — Display: PROGRAMMING MODE

Press both Menu buttons at the same time to enter programming mode.

2 Menu 1 (Parameter Select) — Display: PASSWORD=****

Press the Parameter Select button once.

3 Menu 2 (Cursor), Function (Increment) — Display: PASSWORD=***0

Enter the password using the Cursor and Increment buttons.
To enter the default password, 0 (zero), press the Increment button once.

4 Menu 1 (Parameter Select) — Display: SYSTEM SETUP= NO

Press Parameter Select once.

5 Function (Increment) — Display: SYSTEM SETUP=YES

Press Increment once to allow access to this parameter group.

6 Menu 1 (Parameter Select) — Display: VOLTSMODE=WYE (4W)

Press Parameter Select to advance to the next parameter.

7 Function (Increment) — Display: VOLTSMODE= DELTA

Press Increment until the desired parameter value appears.

8 Menu 1 (Parameter Select) — Display: VOLT SCALE=1,200

Press Parameter Select to advance to the next parameter.

Figure 6.2 Step-by-Step Example Showing How to Program the 4720 Power Meter (Steps 1-8)

Programming the 4720 Power Meter (continued)

	Press these buttons:	Display reads:
9	Function / Increment	VOLT SCALE=1.207
	Enter a new value (277) for the Volt Scale parameter. Set the rightmost digit to 7 by pressing the Increment button seven times.	
10	Menu 2 / Cursor	VOLT SCALE=1.207
	Press the Cursor button once to move the cursor one digit left.	
11	Function / Increment	VOLT SCALE=1.277
	Set the digit under the cursor to 7 by pressing the Increment button seven times.	
12	Menu 2 / Cursor	VOLT SCALE=1.277
	Press the Cursor button twice to move to the leftmost digit.	
13	Phase / Decrement	VOLT SCALE=0.277
	Press Decrement once to set the leftmost digit to 0 (zero).	
14	Menu 1 / Parameter Select	AMP SCALE=5.000
	Press Parameter Select to advance to the next parameter.	
15	Menu 2 / Cursor	AMP SCALE=5.000
	Enter a new value (2000) for the Amp Scale parameter. Press Cursor three times to move the cursor to the leftmost character.	
16	Phase / Decrement	AMP SCALE=2.000
	Press Decrement three times to set the leftmost digit to 2.	
17	Menu 1 / Parameter Select	260 * 1.700 1.241 KW
	Press both Menu buttons at the same time to return to display mode.	

Figure 6.3 Step-by-Step Example Showing How to Program the 4720 Power Meter (Steps 9-17)

Similarly, a 4720 power meter equipped with the 277 option must be set for a VOLTS SCALE of 277, while units with the 347 option must be set to a VOLTS SCALE of 347.

For system voltages between the ratings of the input options provided by the 4720 power meter, the next highest input option should be used. For example, to monitor a 220 VAC line-to-neutral/381 VAC line-to-line wye system, a 4720 power meter equipped with the 277 option should be used. In this case, the VOLTS SCALE must still be set to 277.

VTs must be used for wye systems above 347 VAC line-to-neutral/600 VAC line-to-line, single phase systems above 347 VAC line-to-neutral/694 VAC line-to-line, and for all delta systems.

When using VTs, the volts scale set for the 4720 power meter is dependent on the primary and secondary ratings of the VTs used.

For VTs that provide secondaries up to 120 VAC, use a basic model 4720 power meter (120 VAC input). If the VTs have secondaries rated at 120 VAC, set the VOLTS SCALE to the primary rating of the VT. For example, for a 13.8 kV system, 120:1 ratio VTs with primary ratings of 14.4 kV are typically used. For these VTs, set the VOLTS SCALE to 14400.

If the secondaries of the VTs are not rated at 120 VAC, use the following formula to determine the required volts scale:

$$\text{VOLTS SCALE} = \frac{\text{VT Primary Rating}}{\text{VT Secondary Rating}} \times 120$$

For VTs that provide secondaries with ratings between 120 and 277 VAC, such as 220 VAC, use a 4720 power meter equipped with the 277 option. Use the following formula to determine the required volts scale:

$$\text{VOLTS SCALE} = \frac{\text{VT Primary Rating}}{\text{VT Secondary Rating}} \times 277$$

6.5.2 Amps Scale (Phases A, B, and C)

The basic model 4720 power meter provides 5 A phase current inputs. If the CTs used are rated for a 5 A full scale output, set AMPS SCALE to the primary rating of the A, B, and C phase CTs being used.

The 4720 power meter also offers a 1AMP option for use with CTs with 1 A full scale output.

If the CTs are not rated for a 5 A or 1 A full scale output, contact Siemens for more information.

> **Note:** For the above parameter settings, VOLTS SCALE x AMPS SCALE should be less than 999,999,999 for correct display of kW, kVAR, and kVA readings which have a maximum range of 999.999K.

6.5.3 Fourth Current Input (I4) Scale

The 4720 power meter has a fourth current input, designated I4. This input uses connections I41 and I42 on the terminal strip. Typically, this input is used to measure current in the neutral conductor. In installations with non-linear loads, odd harmonics can fail to cancel, producing significant currents in the neutral conductor.

The ratings of this input are identical to the three-phase current inputs (5 A for the basic model, 1 A for the 1AMP option).

The I4 SCALE parameter of the 4720 power meter specifies the scaling for the fourth current input. The scaling can be set to the CT's primary rating independent from the other phase current inputs. The CT used should be rated for a 5 A full scale output. For other ratings contact Siemens.

6.5.4 Volts Mode

The VOLTS MODE parameter should be set according to the system connection configuration (4W-WYE, 3W-WYE, DELTA, SINGLE). Refer to **Chapter 2 section 2.5** and **Figure 2.2** through **Figure 2.8** for more information.

The 4720 power meter also offers a demonstration mode which generates dynamic readings for all real-time measurements based on the input scales you program. These readings can be viewed from the front panel or via communications. To use this feature, set VOLTS MODE to DEMO.

6.5.5 Standard Frequency

The STANDARD FREQ parameter should be set according to the frequency of the power signal the 4720 power meter is to be monitoring. Options include 50 or 60 Hz.

It is important that this parameter is set correctly, as the accuracy of the power measurements can be seriously affected by this setting.

6.6 Control Relay Operation

The 4720 power meter provides three control relays (R1 to R3). Each relay can switch AC loads of up to 277 Volts at 10 A and DC loads of up to 30 Volts at 10 A. **Chapter 2** provides wiring requirements for the relays.

The operation of each relay may be controlled in a number of different ways for various applications:

1. Setpoint control on selected measured parameters, controlled by user-definable conditions. This is useful for applications such as activation of alarms or tripping of breakers for demand, power factor, or load control. Setpoint operation is described in detail in **Chapter 8**.

2. kWH, kVARH, or kVAH pulse output.

3. Manual forced control by the user through remote commands made via the communications port using WinPM software.

A group of programmable operating parameters are available for assigning relay operations. The parameters allow each of the three relays to be assigned to setpoints (in latch or pulse mode), kWH pulsing, kVARH pulsing, or kVAH pulsing. These parameters are accessible via communications only, and WinPM software provides configuration screens for redefining the relay parameters.

6.6.1 Setpoint Relay Operation

For setpoint operation, the relays can provide latched or pulsed operation. In latch mode, the relay is operated (that is, normally open contacts are closed) for the duration that the assigned setpoint is active. In pulsed mode, when the setpoint becomes active, the relay operates for a specified pulse duration.

Set MODE to SETPOINT for setpoint operation. Set VALUE to select latch mode (VALUE = 0), or set the pulse duration for pulse mode operation (in seconds).

Note: While you are programming the 4720 power meter via communications, no setpoint-controlled relay operations occur until you complete the programming sequence. The 4720 power meter then assesses the status of each setpoint and performs any required operations.

6.6.2 kWH, kVARH, or kVAH Pulse Operation

Each relay can be configured for energy pulsing. Pulses can be based on kWH Imported, kWH Exported, kWH Total, kVARH Imported, kVARH Exported, kVARH Total, or kVAH. The MODE parameter is used to set the type of pulsing. The VALUE parameter is used to set the number of unit-hours (kW, kVAR, or kVA) between pulses.

Note: A relay configured for energy pulsing will not respond to an assigned setpoint that becomes active.

Maximum pulse rate for the relays is 1 pulse every 2 seconds (0.5 Hz).

6.6.3 Manual Forced Relay Operations

Only a setpoint relay (Rx MODE = SETPOINT) may be forced operated or released using commands made via communications. Manual commands override current setpoint condition.

If the relay is operating in pulse mode (Rx VALUE > 0), a forced operate command initiates a pulse of length equivalent to the value set by the Rx VALUE parameter for that relay. This operation is logged in the Event Log and indicates that the relay was pulsed. A forced release command has no effect.

If the relay is operating in latch mode (Rx VALUE = 0), it behaves normally for forced operate, forced release, and return-to-normal (return to setpoint control) commands.

See **section 6.6.5** for manual relay command special cases.

6.6.4 Relay Event Logging

For a relay assigned to setpoint operation (MODE = SETPOINT), the Event Log logs relay operations in one of two ways, depending on whether the relay has been set to operate in latch or pulse mode:

Latch mode (VALUE = 0):
The Event Log records that the relay was operated (on) when the setpoint became active and released (off) when the setpoint returned to an inactive state.

Pulse mode (VALUE > 0):
The Event Log shows that the relay is pulsed when the setpoint becomes active. When the setpoint returns to its inactive state, the setpoint event is logged but does not indicate the relay, since no pulse is generated.

If the relay is assigned to kWH, kVAH or kVAH pulse mode, no relay operations are logged.

Manual forced relay commands are logged in the Event Log; however, special cases exist which are described below.

6.6.5 Manual Relay Command Special Cases

If a manual forced operate command for a selected relay is received while that relay is already in a forced operated state, the relay command is ignored and is not logged. This is also true for a forced release command to a relay already in a forced released state. Manual relay commands made to relays which are in a kWH, kVAH, or kVAH pulse mode will also not be logged.

6.7 Status Input Operation

The 4720 power meter provides four digital status inputs (S1 to S4) which can each be used to sense the condition of an external dry (volts free) contact. **Chapter 2** provides wiring diagrams illustrating various requirements and connection methods for the status inputs.

Your local utility company uses one of two methods to count pulses. One method counts one pulse when the contact turns from on (closed) to off (open) to on (closed). Using the second method, one pulse is counted when the contact changes state—either on to off or off to on. Be sure to check with your local utility company to determine which method they use before indicating the multiplier used to count pulses.

A minimum pulse width of 40 milliseconds is required for reliable sensing of status input changes. The status inputs may only be used for external contact sensing. In this application, a contact closure is sensed as active, and a contact opening is sensed as inactive.

6.7.1 Pulse Counting

The 4720 power meter maintains a counter for each of the four status inputs. The maximum frequency the counter accurately follows is 10 Hz. A number of programmable parameters, accessible via communications, are provided to allow each counter to be customized for specific applications.

RESOLUTION
: The floating decimal point for each counter can be fixed between 0 and 3. For example, a setting of 3 would display a total pulse count of 1234 as 1.234.

SCALE FACTOR
: This parameter allows the total pulse count to be scaled by a factor of 0.001 to 1000 units per pulse. For example, a setting of 200 would display a total pulse count of 10 as 2,000.

ROLLOVER
: The maximum (scaled) reading that each counter can achieve prior to rollover to zero (0) can be defined. The default is 999,999,999. This is the maximum range of the counters.

PRESET
: You can preset each counter reading to a specific value. This is a one-shot function only. If the counter rollover value is reached, it rolls over to zero, not to the preset value.

6.7.2 Resetting Status Input Counters

Status input counter values can be manually reset to zero (0) using the CLEAR STATUS COUNT parameter from the front panel in programming mode or via communications. Each counter can be cleared individually, or all counters can be cleared together. Counters can also be automatically reset using setpoints. Status Input S4 can be used to provide external demand interval synchronization for demand measurements. Refer to **section 7.2.2** for more information.

6.7.3 Viewing Status Input Conditions

The condition of the status inputs and status input counter totals can be viewed from the front panel using the Menu buttons or via communications. **Chapter 7, Displaying Information**, lists all available status parameters.

6.7.4 Logging Status Input Conditions

Status input changes can also be logged in the Event Log of the 4720 power meter which is accessible via the communications port. Logging of status input changes can be enabled or disabled via communications.

6.7.5 Status Input Setpoints

Status input conditions can be used for setpoints. This allows relay control functions to be performed based on status input conditions. Refer to **Chapter 8, Using Setpoints**, for more information.

6.8 Auxiliary Voltage Input Operation

The 4720 power meter has an auxiliary voltage input (VAux) which allows an external voltage (1 VAC nominal, 1.25 VAC max.) to be measured and displayed with user-programmable scaling.

Two parameters must be set:

VAUX SCALE
: This parameter defines what reading is displayed with a 1.000 V (AC or DC) rms input applied (that is, full scale input). Range is 0 to 999,999.

VAUX ZERO
: This parameter defines what reading is displayed with a 0.000 V (AC or DC) rms input applied. Range is -999,999 to 999,999.

Example:
A transducer is used to measure the operating temperature of a transformer's windings. The output of the transducer is connected to the VAux input of the 4720 power meter. A transducer output of 1.000 VAC represents 100.0°C. A transducer output of 0.000 VAC represents 30.0°C.

Set VAUX SCALE to 100. Set VAUX ZERO to 30.

In this example, a transducer output of 1.000 VAC produces a reading of 100, while an output of 0.000 VAC produces a reading of 30.

> **Note:** The 4720 power meter does not display VAux readings with floating point decimals as significant digits; however, additional significant integer digits can be obtained by setting both scaling parameters to larger values. For the example above, setting VAUX SCALE to 1000 and VAUX ZERO to 300 provides one more significant digit. In this case, remember to interpret the least significant digit as a decimal place (for example, a reading of 850 is equivalent to 85.0).

The 4720 power meter's low input impedance of 10 KΩ will determine the resistor size required on the input.

6.9 Auxiliary Current Output Operation

The 4720 power meter is equipped with an analog current output (IOut) that may be programmed to deliver a current proportional to a measured parameter. The maximum load on the current output is 250Ω resistive. Four parameters must be set:

IOUT SCALE
: This parameter defines the value of the associated measured parameter corresponding to full scale current output. If IOUT KEY = FREQUENCY, IOUT SCALE should be set to the desired parameter value x 100 for which the current output is 20.0 mA. Range is 0 to 999,999.

IOUT ZERO
This parameter defines the value of the associated measured parameter corresponding to zero scale current output (the zero offset). For an IOut range value of 0-20 mA, IOUT ZERO should be set to the desired parameter value for which the current output is 0.0 mA. For an IOut range value of 4-20 mA, IOUT ZERO should be set to the parameter value for which the current output is 4.0 mA. IOUT ZERO can be positive or negative. Range is -999,999 to 999,999.

IOUT KEY

This defines the measured parameter to which the current output is proportional. **Table 6.2** in **Chapter 6** provides a list of measured parameters that may be used.

IOUT RANGE

This defines the maximum current output range. Choices are 0-20 mA or 4-20 mA.

Example:
The IOut current output must be proportional to the phase A current reading. The maximum phase A current expected is approximately 2000 A. The minimum phase A current expected is approximately 500 A. The IOut output is being used to provide input to a chart recorder with an input range of 4 to 20 mA.

Set IOUT KEY to CURRENT A. Set IOUT RANGE to 4 to 20 mA to match the full input range of the chart recorder. To produce the maximum chart recorder range of deflection, set IOUT SCALE to 2000 and IOUT ZERO to 500.

In this example, a phase A current input reading of 500 produces 4 mA at the IOut output (minimum scale deflection of the chart recorder). A phase A current reading of 2000 produces an output of 20 mA (maximum scale deflection of the chart recorder).

IOUT POWER FACTOR

Since the scale for Power Factor is essentially two 0.0-1.0 scales (one for leading and one for lagging), the meter must combine these into one scale. To do this, the meter represents the entire Power Factor scale as 0-200, where 0 is 0.0 lagging and 200 is 0.0 leading (see **Figure 6.4**).

The 4720 power meter allows the IOut scale to be customized so that the bottom end (4mA or 0mA) and the top end (20mA) can be programmed to any value on the 0-200 scale. In **Figure 6.4**, 4mA is set to 50 (which is 0.50 lagging), and 20mA is set to 100 (which is 1.00, or unity).

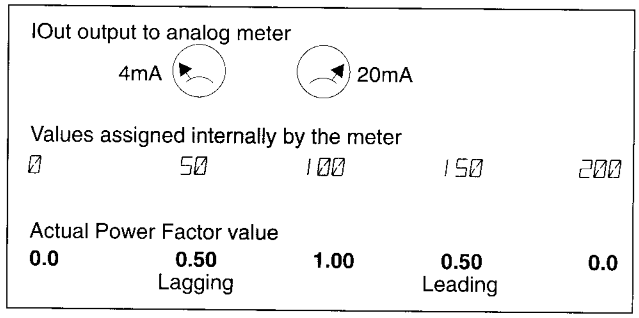


Figure 6.4 Power Factor Scale Representation

6.10 Operating Parameter Descriptions

Table 6.1 through **Table 6.4** provide a brief description of each operating parameter that may be programmed from the front panel. **Table 6.5** through **Table 6.12** list all additional operating parameters which are only accessible via communications.

More detailed descriptions of each operating parameter are provided throughout this manual where operational features are described.

Table 6.1 Operating Parameters Programmable from the Front Panel

Parameter	Description	Range/Options
PROGRAMMING MODE	Initial display upon entering programming mode. Press Parameter Select to advance through each parameter.	not applicable
PASSWORD	Correct password must be entered to allow setup parameters to be modified or clear (reset) functions to be executed. Also used to redefine password. See **section 6.1.3**.	0 to 9999
Basic System Setup Group		
SYSTEM SETUP	Allows access to this group of parameters. Selecting NO (default) will advance to the next group.	NO, YES
VOLTS MODE	Defines the power system configuration.	4W-WYE, DELTA, SINGLE, DEMO, 3W-WYE
VOLTS SCALE	Defines the full-scale input reading (in Volts) for the phase A, B, and C voltage inputs. This should match the VT primary rating, or if connected directly, the system line-to-neutral rating.	0 to 999,999
AMPS SCALE	Defines the full-scale input reading (in Amps) for the phase A, B, and C current inputs. This should match the CT primary current rating.	0 to 30,000
I4 SCALE	Defines the full-scale input reading (in Amps) for the I4 (neutral/ground) current input. This should match the CT primary current rating.	0 to 9,999
STANDARD FREQ	Defines the line frequency the 4720 power meter is to monitor (in Hertz).	50 or 60
PHASE ROTATION	Defines the normal phase sequence used for power factor polarity detection in delta mode, and for the phase reversal detection setpoint. See **Chapter 8** for setpoint operation.	POS (=ABC), NEG (=ACB)
DEMAND PERIOD	Defines the length of the demand period (in minutes) used in calculating sliding window demand values. See **section 7.2.2**.	0 to 99
DEMAND SYNC	Defines the method of demand synchronization. INTERNAL synchronizes to the memory clock. EXTERNAL synchronizes to the S4 pulse.	INTERNAL, EXTERNAL
THERMAL PERIOD	Sets the time (in minutes) it takes the demand to reach 90% of the thermal constant for thermal demand measurements.	2 to 99, 0 or 1 = off
NUM DEMAND PERIOD	Defines the number of demand periods to be averaged in calculating all sliding window demands.	1 to 15
PREDICT DMD BASE	Defines the base (in percentage of demand period) for predicted demand. Lower percentage gives faster prediction.	1 to 99% (default = 5%)

Table 6.2 Operating Parameters Programmable from the Front Panel (continued)

Parameter	Description	Range/Options
Auxiliary Setup Group		
AUXILIARY SETUP	Allows access to this group of parameters. Selecting NO (default) will advance to the next group.	NO, YES
VAUX SCALE	Defines the reading for a full-scale (1.000V AC or DC) auxiliary voltage input. See **section 6.8**.	0 to 999,999
VAUX ZERO	Defines the reading for a zero-scale (0.000V AC or DC) auxiliary voltage input. To define a negative number, toggle the 7th (the most significant) digit with the Increment button.	-999,999 to 999,999
IOUT SCALE	Defines the reading of the associated parameter corresponding to a full-scale auxiliary current output. See **section 6.9**. **Note:** Frequency values must be entered x100. Example: 60Hz = 6000	0 to 999,999
IOUT ZERO	Defines the reading of the associated parameter corresponding to a zero-scale auxiliary current output. To define a negative number, toggle the 7th (the most significant) digit with the Increment button.	-999,999 to 999,999
IOUT KEY	Defines the measured parameter to which the current output will be proportional. **Note:** SD PARAMETER # 1 and SD PARAMETER #2 are the first two in the list of sliding window demand parameters defined by the user.	VOLTAGE A, VOLTAGE B, VOLTAGE C, VOLTAGE AV, CURRENT A, CURRENT B, CURRENT C, CURRENT AV, CURRENT I4, kW A, kW B, kW C, kVAR A, kVAR B, kVAR C, kVA A, kVA B, kVA C, kW TOTAL, kVAR TOTAL, kVA TOTAL, PF TOTAL, SD PARAMETER #1, SD PARAMETER #2, FREQUENCY, VAUX
IOUT RANGE	Defines the output range for the auxiliary current output.	0-20mA, 4-20mA

Table 6.3 Operating Parameters Programmable from the Front Panel (continued)

Parameter	Description	Range/Options
Clear Functions Group		
CLEAR FUNCTIONS	Allows access to this group of parameters. Selecting NO (default) will advance to the next group.	NO, YES
CLEAR MAX/MIN?	Selecting YES resets the preset and programmable max/min logs when Parameter Select is pressed. **Note:** Logs can be reset individually via communications. See "Resetting Min/Max Parameters" in **section 7.2.2** for instructions.	NO, YES
CLEAR HOURS?	Selecting YES resets kWH, kVARH, and kVAH counters to zero when Parameter Select is pressed. **Note:** Time-of-use energy registers are not affected.	NO, YES
CLEAR STAT COUNT	Selected status input counter total(s) are cleared when Parameter Select is pressed.	0 (none), 1, 2, 3, 4, ALL
Communications Group		
COMMUNICATIONS	Allows access to this group of parameters. Selecting NO (default) will advance to the next group.	NO, YES
UNIT ID	Defines the SEAbus communications address for the 4720 power meter.	1 to 256
BAUD RATE	Defines the baud rate.	300, 1200, 2400, 4800, 9600, or 19,200
COMM MODE	Displays the communications mode. Not programmable.	RS-232 or RS-485
RTS ACTIVE LVL	Sets the active logic level asserted by the RTS line when using RS-232 communications. See **Chapter 11**.	LOW, HIGH
PASSWORD PROTECT	Provides password protection for all configurations and relay operations. The default is NO.	NO, YES
TRANSMIT DELAY	Sets the delay between asserting RTS and the transmission of the first bit.	0 to 999 ms

Table 6.4 Operating Parameters Programmable from the Front Panel (continued)

Parameter	**Description**	**Range/Options**
Front Panel Display Group		
DISPLAY	Allows access to this group of parameters. Selecting NO (default) will advance to the next group.	NO, YES
DISPLAY TIMEOUT	Duration (in minutes) between last button press and display turn off.	0 (always on), 1 to 999
FORMAT	Defines numeric format. 1,234.5 is the default.	1,234.5 or 1234,5
PHASE LABEL	Defines the phase label format.	ABC, XYZ, RYB, RST
RESTORE DISPLAY	Used to restore front panel display brightness. Selecting YES lights all segments of display upon exit from programming mode. See **section 12.1.2**.	NO, YES
Diagnostics Group		
DIAGNOSTICS	Allows access to this group of parameters. Selecting NO (default) returns to PASSWORD.	NO, YES
FIRMWARE VER	Firmware version currently installed.	WWW X.X.X.X WWW = standard (V) or custom X.X.X.X = version number
EXTENDED	Allows access to an extended group of diagnostic parameters using a special button combination from display mode. See **section 7.6.2** for instructions and a list of extended parameters.	NO, YES

Table 6.5 Operating Parameters Programmable via Communications only

Parameter	Description	Range/Options
Waveform Recorder Setup		
WFR CONFIGURATION	Configures storage for the waveform recorder. Option format = (number of events) x (cycles per event).	3x12, 2x18, 1x36
Sliding Window Demand Setup **Note:** Only the additional demand setup parameters not available from the front panel of the 4720 power meter are listed here.		
SWD PARAMETER	Selects one of ten sliding window demand measured parameters to configure.	1 to 10
PARAMETER TYPE	Defines the type of measured parameter. NOT USED disables the selected parameter.	NOT USED, VOLTAGE LN, VOLTAGE LL, CURRENT, kW, kVA, kVAR, PF, FREQUENCY, THD, HD ODD, HD EVEN, HDxx (xx = 02 to 15), K-FACTOR
INPUT	Selects the phase or input for the selected parameter type, if applicable.	A, B, C, AVG, TOT, I4, VAUX
Standard Setpoints Setup		
STD SETPOINT	Selects one of the eleven standard setpoints to be programmed.	1 to 11
PARAMETER TYPE	Defines the type of parameter the selected setpoint is to monitor. A setting of NOT USED disables the setpoint. See **Chapter 8** for setpoint type descriptions.	NOT USED, OVER VOLTAGE LN, OVER VOLTAGE LL, UNDER VOLTAGE LN, UNDER VOLTAGE LL, VOLTAGE UNBALANCE, OVER CURRENT, UNDER CURRENT, CURRENT UNBALANCE, PHASE REVERSAL, OVER kW IMP, OVER kW EXP, OVER kVAR IMP, OVER kVAR EXP, OVER kVA, OVER kWD, OVER kVAD, OVER FREQ, UNDER FREQ, UNDER PF LAG, UNDER PF LEAD, STATUS x INACTIVE (x = 1 to 4), STATUS x ACTIVE (x = 1 to 4), ANY STATUS INACTIVE, ANY STATUS ACTIVE, OVER Sx COUNTER (x = 1 to 4), OVER THD, OVER HD ODD, OVER HD EVEN, OVER HDxx (xx = 02 to 15), K-FACTOR, NEW HOUR, NEW DAY, NEW WEEK, NEW MONTH, NEW YEAR
INPUT	Selects the phase or input for the selected parameter type, if applicable.	A, B, C, AVG, TOT, I4, VAUX

Table 6.6 Operating Parameters Programmable via Communications only (continued)

Parameter	Description	Range/Options
Standard Setpoints Setup (continued)		
HIGH LIMIT	Defines the high limit for the selected setpoint.	-999,999 to 999,999
MEASUREMENT MODE	Defines the variation of measurement for the selected parameter type, if applicable.	RT, RT MIN, RT MAX, (RT = real-time) TD, TD MIN, TD MAX, (TD = thermal demand) SD, SD MIN, SD MAX, (SD = sliding window demand) PD, PD MIN, PD MAX (PD = predicted demand)
LOW LIMIT	Defines the low limit for the selected setpoint.	-999,999 to 999,999
TIME DELAY OPERATE	Defines the time delay to operate (in seconds) for the selected setpoint.	0 to 32,000
TIME DELAY RELEASE	Defines the time delay to release (in seconds) for the selected setpoint.	0 to 32,000
ACTION 1	Defines the first of two possible actions triggered when the selected setpoint becomes active. **Note:** ACTION 1 is always executed first. See **Chapter 8**.	NOT USED, RELAY 1, RELAY 2, RELAY 3, WAVE CAPTURExx (xx = V1, V2, V3, I1, I2, I3, I4, VX), WAVE RECORDER, SNAPSHOTx (X = 1 to 8), CLEAR PRESET RT MIN/MAX LOGS, CLEAR PRESET TD MIN/MAX LOGS, CLEAR PRESET SD MIN/MAX LOGS, CLEAR PRESET PD MIN/MAX LOGS, CLEAR PRESET HARM.DIST. MIN/MAX, CLEAR PRESET HARM.DIST. TD MIN/MAX, CLEAR PROGRAMMABLE MIN/MAX x (x = 1 to 8), CLEAR ALL MIN/MAX LOGS (preset and programmable), CLEAR Sx COUNTER (x = 1 to 4, ALL)
ACTION 2	Defines the second of two possible setpoint actions. **Note:** ACTION 2 is always executed following any specified ACTION 1. See **Chapter 8**.	Same as ACTION 1

Table 6.7 Operating Parameters Programmable via Communications only (continued)

Parameter	Description	Range/Options
High-Speed Setpoints Setup		
HIGH SPD SETPOINT	Selects one of the six high-speed setpoints to be programmed.	1 to 6
PARAMETER TYPE	Defines the type of parameter the selected setpoint is to monitor. A setting of NOT USED disables the setpoint. Curve characteristics for time-overcurrent (option TOC) must be programmed separately. See **Table 6.8**.	NOT USED, OVER VOLTAGE, UNDER VOLTAGE, VOLTAGE UNBALANCE, OVER CURRENT, UNDER CURRENT, CURRENT UNBALANCE, OVER I4, PHASE REVERSAL, OVER kW IMP, OVER kW EXP, OVER kVA, OVER FREQUENCY, UNDER FREQUENCY, TOC (time-overcurrent), STATUS x INACTIVE (x = 1 to 4), STATUS x ACTIVE (x = 1 to 4), ANY STATUS INACTIVE, ANY STATUS ACTIVE, OVER Sx COUNTER (x = 1 to 4)
INPUT	Selects the phase for the selected parameter type, if applicable.	A, B, C, AVERAGE, TOTAL
HIGH LIMIT	Defines the high limit for the selected setpoint.	0 to 999,999
LOW LIMIT	Defines the low limit for the selected setpoint.	0 to 999,999
TIME DELAY OPERATE	Defines the time delay to operate (in cycles) for the selected setpoint.	0 to 32,000
TIME DELAY RELEASE	Defines the time delay to release (in cycles) for the selected setpoint.	0 to 32,000
ACTION 1	Defines the first of two possible actions triggered when the selected high-speed setpoint becomes active.	NOT USED, RELAY 1, RELAY, 2, RELAY 3, WAVE CAPTURExx (xx = V1, V2, V3, I1, I2, I3, I4, VX), WAVE RECORDER, SNAPSHOT 8 (high-speed snapshot log), CLEAR Sx COUNTER (x = 1 to 4, ALL)
ACTION 2	Defines the second of two possible actions triggered when the selected high-speed setpoint becomes active.	Same as ACTION 1

Table 6.8 Operating Parameters Programmable via Communications only (continued)

Parameter	Description	Range/Options
Time-Overcurrent Curve Setup		
HIGH SPEED FEATURE	Specifies the active high speed feature: Time-Overcurrent Curve (TOC), or High-Speed Snapshot (HSS) Log. Default is TOC. **Note:** The parameters listed below are for programming the time-overcurrent curve.	TOC, HSS
MAX CURRENT	Defines the maximum (pickup) current for the time-overcurrent curve.	1 to 30,000
DATA PTS	Selects one of the eight data points on the curve characteristic to be defined.	0 to 8
XCURRENT	Defines the X (current) coordinate for the selected curve point. Specified in multiples of MAX CURRENT parameter value.	1.00 to 110.00
TIME	Defines the Y (time) coordinate for the selected curve point (in milliseconds).	33 to 10,000
Relay Setup		
RELAY CONTROL	Selects one of the three relays to be programmed.	1 to 3
MODE	Defines the type of operation the selected relay is to perform. See **section 6.6**.	SETPOINT, kWH IMP, kWH EXP, kWH TOT, kVARH IMP, kVARH EXP, kVARH TOT, kVAH
VALUE	For Rx MODE = SETPOINT, specifies latch mode or sets pulse mode duration (in seconds). For Rx MODE = kWH, kVARH, or kVAH pulsing, disables pulsing or defines number of unit-hours (kW, kVAR, or kVA) between pulses.	0 = latch mode or disable pulsing 1 to 65,535 = pulse duration or unit-hours (kW, kVAR, or kVA)
Status Input Counter Setup		
STATUS COUNTER	Selects the status input counter to be programmed.	1 to 4
RESOLUTION	Fixes the floating decimal point for the selected counter. Default is 0. See **section 6.7.1**.	0 to 3
SCALE FACTOR	Specifies the value represented by one pulse on the selected counter input (in units/pulse). Default is 1.	0.001 to 1000
ROLLOVER	Specifies the maximum range before the selected counter rolls over to zero (0). Default is 999,999,999.	0 to 999,999,999
PRESET	Presets the counter reading to a specific value. **Note:** Counter will rollover to zero (0), not to the preset value.	0 to 999,999,999
Event Log Setup		
LOG STATUS CHANGES?	Selects whether status input events will be logged. Default is YES. User must select for each individual status input.	YES, NO

Table 6.9 Operating Parameters Programmable via Communications only (continued)

Parameter	Description	Range/Options
Standard Snapshot Logs Setup		
SNAPSHOT LOG	Selects one of eight snapshot logs to configure.	1 to 8
MEMORY ALLOCATION	Defines the triggering method for the selected log. See **section 10.3.1** for information on memory requirements.	0 to 100%
TRIGGER TYPE	Defines the triggering method for the selected log. If SETPOINT is defined, the desired setpoint must be programmed to trigger the selected log. See Standard Setpoints Setup in **Table 6.5** and **Table 6.6**.	INTERVAL, SETPOINT
INTERVAL	Defines the time interval between snapshots. If TRIGGER TYPE = INTERVAL, logging will run continuously at specified intervals. If TRIGGER TYPE = SETPOINT, logging will occur at specified intervals only while the setpoint is active.	DAYS: 1 to 399 HOURS: 1 to 23 MINUTES: 1 to 59 SECONDS: 1 to 59
PARAMETER NUMBER	Selects one of twelve possible measured parameters for the selected log to be defined.	1 to 12
PARAMETER TYPE	Defines the type of measured parameter.	VOLTAGE LN, VOLTAGE LL, VOLTAGE UNBAL, CURRENT, CURRENT UNBAL, PHASE REVERSAL, kW, kVAR, kVA, kWH, kVARH, kVAH, PF, FREQ, THD, HD EVEN, HD ODD, HDxx (xx = 2 to 15), K-FACTOR, DATE/TIME, RELAY OUTPUT, STATUS CONDITION, STATUS COUNT, SETPOINT CONDITION
INPUT	Selects the phase, input, output, register, or setpoint number for the selected parameter type, if applicable.	A, B, C, AVG, TOT, I4, VAUX, 1, 2, 3, R1, R2, R3, S1, S2, S3, S4, SPxx (xx = 1 to 11), HSxx (xx = 1 to 6)
MEASUREMENT MODE	Defines the variation of measurement for the selected parameter type, if applicable.	RT, RT MIN, RT MAX, TD, TD MIN, TD MAX, SD, SD MIN, SD MAX, PD, PD MIN, PD MAX, IMP, EXP, NET, TOT

Table 6.10 Operating Parameters Programmable via Communications only (continued)

Parameter	Description	Range/Options
High-Speed Snapshot Log Setup		
MEMORY ALLOCATION	Defines the memory allocated in snapshot memory for the high-speed log. See **section 10.3.1** for information on memory requirements.	0 to 100%
TRIGGER TYPE	Defines the triggering method. MANUAL requires a trigger command received via communications. If SETPOINT is defined, the setpoint must be programmed to trigger the high-speed log. See High-Speed Setpoints Setup in **Table 6.7**. **Note:** Only one setpoint trigger is possible prior to re-arming the high-speed log.	MANUAL, SETPOINT
STOP CONDITION	Defines the condition following a trigger that will stop the high-speed logging function.	LOG FULL = Stop when allocated memory is used up. TIMED OUT = Stop when DURATION has passed. SETPT OFF = Stop when setpoint returns to inactive.
DURATION	If STOP CONDITION = TIMED OUT, specifies number of cycles until logging is stopped, in increments of two cycles.	0 to 130,000
INTERVAL	Defines the time interval between snapshots in increments of two cycles. Logging will run continuously at specified intervals until stop condition is reached. See **section 10.3.3** for configuring a one-shot mode.	0 to 130,000
PARAMETER NUMBER	Selects one of the twelve possible measured parameters for the high-speed log to be defined.	1 to 12
PARAMETER TYPE	Defines the type of measured parameter.	VOLTAGE HS (LN or LL dependent on voltage mode), VOLTAGE UNBAL HS, CURRENT HS, PHASE REVERSAL HS, kW, kVA, STATUS CONDITION, STATUS COUNT
INPUT	Selects the phase or input for the selected parameter type, if applicable.	A, B, C, AVG, TOT, I4, S1, S2, S3, S4

Table 6.11 Operating Parameters Programmable via Communications only (continued)

Parameter	Description	Range/Options
Menu Buttons Setup		
MENU BUTTON	Selects which Menu button to configure.	1 or 2
PARAMETER NUMBER	Selects the measured parameter to be defined.	1 to 18
PARAMETER TYPE	Defines the type of measured parameter.	VOLTAGE LN, VOLTAGE LL, VOLTAGE UNBAL, CURRENT, CURRENT UNBAL, kW, kVAR, kVA, kWH, kVAH, PF, FREQ, THD, HD EVEN, HD ODD, HDxx (xx = 2 to 15), K-FACTOR, DATE/TIME, RELAY OUTPUT, STATUS CONDITION, STATUS COUNT, SETPOINT CONDITION
PHASE BUTTON	Defines the sequence of phases, inputs, setpoint numbers, or harmonic numbers accessible using the Phase button. List of available options is dependent on the PARAMETER TYPE defined above.	Any phase sequence, any three-phase display, any relay or status input sequence, any setpoint sequence, any combination of other measured or status parameters.
MODE FUNCTION	Defines the sequence of measurement variations accessible using the mode function, if applicable. Options listing only a single mode will effectively disable the mode function, since no additional modes will be available to the user.	Any combination of modes, including: RT, TD, SD, MIN, MAX, IMP, EXP, NET, TOT
Programmable Minimum/Maximum Logs Setup		
MIN/MAX LOG	Selects one of the minimum/maximum logs to configure.	1 to 16
PARAMETER NUMBER	Selects the minimum/maximum trigger or one of the 15 possible coincident parameters for the selected log to be defined. PARAMETER 1 is the trigger parameter.	1 to 16
PARAMETER TYPE	Defines the type of measured parameter. *	VOLTAGE LN, VOLTAGE LL, VOLTAGE UNBAL, CURRENT, CURRENT UNBAL, PHASE REVERSAL, kW, kVAR, kVA, kWH*, KVARH*, kVAH*, PF, FREQ, THD, HD EVEN, HD ODD, HDxx (xx = 2 to 15), K-FACTOR, DATE/TIME*, RELAY OUTPUT*, STATUS CONDITION* STATUS COUNT*, SETPOINT CONDITION*
INPUT	Selects the phase or input for the selected parameter type, if applicable.	A, B, C, AVERAGE, TOT, I4, VAUX
MEASUREMENT MODE	Defines the variation of measurement for the selected parameter type, if applicable.	RT, TD, SD, MIN*, MAX*, IMP*, EXP*, NET*, TOT*

* *These parameter types or modes cannot be used as the minimum/maximum trigger but can be defined as coincident parameters.*

Table 6.12 Operating Parameters Programmable via Communications only (continued)

Parameter	Description	Range/Options
Status Input and Relay Labels Setup		
STATUSx INACTIVE	Defines the label for the inactive state of status input x (x = 1 to 4).	20 character label
STATUSx ACTIVE	Defines the label for the active state of status input x (x = 1 to 4).	20 character label
RELAYx INACTIVE	Defines the label for the inactive state (released) of relay x (x = 1 to 4).	20 character label
RELAYx ACTIVE	Defines the label for the active state (operated) of relay x (x = 1 to 4).	20 character label

7 Displaying Information

This chapter provides detailed descriptions of each measured parameter and all status information provided by the 4720 power meter. All measurements, measurement modes (including user-defined sliding window demands), and status parameters are continuously monitored or calculated internally by the 4720 power meter.

The parameters discussed in this chapter are categorized as follows:

1. High-Speed Triggers
2. Real-Time Measurements
   - Power Parameters
     - Voltage
     - Current
     - Real, Reactive, and Apparent Power
     - Power Factor
     - Frequency
   - Harmonic Distortion
     - Total, Even, Odd, and Individual Harmonics
     - K-Factor
3. Accumulated Measurements
   - Real, Reactive, and Apparent Energy
4. Status Information
   - Control Relay Conditions, Status Input Conditions, Status Input Counter Totals, and Setpoint Conditions
   - Self-Diagnostic Information

The following sections of this chapter provide complete listings of all measured parameters, their associated display labels, and detailed information on each parameter type. Parameter names that require a large number of characters will be presented using the entire display.

A complete list of accuracies, display resolutions, and range of readings for all measurements can be found in **Appendix A**. Refer to **Chapter 5, Operator Interface**, for instructions on using the buttons on the front panel of the 4720 power meter to access a specific parameter.

Note: The complete selection of measured parameters and status information is always accessible via remote communications (**Chapter 11**).

7.1 High-Speed Triggers

A set of high-speed measured parameters are calculated by the 4720 power meter which are true rms, including harmonics, and are updated every two cycles. These parameters are used exclusively as user-definable triggers for the six high-speed setpoints (see **Chapter 8**) and as parameter options for high-speed snapshot logging. These parameters include:

- Voltage line-to-neutral
  - Each phase
  - Three-phase average
- Voltage line-to-line
  - Each phase
  - Three-phase average
- Voltage unbalance (%)
- Current
  - Each phase
  - Three-phase average
- I4 (neutral or ground current)
- Frequency (phase A)
- kW (signed value indicates import/export)
  - Each phase
  - Total of all phases
- kVA
  - Each phase
  - Total of all phases
- Phase reversal
- Status input condition (S1 to S4, or any)
- Status input counter (S1 to S4)
- Time-overcurrent curve
  - One selected current phase

These parameters are all accessible via communications. Note that most high-speed parameters, except the time-overcurrent curve, are also calculated as real-time (one second update) parameters.

7.2 Real-Time Measurements

Real-time measurements include power parameters and harmonic distortion measurements. The following sections list the base (primary) parameters provided and the additional measurement modes available for each. **Table 7.1** lists all measurements, their associated phases or inputs, and display labels.

Table 7.1 Real-Time Measurements and Display Labels

Measurement		Display Labels						
Type	**Description**	**Phase or Input**						
		A	**B**	**C**	**Average**	**Total**	**I4**	**VAux**
Voltage	Voltage line-to-neutral (VLN)	A	B	C	*			VX
	Voltage line-to-line (VLL)	A,	B,	C,	*,			
	Voltage unbalance (%)	V UNB						
Current	Current	A	B	C	*		I4	
	Current unbalance (%)	A UNB						
Power	Real power	KW A	KW B	KW C		KW*		
	Reactive power	KVR A	KVR B	KVR C		KVR*		
	Apparent power	KVA A	KVA B	KVA C		KVA*		
Power Factor	Power factor	PF A	PF B	PF C		PF*		
Frequency	Frequency (phase A)	HZ						
Harmonic Distortion (in percent of funda-mental)	Total harmonic distortion (2nd + 3rd + ... 15th)	THD V1	THD V2	THD V3			THD I4	THD VX
		THD I1	THD I2	THD I3				
	Total even harmonic distortion (2nd + 4th + ... 14th)	TEHD V1	TEHD V2	TEHD V3			TEHD I4	TEHD VX
		TEHD I1	TEHD I2	TEHD I3				
	Total odd harmonic distortion (3rd + 5th + ... 15th)	TOHD V1	TOHD V2	TOHD V3			TOHD I4	TOHD VX
		TOHD I1	TOHD I2	TOHD I3				
	Individual harmonic distortion x = 2 to 15	HDx V1	HDx V2	HDx V3			HDx I4	HDx VX
		HDx I1	HDx I2	HDx I3				
K-Factor	K-factor	KF V1	KF V2	KF V3			KF I4	KF VX
		KF I1	KF I2	KF I3				

7.2.1 Standard Measurements

The following sections are the base measurements displayed by the 4720 power meter.

Power-Related Parameters

These parameters include all voltage, current, power, power factor, and frequency measurements. For phase dependent measurements, this includes per phase readings, and averages or totals for all phases. The I4 (neutral/ground current) and VAux (auxiliary voltage) inputs are also included. All measurements are true rms and are updated approximately each second. **Table 7.1** lists all measurements and their associated phases or inputs. A comma indicates a line-to-line voltage measurement, an asterisk represents average of all phases or total for power measurements.

Reverse kW or kVAR readings are indicated as a negative value (minus sign).

Power factor readings are displayed as leading (PF LD) or lagging (PF LG). See **section 7.5** for polarity conventions.

Harmonic Distortion and K-Factor

The 4720 power meter calculates harmonic distortion as a percentage of the fundamental for each of the three phase voltage inputs, the three phase current input channels, the I4 (neutral/ground current) input, and the VAux (auxiliary voltage) input. For each input, the following parameters are calculated:

- Percent total harmonic distortion (THD) up to the 15th harmonic
- Total even harmonic distortion (TEHD)
- Total odd harmonic distortion (TOHD)
- Harmonic distortion for individual harmonics (HD2 to HD15)

K-factor (KF) is also calculated using the first 15 harmonics for all seven voltage and current inputs. K-factor can be useful in the selection of properly rated transformers for application in systems with high harmonic content.

The update rate for each harmonic distortion and K-factor parameter is between 5 and 30 seconds. Setpoints programmed to trigger on harmonic distortion parameters can have response times of over 30 seconds. Setpoints are described in detail in **Chapter 8**.

7.2.2 Additional Measurement Modes

Additional measurement modes available for real-time parameters include thermal demand, sliding window demand, and predicted sliding window demand. Minimum and maximum values are also available for all base and demand parameters. **Table 7.2** illustrates the modes available to all base parameters, the display labels used to identify them, and examples of combined display labels.

Table 7.2 Measurement Mode Parameter Display Labels

Real-Time Measurement Mode	Display Labels		
	Mode	Minimum	Maximum
Standard Measurement	*	MN	MX
Thermal Demand	TD	TD.MN	TD.MX
Sliding Window Demand	SD	SD.MN	SD.MX
Predicted Sliding Window Demand	PD	PD.MN	PD.MX

For parameters that have been assigned to the front panel Menu buttons, additional measurement modes can be accessed using the mode function described in **section 5.2.10** in **Chapter 5, Operator Interface**. The sequence of modes available using the mode function are user-definable and dependent on the parameter type.

Power utilities generally bill commercial customers based on both their energy consumption (in kWH) and their peak usage levels called peak demand (in kW). Demand is a measure of average power consumption over a fixed time period, typically 30 minutes. Peak (or maximum) demand is the highest demand level recorded over the billing period.

Demand measurement methods and intervals vary between power utilities. Some common methods include thermal averaging, sliding window, and fixed interval techniques. The 4720 power meter can perform demand calculations using both the thermal averaging and sliding window demand techniques. Beyond these methods, the 4720 power meter can also calculate predicted values on all sliding window demand measurements.

Thermal Demand

Thermal demand values are calculated automatically for all base real-time parameters. The 4720 power meter uses a method which is equivalent to thermal averaging. For thermal averaging, the traditional demand indicator responds to heating of a thermal element in a Watt-Hour meter. The thermal demand period is determined by the thermal time constant of the element, typically 15 to 30 minutes. The demand period is the period of time it would take the demand to ramp up to approximately 90% of the steady-state value (see **Figure 7.1**).

For thermal demand, the programmable demand period is set by the THERMAL PERIOD parameter.

This allows you to match the power utility's demand calculation technique. Each thermal demand measurement also has associated minimum/maximum parameters available.

On the front panel display, thermal demand parameters are indicated using the label "TD." See **Table 7.2**.

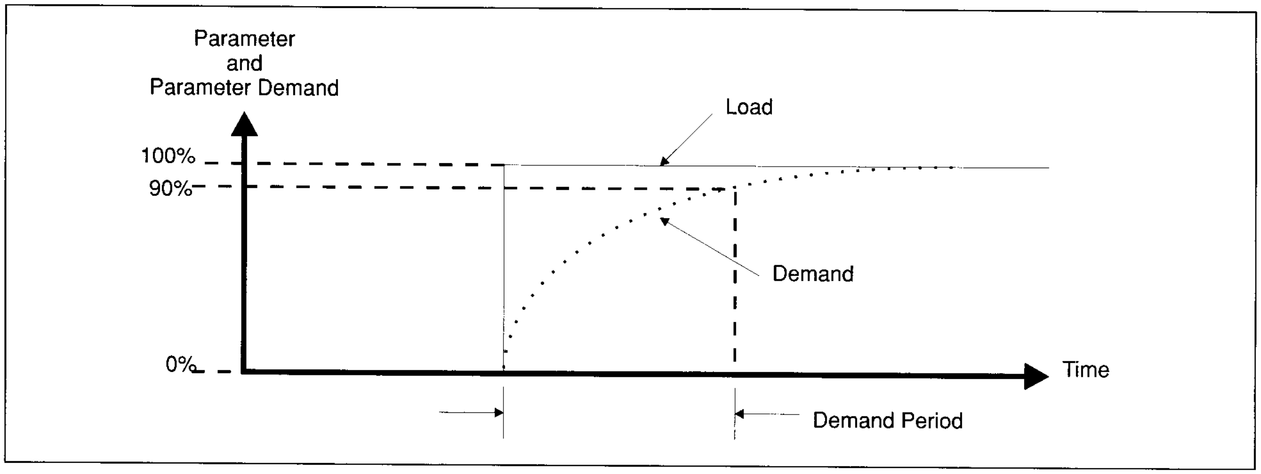


Figure 7.1 Thermal Demand Calculation

Sliding Window Demand

The 4720 power meter can provide up to ten sliding window demand measurements. Their parameters can be programmed via communications. The first four sliding window demand parameters have been preprogrammed at the factory, but they may be changed as needed. These are:

- Current, average of all phases
- kW, total of all phases
- kVAR, total of all phases
- kVA, total of all phases

To compute sliding window demand values, the 4720 power meter uses the sliding window averaging (or rolling interval) technique, which divides the demand interval into subperiods. The demand is measured electronically based on the average load level over the most recent set of subperiods. This method has the effect of improving the response time as compared to the fixed interval method.

The DEMAND PERIOD and NUM DEMAND PERIOD parameters allow you to match the power utility's demand calculation technique. For sliding window measurements, DEMAND PERIOD represents the length of the utility's demand subperiod, while NUM DEMAND PERIOD represents the number of subperiods that make up the total demand interval. For example, with a 6 x 5 minute (30 minutes total) sliding window method, demand is the average power consumption over the last six 5-minute periods. This allows you to match virtually any type of sliding window measurement method used by the utilities (for example, 2 x 15 minutes, 6 x 5 minutes, 1 x 30 minutes).

Each sliding window demand measurement also offers minimum/maximum parameters.

Using the sliding window method, the 4720 power meter readings will always be as high or slightly higher than the utility readings.

On the front panel display, sliding window demand parameters are indicated using the label "SD." See **Table 7.2**.

Predicted Sliding Window Demand

The 4720 power meter automatically predicts the value that each sliding window demand parameter will attain when updated at the start of the next sliding demand interval. Additional predicted demand peak values can be provided by the Preset and Programmable Min/Max Logs.

The 4720 power meter predicts changes in demand as they occur. With predicted demand, the 4720 power meter can be easily applied in energy management strategies. All demand results are available as setpoint triggers that can be used to control any of the relays (R1 to R3) for load shedding, backup generator control, and so on.

The setup parameters DEMAND PERIOD and NUM DEMAND PERIOD used by the sliding window demand calculations are the same for predicted demand. An additional predicted demand base parameter sets the sensitivity of the demand prediction, allowing the instrument's response to be carefully tuned to demand variations in the power system. Smaller values provide faster response. The default value is 5%. A value between 1% and 25% is recommended. Setting to zero disables prediction and returns values of zero (0) for all predicted sliding window demand parameters.

On the front panel display, predicted sliding window demand parameters are indicated using the label "PD." See **Table 7.2**.

External Demand Synchronization

When the DEMAND SYN parameter is set to EXTERNAL, the 4720 power meter looks for a pulse (INACTIVE to ACTIVE transition) on status input S4 to indicate the start of the subsequent demand interval. This allows you to synchronize the 4720 power meter demand calculations to the utility's demand period. The NUM DEMAND PERIOD parameter is still operational in this mode and can be used to set the number of subperiods that make up the total demand interval.

Resetting Demand Parameters

The accumulated demand, minimum demand, and maximum (peak) demand measurements are all cleared at the same time when the CLEAR MIN/MAX? parameter is set to YES in programming mode or via communications. However, all demand measurements are always cleared when any 4720 power meter operating parameter is changed either from the front panel or via communications.

It is important that any reset of the demand values be performed near the beginning of a demand subperiod (synchronized with the utility's subperiod). Resets performed in the middle or near the end of a demand subperiod cause erroneous predicted sliding window demand readings. These occur only for the first one or two subperiods following the reset. Lower settings for the user-definable predicted demand base (for example, < 25%) allow for faster recovery of the predicted demand readings under these circumstances.

Minimum/Maximum Parameters

The 4720 power meter maintains all min/max values in its Preset Min/Max Log. This log records the extreme values for all real-time, harmonic distortion, and demand parameters. This includes all user-defined and predicted sliding window demands.

On the front panel display, minimum and maximum values are indicated using the labels "MN" and "MX," respectively. See **Table 7.2**.

Resetting Min/Max Parameters

All min/max values in the Preset Min/Max Log can be cleared using the CLEAR MIN/MAX? parameter from the front panel in programming mode. This also clears the 16 Programmable Min/Max Logs. Individual logs can be cleared via communications as described in more detail in **Chapter 11**.

7.3 Accumulated Measurements

The following sections describe the standard energy measurements of the 4720 power meter.

Energy parameters are accumulating values. The base energy parameters include:

- Real energy, or kW hours (kWH)
- Reactive energy, or kVAR hours (kVARH)
- Apparent energy, or kVA hours (kVAH)

All energy parameters represent the total for all three phases.

Energy readings are true rms and are updated approximately once each second. Maximum range of energy readings is 0 to 999,999,999. Beyond this value, readings roll over to zero (0).

kWH and kVARH energy parameters provide four measurement modes that indicate bi-directional power flow: imported, exported, net, and total. The kVAH energy parameter provides only a net and a total reading, which produce the same result. **Table 7.3** describes the modes available to each energy parameter and the display labels used to identify them.

Imported
: Imported energy represents energy in the positive or forward direction (that is, energy consumed). Readings for imported energy use the label "IM."

Exported
: Exported energy represents energy in the negative or reverse direction (that is, energy generated or fed back to the utility). Readings for exported energy use the label "EX."

Net
: Net measurements represent the difference between energy imported and exported for all three phases. A net export of energy is displayed as a negatively signed number. Net readings are indicated by an "NT" label.

Total
: Total measurements represent the sum of (the absolute values of) the energy imported and exported for all three phases. In other words, a total energy counter increments whether energy is being imported or exported. Total readings do not use any additional mode labels to identify them.

Conventions used in regards to energy import/export are described in **section 7.5**.

Table 7.3 Energy Parameter Display Labels

Accumulated Measurement	Imported	Exported	Net	Total
kWH (real energy)	KWH* IM	KWH* EX	KWH* NT	KWH*
kVARH (reactive energy)	KVARH* IM	KVARH* EX	KVARH* NT	KVARH*
kVAH (apparent energy)			KVAH* NT	KVAH*

*Measurements represent the total of all phases.

7.4 Resetting Energy Counters

You can reset all kWH, kVARH and kVAH counters to zero (0) using the CLEAR HOURS? parameter from the front panel in programming mode, or via communications. This action clears the import, export, net, and total counters for each parameter.

7.5 Power Reading Polarities

Figure 7.2 illustrates how the 4720 power meter interprets and displays signed values for power, energy import/export indication, and power factor leading/lagging indication.

The polarity of energy import/export readings can be reversed by reversing the polarity of the CTs connected to the 4720 power meter.

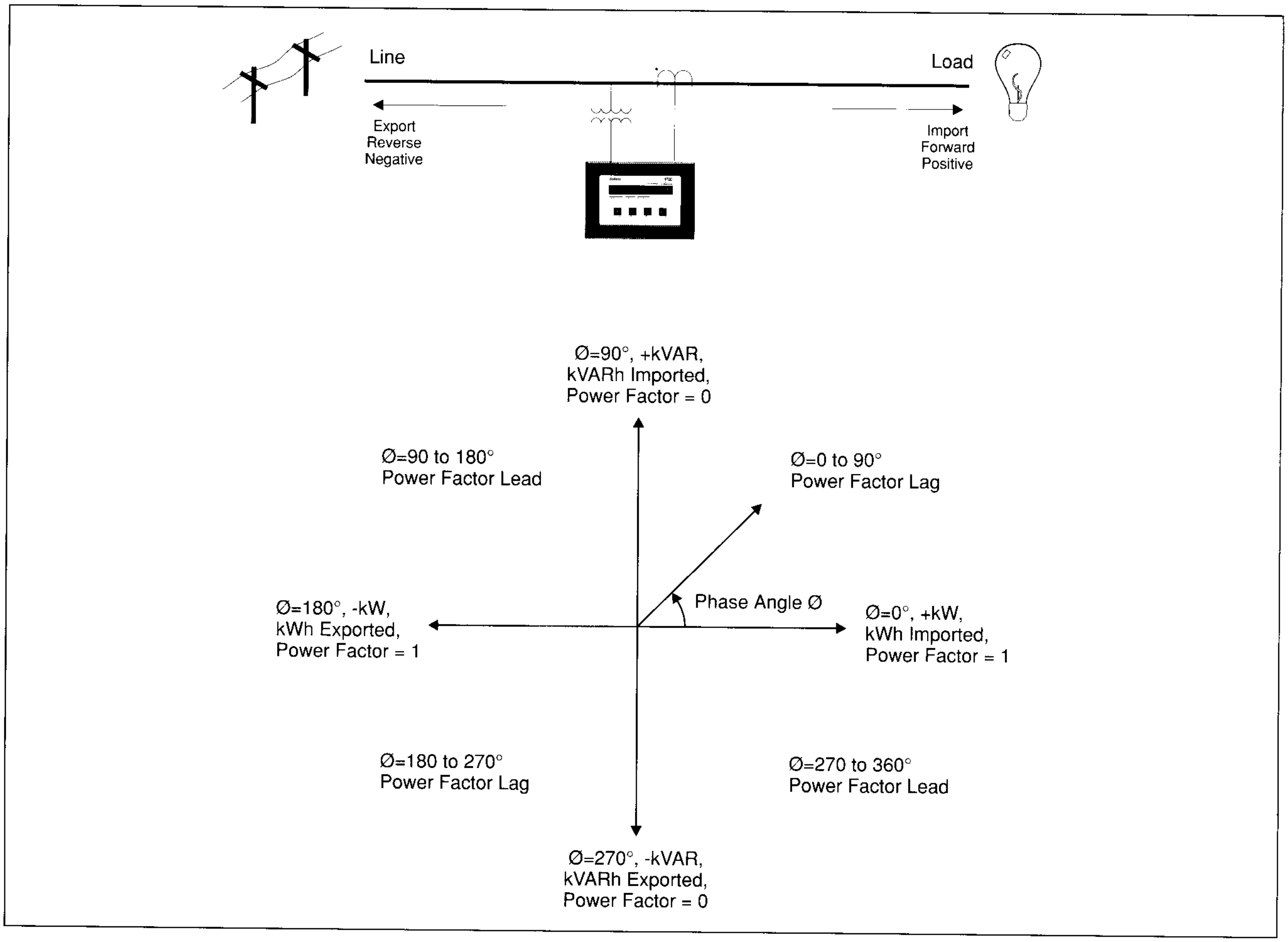


Figure 7.2 Power Reading Polarities

7.6 Status Information

Status information includes the present conditions of the three relays, four digital (binary) status inputs, four status input counters, and seventeen user-programmable setpoints.

Also included under this category is self-diagnostic information.

This section discusses only the display formats for all status information. Relay and status input operations are described in detail in **Chapter 5**. Setpoint operation is described in **Chapter 8**.

7.6.1 Relays, Status Inputs, and Setpoints

Table 7.4 lists examples of the display label formats used for relay, status input, counter, and setpoint conditions. The 4720 power meter displays relay and status input conditions using the set of default display labels shown. Display labels for the active and inactive condition of each relay and status input can be redefined via communications. Labels are limited to 20 alphanumeric characters. Both upper and lower case letters can be defined. Most punctuation can be displayed. Note that all punctuation and spaces are counted as single characters. Delimiters (decimals, brackets, equal sign, and so on) may be defined as part of the label.

Examples:

BREAKER 82B = TRIP

GENERATOR = ON

Siemens WinPM software provides configuration screens for redefining display labels for the 4720 power meter. Labels defined by the system operator are displayed at the computer.

Display labels for status input counters and setpoints are not user-definable.

7.6.2 Diagnostics Parameters

These parameters are non-programmable and are used to indicate various internal status conditions of the 4720 power meter. Diagnostic parameters can be accessed in programming mode by setting the DIAGNOSTICS parameter to YES.

Diagnostic Firmware Version
This indicates the current firmware version installed in the 4720 power meter. **Table 6.4** in **Chapter 6** describes the format of firmware version numbers.

As a policy of ongoing product development, Siemens will offer firmware upgrades when additional features or expansion of existing functionality becomes available.

The 4720 power meter provides three groups of extended diagnostics parameters. **Table 7.5** lists all extended parameters. These parameters can be used as follows:

Group 1: COMMUNICATIONS
This group of parameters can be useful to third-party developers requiring real-time remote communications diagnostics information. Refer to the 4720 power meter Communications Protocol document for more detailed descriptions of these parameters.

Group 2: BATTERIES
These parameters indicate the current condition of the two backup batteries. Low levels indicate that remaining battery life is limited and that one or both of the batteries should be replaced.

Group 3: METER TIME
This parameter can be used to view the current date and time indicated by the meter's clock. Date and time can be reset via communications only.

To access the extended diagnostics parameters, use the following procedure:

1. Enter programming mode and set the EXTENDED parameter (under DIAGNOSTICS) to YES.
2. Return to display mode.
3. Access the extended parameters by pressing the Phase and Function buttons at the same time. The first group that appears is COMMUNICATIONS.
4. Use the Phase button to advance through each parameter in the group. The list wraps around.
5. Press the Phase and Function buttons at the same time to advance to the next group. The list wraps around.
6. Press the Function button to return to normal display mode.

You can continue to access the extended parameters as described above if the EXTENDED parameter remains set to YES.

Table 7.4 Status Information Display Labels

Information	Source	Condition	Display Label
Relay Output	Relay x, x = 1, 2, or 3	Released (Inactive)	RELAY x INACTIVE1*
		Operated (Active)	RELAY x ACTIVE1*
Status Input	Status Input x, x = 1, 2, 3, or 4	Inactive	STATUS x INACTIVE1*
		Active	STATUS x ACTIVE1*
Status Input Counter	Status Counter x, x = 1, 2, 3, or 4	Accumulated Pulse Count	Sx COUNT = 123456789
Standard Setpoint	Standard Setpoint xx, xx = 1 to 11	Inactive	STD Sxx INACTIVE
		Active	STD Sxx ACTIVE
High-Speed Setpoint	High-Speed Setpoint x, x = 1 to 6	Inactive	Hx INACTIVE
		Active	Hx ACTIVE

*The inactive and active state labels for status inputs and relays are user-definable via communications.

Table 7.5 Diagnostic Parameters

Display Label	Description	Value
Group 1: Communications		
RX FRAME	Number of SEAbus packets detected on the bus	Total increments by 1
TX FRAME	Packets transmitted	Total increments by 1
NO RESPONSE	Application layer not ready	If true, total increments by 1
BAD CHECKSUM	Bad CRC-16	If true, total increments by 1
INCOMPLETE	Reserved for future use	If true, total increments by 1
WATCHDOG	No SEAbus packets detected on the bus for a period exceeding five minutes	If true, total increments by 1
BYTE ERROR	Framing errors (indicates data collisions)	Total increments by 1
OVERRUN	Data received at too high a rate	If true, total increments by 1
Group 2: Batteries		
RTC	Real-time clock battery life remaining (percent of maximum)	0 to 100
RAM	NVRAM battery life remaining (percent of maximum)	0 to 100
Group 3: Meter Time		
WWW MMM DD HH:MM:SS	Real-time clock date and time	WWW=MON, TUE, WED, THU, FRI, SAT, SUN MMM=JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC DD = 1 to 31 HH = 0 to 23 MM = 0 to 59 SS = 0 to 59

8 Using Setpoints

The 4720 power meter user-programmable setpoints provide a host of control, protection, and analysis tools. Setpoints provide extensive control over the three relay outputs, as well as triggering capabilities for the waveform capture, waveform recording and snapshot logging features. Seventeen individual setpoints are provided, six of which offer high-speed capabilities.

Setpoint-controlled relays can be used to perform such functions as automated demand, power factor, or voltage control. Setpoints can also enhance system reliability and safety by protecting against such conditions as neutral current or transformer heating, and ground current leakage. Upon the detection of a fault condition, the relays can be used to activate external alarms or to provide shadow protection on critical breakers. Fault conditions can be analyzed in detail to determine their source(s) using sampled waveform data or logged data triggered by user-defined setpoint levels.

8.1 Setpoint Operations

A group of programmable parameters specify how a setpoint is to operate. These parameters are programmable via communications only:

- The trigger parameter defines the parameter a setpoint is to monitor. This can be a measured parameter, status input condition, and so on.
- Two setpoint limits are provided (high limit, low limit). One of these limits defines the value of the trigger parameter which will activate the setpoint. The other limit defines the value of the trigger parameter which will deactivate the setpoint.
- Setpoint actions define the operations that each setpoint can be used to control. When a setpoint becomes active it can be used to trigger relay control, waveform capture, waveform recording, snapshot logging, or a number of different register clearing operations (for example, Min/Max Log, status input counters). Each setpoint can control up to two independent actions simultaneously. If you only want to log a setpoint condition when it occurs, the setpoint can be programmed to perform no subsequent actions.
- Two programmable time delays are provided: time delay to operate and time delay to release. The function of these time delays is described in **section 8.2.1**.

8.1.1 Setpoint Programming

Setpoint programming facilitates a wide range of alarm, control, and analysis applications. Each of the seventeen setpoints can be programmed to concurrently monitor a separate parameter. A single active setpoint can trigger up to two independent actions (relay control, logging, and so on). For multi-level control, more than one setpoint can monitor the same parameter. Multiple setpoints can also be assigned to trigger the same action (that is, the "or" function).

8.1.2 Setpoint Recording

All setpoint activation and deactivation conditions are automatically recorded in the Event Log. This information includes any setpoints that become activated but are not programmed to perform any subsequent setpoint actions such as relay control.

Event Log entries include the date and time stamp for when the setpoint event occurred, and the value of the trigger parameter. Any subsequent setpoint action is displayed in the log, along with a date and time stamp. The Event Log is described in more detail in **Chapter 10**.

8.1.3 Setpoint Monitoring

Monitoring of all setpoint conditions is performed continuously by the 4720 power meter, uninterrupted by the execution of other measurement, control or logging operations. This means that critical setpoint-related events of short duration are always captured.

The following sections describe setpoint operation and programming in detail.

8.2 Setpoint Types

The 4720 power meter offers six high-speed setpoints and eleven standard setpoints. Both setpoint types are similar in their operation and programmability; however, response times for each differ significantly. The characteristic response of each setpoint type makes each ideal for specific ranges of applications.

8.2.1 Setpoint Response Times

Due to the difference in response characteristics between high-speed and standard setpoints, the response times and programmable delays for each are specified using different units. High-speed setpoint times are specified in number of cycles (where a cycle = 16.6 ms for a 60 Hz input, or 20 ms for a 50 Hz input). Standard setpoint times are specified in number of seconds.

Under normal operating conditions, the response time of setpoint functions is defined as the time lapse between a setpoint event occurring and an associated setpoint action being executed. Response times are as follows:

High-Speed Setpoint
: Three cycles (typical), four cycles (maximum).

Standard Setpoints
: One second (typical), two seconds (maximum). This does not include harmonic distortion parameters (see the following note).

Note: The update rate for each harmonic distortion parameter is between five and 30 seconds. Setpoints programmed to trigger on harmonic distortion parameters can have response times over 30 seconds.

The 4720 power meter relays have a response time of eight milliseconds (typical), and 15 milliseconds (maximum). This does not include any additional contact bounce which may occur. This response must be added to setpoint response times when using setpoints to trigger relay control actions.

Power-Up Response

For both high-speed and standard setpoints, response time could be up to five seconds after any meter power-up (for example, initial power or subsequent power-ups following any system power failures). The 4720 power meter should not be used for protective functions that require faster operation. A battery-backed DC power supply should be considered for 4720 power meter devices whose setpoints are being used to perform protective functions in which response time is important.

8.2.2 High-Speed Setpoints

The six high-speed setpoints are numbered H01 to H06. High-speed setpoints are ideally suited for conditions in which fast response is essential such as overcurrent, overvoltage, reverse power, or ground faults on high impedance ground systems.

Note: The 4720 power meter is not intended for use as a primary overcurrent protection device. Setpoint relay control capabilities are designed to execute a variety of less critical functions, or to perform shadow (backup) protection on critical breakers.

The setpoint trigger parameters that can be used with the high-speed setpoints are listed in **Table 8.1**. The measured parameters associated with these trigger parameters are the internal high-speed parameters described in **Chapter 7**.

8.2.3 Standard Setpoints

The eleven standard setpoints are numbered S01 to S11. Standard setpoints are ideally suited for a wide range of operations ranging from simple alarm activations to fully automated demand, power factor, or load control.

The setpoint trigger parameters that can be used with the standard setpoints are listed in **Table 8.2**. The measured parameters associated with these trigger parameters are the real-time and harmonics parameters described in **Chapter 7**.

8.3 Trigger Parameters

This section describes the characteristics of various types of trigger parameters. **Table 8.1** and **Table 8.2** list all trigger parameters, including parameters that can only be used with the six high-speed setpoints and parameters that can be used with the eleven standard setpoints.

8.3.1 Over and Under Setpoints With Time Delays

Many trigger parameters can function either as an over setpoint such as for overcurrent, or as an under setpoint such as for undervoltage.

Over Setpoint

Figure 8.1 illustrates the operation of an OVER setpoint. An OVER setpoint becomes active when the parameter that is being monitored exceeds and remains over the value of the programmable high limit parameter for a time greater than the value of the TIME DELAY OPERATE parameter. An OVER setpoint becomes inactive when the trigger parameter that is being monitored falls below the value of the low limit parameter for a time greater than the value of the TIME DELAY RELEASE parameter. The difference between the high and low limits effectively produces a programmable level of operational hysteresis (or deadband).

Under Setpoint

Figure 8.2 illustrates the operation of an UNDER setpoint. An UNDER setpoint differs from an OVER setpoint only in that the meanings of high limit and low limit are reversed. The setpoint becomes active when the trigger parameter falls below the value of the low limit parameter for a time greater than the value of the TIME DELAY OPERATE parameter. The UNDER setpoint becomes inactive when the parameter exceeds and remains over the value of the high limit parameter for a time greater than the value of the TIME DELAY RELEASE parameter. Similar to over setpoint operation, the difference between the high and low limits produces an area of hysteresis.

8.3.2 On/Off and Counter Setpoints

Some trigger parameters provide a simple on or off condition such as phase reversal, or status input conditions. For status input types, setpoints can monitor the condition of individual inputs such as S1 active, S2 normal, and so on, or monitor all four status inputs together (for example, sx active). This second method effectively operates as an "or" function. For all ON/OFF trigger parameters, the setpoint will become active when the defined condition becomes true. These trigger parameters do not use the high or low limit parameters.

Setpoints can also monitor status input counter totals. The setpoint will become active when the associated counter exceeds the total defined by the high limit parameter. These trigger parameters do not use the low limit parameter.

Table 8.1 Setpoint Trigger Parameters (High-Speed)

High-Speed Setpoint Trigger Parameters	
Parameter	**Description**
NOT USED	Disables the setpoint.
OVER V [1]	Active if measured voltage exceeds specified value, for selected phase or phase average.
UNDER V [1]	Active if measured voltage falls below specified value, for selected phase or phase average.
V IMBAL	Active if measured value for any voltage phase differs from the measured phase average by the specified percent (%) value.
OVER AMP	Active if measured current exceeds specified value, for selected phase or phase average.
UNDER AMP	Active if measured current exceeds specified value, for selected phase or phase average.
OVER I4	Active if measured I4 (neutral) current exceeds specified value.
OVER KW IMP [2]	Active if measured kW imported exceeds specified value, for selected phase or phase total.
OVER KW EXP [2]	Active if measured kW exported exceeds specified value, for selected phase or phase total.
OVER KVA [2]	Active if measured kW exported exceeds specified value, for selected phase or phase total.
OVER FREQUENCY	Active if measured frequency exceeds specified value.
UNDER FREQUENCY	Active if measured frequency falls below specified value.
TOC	Response based on user-programmable time-overcurrent curve, for selected phase or phase average (see **section 8.3.3**).
PHASE REVERSAL [3]	Active if the actual phase rotation does not match the programmable PHASE ROTATION parameter.
STATUS x OFF	Active if status input Sx becomes inactive (x = 1 to 4).
STATUS x ON	Active if status input Sx becomes active (x = 1 to 4).
ANY STATUS OFF	Active if any status input becomes inactive.
ANY STATUS ON	Active if any status input becomes active.
Sx COUNTER	Active if status input Sx counter total exceeds specified limit (x = 1 to 4).

Table 8.2 Setpoint Trigger Parameters (Standard)

Standard Setpoint Trigger Parameters	
Parameter	**Description**
NOT USED	Disables the setpoint.
OVER <parameter> [4]	Active if measured value for the selected parameter exceeds specified value. Parameter options include all real-time, harmonics, demand, and min/max measurements for all applicable phases, phase averages, phase totals, I4 or VAux inputs. A total of over 700 parameter options are provided.
UNDER <parameter> [4]	Active if measured value for the selected parameter falls below specified value. Parameters options are the same as in OVER setpoint described above.
V IMBAL	Active if measured value for any voltage phase differs from the measured phase average by the specified percent (%) value.
A IMBAL	Active if measured value for any current phase differs from the measured phase average by the specified percent (%) value.
PHASE REVERSAL [3]	Active if the actual phase rotation does not match the programmable PHASE ROTATION parameter.
STATUS x OFF	Active if status input Sx becomes inactive (x = 1 to 4).
STATUS x ON	Active if status input Sx becomes active (x = 1 to 4).
ANY STATUS OFF	Active if any status input becomes inactive.
ANY STATUS ON	Active if any status input becomes active.
Sx COUNTER	Active if status input Sx counter total exceeds the specified limit (x = 1 to 4).
NEW xxxx	Momentarily active when real-time clock advances to a new hour, day, week, month, or year (xxxx = HOUR, DAY, WEEK, MONTH, or YEAR).

Notes for Table 8.1 and Table 8.2

1. Volts line-to-line is not functional if VOLTS MODE = WYE. Volts line-to-neutral is not functional if VOLTS MODE = DELTA.
2. Per phase measurements are not available for OVER KW IMP, OVER KW EXP, or OVER KVA if VOLTS MODE = DELTA.
3. Not functional if VOLTS MODE = SINGLE or 3W-WYE.
4. Volts line-to-neutral is not functional if VOLTS MODE = DELTA. Per phase kW, kVAR, and kVA options are not available if VOLTS MODE = DELTA.

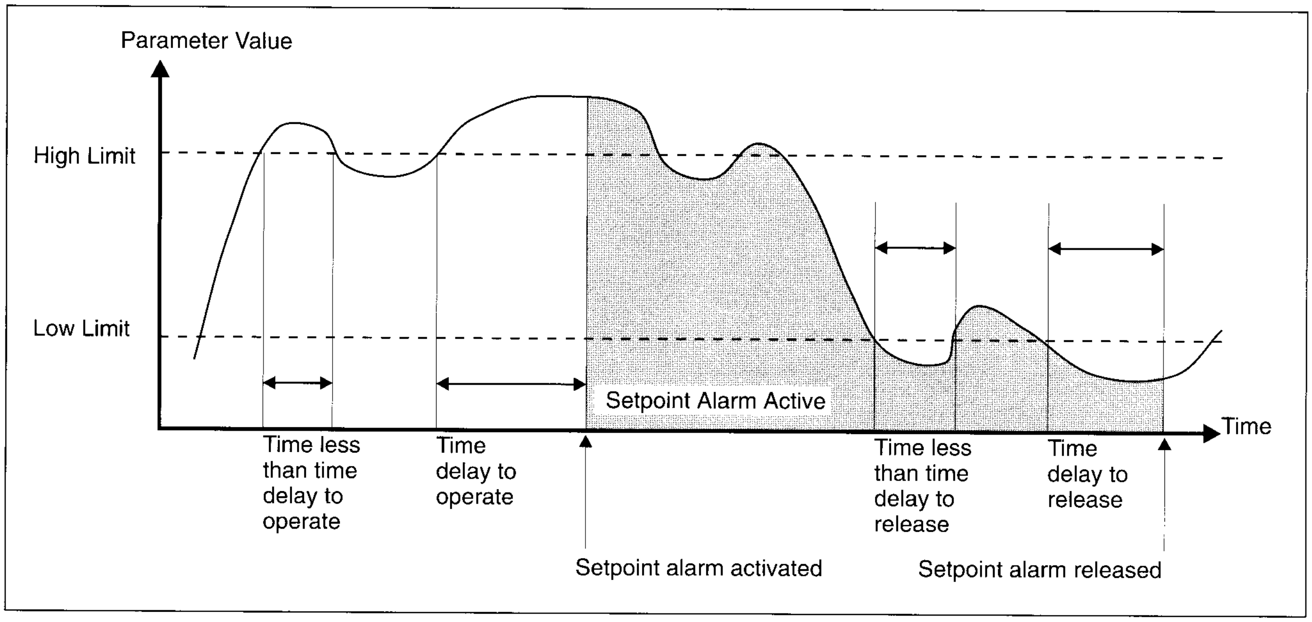


Figure 8.1 Over Setpoint Operation

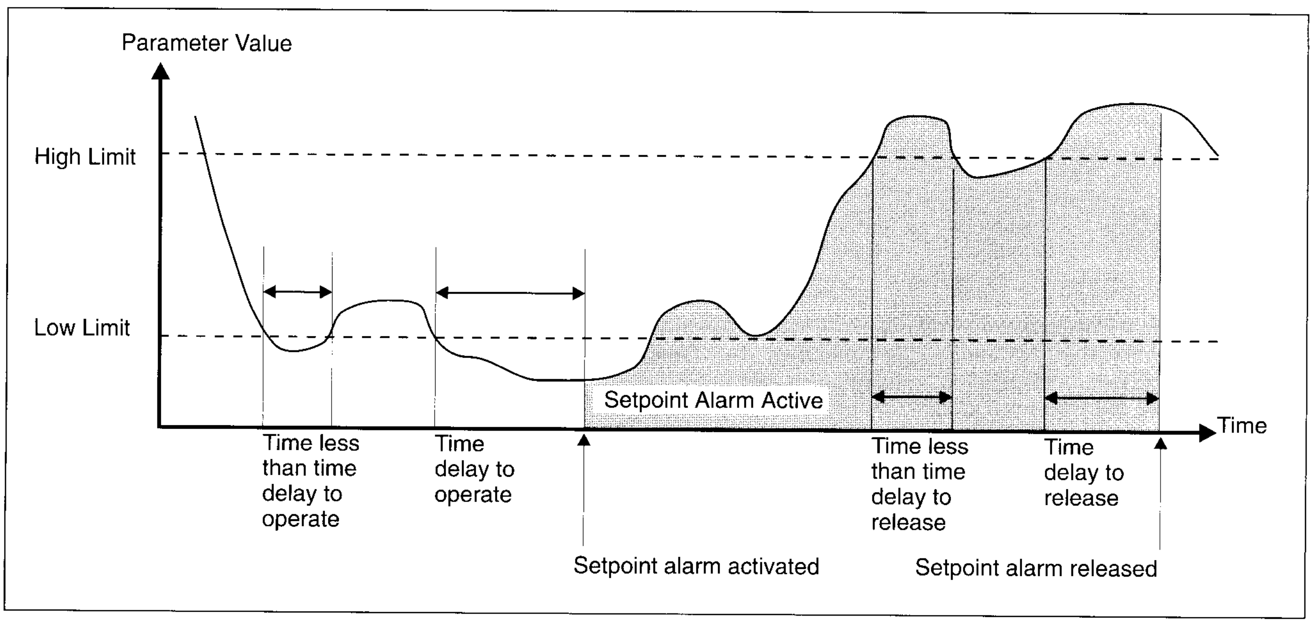


Figure 8.2 Under Setpoint Operation

8.3.3 Time-Overcurrent Curve

Note: The Time-Overcurrent Curve (TOC) cannot be used concurrently with the High-Speed Snapshot Log (HSS) feature. You must select which feature to enable by setting the HIGH SPEED FEATURE parameter via communications. To enable the Time-Overcurrent Curve, set it to TOC.

The 4720 power meter offers additional overcurrent protection capabilities using a programmable inverse time characteristic. Only the six high-speed setpoints can use this setpoint type. Virtually any time-current characteristic can be defined to match a wide range of applications.

The time-overcurrent curve represents a boundary for safe current operation of a feeder. The curve is represented by current on the x-axis and time on the y-axis. The curve's shape is such that as the current increases, the time necessary to trip the setpoint is reduced. The amount of time required to trip the setpoint is configurable through selection of the proper data points.

Note: For accurate time-overcurrent response times, the meter must provide adequate current overrange capability to measure the expected peak current. To provide this, the meter must be equipped with the correct overrange option (for example, Basic, 200%, or 500%). See **Chapter 2 section 2.5.3** and **section 2.5.4**, and **Appendix A**.

Setpoint Active Condition

The time-overcurrent setpoint operates similar to all other setpoints. If the 4720 power meter measures a current that is maintained for a period of time longer than is specified on the characteristic curve, the setpoint becomes active. This curve is based on time versus xcurrent multiplied by the max current (or pickup current).

Note: Time-overcurrent calculations are based on the high-speed setpoint system which provides responses times in increments of two cycles. Refer to **section 8.2.1** for minimum response times.

Setpoint Inactive Condition

An inverse version of the time-overcurrent curve is used to determine when the setpoint becomes inactive. This curve is based on time versus the max current divided by the xcurrent.

Additional Time Delays

The programmable time delay to operate and release delays are still operational for this setpoint type; however, it is not recommended that they be used. Required delays should be implemented using the characteristic time delays of the time-overcurrent curve. Using the TIME DELAY OPERATE and TIME DELAY RELEASE parameters to provide additional delays could produce unexpected results.

Programming

You can program response curve parameters via the communications port. Siemens WinPM software provides a setup screen for the time-overcurrent curve. Specify the MAX CURRENT parameter, then define the eight data points on the curve using the y-axis coordinate xCURRENT and the x-axis coordinate TIME parameters. Once the curve has been calculated and displayed, it can be sent to the 4720 power meter via communications and stored. To define a high-speed setpoint as a time-overcurrent type, set its type parameter to TOC.

8.4 Setpoint Actions

An active setpoint condition can be used to simultaneously trigger up to two separate actions. Each setpoint has two programmable parameters which allow you to define each action. These are named ACTION 1 and ACTION 2.

Note: If ACTION 1 and ACTION 2 are both configured for a setpoint, ACTION 1 is always performed first.

For each setpoint action, many action types are available. The eleven standard setpoints can be used to trigger:

- Relay Control
- Waveform Capture
- Waveform Recording
- Snapshot Logging (standard only)
- Clearing Functions:
  - Clearing the Min/Max Logs (Preset and/or Programmable)
  - Clearing the Status Counters (One or All)

The six high-speed setpoints can trigger:

- Relay Control
- Waveform Capture
- Waveform Recording
- Snapshot Logging (High-Speed Only)
- Clearing Functions:
  - Clearing the Status Counters (One or All)

ACTION 1 and ACTION 2 for each setpoint are both programmable via communications. The following sections describe each setpoint action in detail.

8.4.1 Relay Control

Any of the three relays of the 4720 power meter can be automatically controlled by a high-speed or standard setpoint. Setpoint-controlled relays can perform a wide range of operations, including:

- Tripping a breaker
- Activating an alarm buzzer or light
- Controlling an external piece of equipment

> **Note:** Refer to **section 8.2.1** for information regarding setpoint and relay response times and other considerations.

A relay assigned to a setpoint is automatically operated when the setpoint becomes active, and released when the setpoint returns to its inactive state.

To configure a setpoint for relay control, you must program the parameters for both the setpoint and for the assigned relay:

1. Set the ACTION 1 or ACTION 2 parameter to the desired relay.
2. The MODE parameter for the assigned relay must be defined as SETPOINT.

The programmable time delay to operate delay can be used to delay a setpoint from becoming active, thus delaying the assigned relay operation. The programmable time delay to release delay can be used to delay when the setpoint returns to its inactive state, thus delaying when the assigned relay is released.

As described in **Chapter 6**, **section 6.6.2**, relays may also be used for kWH, kVARH, or kVAH pulsing. Be sure that a relay configured for pulsing is not also assigned to setpoint operation. Pulsing operations always override setpoint control.

The 4720 power meter setpoint system allows for multi-level and multi-function relay control operations. The following examples illustrate this flexibility.

Examples:

1. By assigning the same relay number to more than one setpoint, multiple setpoints can be channelled to a single relay. This feature can effectively produce a logical "or" function. This also allows a single relay to perform multiple functions; however, as mentioned above, care must be taken to avoid operational conflicts.
2. You want to configure a two-level relay protection scheme. First assign two setpoints to monitor the same trigger parameter (for example, OVER CURRENT). Set each setpoint to trigger on a different parameter limit, one higher than the other (for example, H01 HI LIMIT = 500, H02 HI LIMIT = 750). Configure each setpoint to control a different relay (for example, H01 ACTION 1 = RELAY1, H02 ACTION 1 = RELAY2). Each relay could control a different external protection device. As the value of the measured parameter increases, each relay will activate in sequence.

A relay configured for setpoint control (MODE = SETPOINT) may be forced operated or released using commands issued via communications. Manual commands override any present setpoint-controlled relay operations. Once a command to return to normal is issued via communications, the affected relay is immediately returned to setpoint control.

8.4.2 Waveform Capture Triggering

Any of the standard or high-speed setpoints can be used to trigger the waveform capture functions. Setpoint triggered waveform capture allows the 4720 power meter to automatically perform a high-resolution capture of one cycle of a single selected input. Input options include any one of the six phase voltage and current inputs, I4 (neutral) input, or VAux input. This data can be uploaded to WinPM software to facilitate analysis of the harmonic content that existed at the same time of the fault condition defined by the setpoint. This is described in more detail in **Chapter 9**, **section 9.2**.

To configure a setpoint condition to trigger waveform capture, the user must program one of the setpoint's two ACTION parameters as WAVE CAPTURExx, where xx represents the specific input to be captured (V1, I1, and so on).

The programmable TIME DELAY OPERATE parameter can be used to provide a delay interval between when the setpoint becomes active and when waveform capture is triggered. The TIME DELAY RELEASE parameter has no effect.

A waveform capture trigger command received via communications overrides any setpoint-controlled waveform capture action. Once the capture data is uploaded via communications, the recorder automatically re-arms and returns to setpoint control.

8.4.3 Waveform Recorder Triggering

Any of the standard or high-speed setpoints can be used to trigger the waveform recording function. Waveform recording can provide a detailed 12 to 36-cycle record of all input signals before, during, and after the occurrence of a fault. Inputs include all six phase voltage and current inputs, plus the I4 (neutral) and VAux inputs.

The recorder can be configured to store three 12-cycle events, two 18-cycle events, or one 36-cycle event for all inputs. The waveform recorder runs continuously until it is triggered either by a setpoint event or manually by a command issued via communications. At that time, the waveform data is captured and stored in memory. This is described in more detail in **Chapter 9**, **section 9.3**.

To configure a setpoint condition to trigger waveform recording, you must program one of the setpoint's two ACTION parameters to WFR.

The programmable time delay to operate can be used to delay a setpoint from becoming active, thus delaying the triggering of the waveform recorder. This is described in detail in **Chapter 9**, **section 9.3**. The TIME DELAY RELEASE parameter can be used to delay when the setpoint becomes inactive, but this has no effect on waveform recorder triggering.

A waveform recorder trigger command received via communications overrides any setpoint-controlled waveform recorder action. Once the recorded data is uploaded via communications, the recorder automatically re-arms and returns to setpoint control.

8.4.4 Snapshot Log Triggering

Triggering of Snapshot Logs using setpoints allows you to define groups of important measured parameters or status information whose values or conditions are logged when a setpoint becomes active. The Snapshot Log records all user-defined parameters with a time stamp. This can provide detailed operations information to aid in isolating problem sources.

Any of the eleven standard setpoints can be programmed to trigger any of the eight standard Snapshot Logs. Only high-speed setpoints can be programmed to trigger a high-speed Snapshot Log, if one has been configured.

Snapshot Logs can be triggered by setpoints in one of two ways:

One Shot
: If the Snapshot Log's programmable INTERVAL parameter is set to zero seconds, the log records once when the setpoint condition initially occurs.

Gated
: If the programmable INTERVAL parameter is set to a non-zero time interval, the Snapshot Log records once when the setpoint condition initially occurs, and continues to record at the specified intervals the entire time the setpoint remains in an active condition.

Note that a high-speed Snapshot Log operates differently than a standard log, using an additional user-defined stop condition. This is described in more detail in **Chapter 10**.

Setpoint parameters related to snapshot logging are not accessible via the front panel of the 4720 power meter. To configure a setpoint condition to trigger a Snapshot Log, you must program the setpoint via communications. One of the setpoint's two ACTION parameters (ACTION 1 or ACTION 2) must be set to one of the standard Snapshot Log numbers 1 to 8 (see **Table 6.6** in **Chapter 6**); or to SNAPSHOT 8 if the high-speed Snapshot Log is configured (see **Table 6.7** in **Chapter 6**).

The programmable TIME DELAY OPERATE parameter can be used to delay a setpoint from becoming active, thus delaying the triggering of the Snapshot Log. The TIME DELAY RELEASE parameter can be used to delay when the setpoint becomes inactive, but this has no effect on Snapshot Log triggering.

Example:

Setpoint triggered snapshot logging is ideal for saving critical information prior to the clearing of registers or logs. Suppose a standard setpoint is configured to trigger on NEW HOUR, NEW DAY, NEW MONTH, or NEW YEAR. To save the current values of the MIN/MAX parameters, assign those parameters of interest to a standard Snapshot Log, then configure the log to be one-shot triggered by the setpoint. The first action of the setpoint would be to trigger the log. The second action would be to clear the Min/Max Log. Each time a new month occurs, the current data is saved, and the parameters are reset. See **section 8.4.5** and **Table 6.3** in **Chapter 6** for information on clearing registers and logs.

> **Note:** As mentioned above, ACTION 1 of any setpoint is always performed before ACTION 2. Therefore, it is very important that ACTION 1 performs the Snapshot Log trigger while ACTION 2 performs the subsequent clearing function. Otherwise the present data will always be lost.

8.4.5 Clearing Functions

Preset and programmable Min/Max Logs and counters can be cleared automatically using setpoints. Refer to **Table 6.3** in **Chapter 6** for a detailed list of the clearing functions you can assign to a setpoint-triggered action.

8.5 Programming Setpoints

It is recommended that setpoint utilization be planned using a Setpoint Parameter Form. **Appendix C** provides a blank Setpoint Parameter Form for this purpose. This form contains the setpoint information that the user programs into the 4720 power meter. A copy of this information should be kept with the meter.

Figure 8.3 provides an example of a Setpoint Parameter Form used to plan setpoint usage. The form contains all the parameter values required to program the 4720 power meter to perform the operations described in the following examples:

1. Setpoints S01 to S02 are used to sense loads that are over 70% of the breaker rating. This includes overcurrent and overvoltage conditions. Setpoints S03 to S04 are used to sense excessive power factor lead or lag. Setpoint S05 is used to sense a voltage unbalance condition. For all these conditions, Relay 2 is triggered to operate as an alarm relay, with its output connected to a buzzer. Setpoint S01 is also used to trigger Snapshot Log #1 to record the real-time readings of measured parameters associated with the overcurrent condition.

2. Relay 3 is used by setpoint S06 as a kW demand control relay, and is connected to a sheddable load or backup generator.

3. Setpoints H01 to H02 are used to sense over and under voltage conditions. Both setpoints are triggering Relay 1 to operate as a trip relay, which is connected to a breaker shunt trip input. Setpoint H01 is also used to trigger the waveform recorder if an overvoltage condition occurs.

During the programming of a setpoint via communications, any relay currently assigned to that setpoint is temporarily forced into its released state (normally-open contacts forced open). The 4720 power meter then re-evaluates setpoint conditions based on the new parameter settings and performs any required relay operation.

8.6 Power Outages

When the power control to the 4720 power meter is interrupted, even momentarily, the output relays release. When power is restored, the 4720 power meter allows a three second settling time. After this interval, the setpoint conditions are re-evaluated and, if appropriate, the relays operate after the programmed time delays.

If any relay has been forced operated or forced released using commands issued via the communications port prior to the power outage, the relay is released when the outage occurs. When power is restored, the 4720 power meter resumes normal setpoint operation as described above. Relays will not automatically return to a forced operated or forced released condition following a power outage.

Setpoint Parameter Form							
Setpoint	**Trigger Parameter**	**High Limit**	**TD Operate**	**Low Limit**	**TD Release**	**Action 1**	**Action 2**
S01	Overcurrent	2100	10	2000	1	Relay2, Alarm	Snapshot1
S02	Overvoltage	300	10	290	1	Relay2, Alarm	
S03	Under PF Lag	90	10	85	10	Relay2, Alarm	
S04	Under PF Lead	90	10	85	10	Relay2, Alarm	
S05	Volts Unbalance	30%	5	10%	1	Relay2, Trip	
S06	Over KWD	1200	10	900	10	Relay3, Dmd-Cntl	
S07	Not Used						
S08	Not Used						
S09	Not Used						
S10	Not Used						
S11	Not Used						
H01	Overvoltage	332	5	290	1	Relay1, Trip	WaveRecord
H02	Undervoltage	270	5	220	1	Relay1, Trip	
H03	Not Used						
H04	Not Used						
H05	Not Used						
H06	Not Used						

Figure 8.3 Example Setpoint Parameter Form

9 Using Waveforms

The 4720 power meter is equipped with digital waveform sampling capabilities. The 4720 power meter provides two powerful methods for acquiring waveform data: waveform capture and waveform recording. Waveform capture can be used for detailed power quality analysis beyond that offered by the harmonics measurements. Waveform recording can assist in analyzing short duration events such as faults, surges, and so on.

Waveform capture and recording are independent functions and can be used concurrently. Each function can be independently triggered by a user-defined setpoint condition or by a command issued via communications.

9.1 Importance of Power Quality Monitoring

Power quality has become a foremost concern for power utilities and their customers due to an increasing presence of induced harmonic voltages and currents in industrial, commercial, and residential electrical supplies. Harmonics are typically generated within a power distribution system by non-linear loads (variable frequency drives, UPS systems, HVAC and lighting systems, computers, and so on).

Poor power quality can have serious and potentially damaging consequences, including equipment malfunctions or failures, reduced efficiency and mechanical vibration in motors, or incorrect tripping and/or failure of circuit breakers. Harmonic currents from individual phases can also add in the neutral line, sometimes producing dangerously high neutral currents.

As harmonic sources become more prevalent, it is important to have the analytical tools necessary to identify potential problem sources and help in determining the preventive or corrective measures necessary to improve power quality in electrical distribution systems.

9.2 Waveform Capture

Waveform capture allows you to perform high-speed sampling of the V1, V2, V3, VAux, I1, I2, I3, or I4 (neutral current) inputs. One full cycle of the signal at a single selected input is sampled at a rate of 128 samples per cycle. All samples are taken synchronously to the line frequency and within one input cycle.

Sampled waveform data is stored in memory and can be read via the communications port. The high sampling rate used by the 4720 power meter produces high-resolution data which allows analysis of frequency components to the 63rd harmonic.

Siemens WinPM software can be used to upload captured waveform data from the 4720 power meter to a master computer station and display the waveforms on the computer screen. WinPM software automatically performs a Fast Fourier Transformation on each waveform, and provides an indication of total harmonic distortion and a breakdown of individual frequency components both in graphical and tabular form to the 63rd harmonic. This wide variety of data formats can help you quickly pinpoint the source and severity of harmonics, evaluate which sources must be minimized, and develop corrective strategies.

9.2.1 Triggering From a Setpoint

Triggering waveform capture from a setpoint allows you to analyze the harmonic character of any single selected voltage or current input that existed coincidental with the user-defined setpoint condition. An example might be a power line fault condition that is being produced by high harmonic content.

Triggering can be performed by either a high-speed or standard type setpoint. The user must set the programmable ACTION 1 or ACTION 2 parameter for the selected setpoint to WAVE CAPTURE. This parameter option must be programmed via communications. You must also select the input that is to be captured (V1, V2, V3, VAux, I1, I2, I3, I4).

The TIME DELAY OPERATE parameter can be used to provide an additional delay before the setpoint becomes active, thus delaying when waveform capture is triggered. The TIME DELAY RELEASE parameter has no effect.

When the setpoint becomes active (following any programmed time delay), waveform capture is automatically initiated on the selected input and the data is held in memory. No subsequent capture actions are allowed until the currently stored data is read via communications and waveform capture has been re-armed.

WinPM software's waveform capture screen can be used to retrieve one or more captured waveforms and display them graphically with the time stamp and an indication of the trigger source.

9.2.2 Triggering Manually via Communications

You can manually initiate waveform capture from the master station. Manual trigger commands override any currently active setpoint-triggered waveform capture.

With Siemens WinPM software, you can perform a waveform capture for each of the eight possible inputs individually. A command from the computer immediately initiates capture at the 4720 power meter. The computer automatically uploads and displays the waveform on the screen. The waveforms captured in turn for each of the eight inputs can be displayed on the screen at the same time, presented with correct phase relationships.

9.3 Waveform Recording

Power line faults, surges, sags, or other disturbances can cause expensive service interruptions. The 4720 power meter waveform recording feature is ideal for fault and surge analysis and to aid in fault location. It provides a powerful method for analyzing the conditions occurring before, during, and after a power fluctuation or failure. For example, fault recording can be performed by triggering on a status input setpoint that is monitoring a breaker trip. Other applications include the recording of voltage or current transients, transformer inrush currents, or motor start-up currents.

Waveform recording allows for simultaneous 12, 18, or 36-cycle sampling of all eight voltage and current inputs at a rate of 16 samples per cycle. The recorder runs continuously until triggered by a user-specified setpoint condition or by a manual command made via communications. You can also set a programmable trigger delay which allows you to define the amount of pre-event and post-event waveform data to be captured.

Siemens WinPM software can be used to display one or more of the eight recorded waveforms on the computer screen. The waveforms for single inputs or groups of inputs can be displayed together, presenting a comprehensive picture of the power line conditions surrounding the disturbance.

9.3.1 Configuring the Recorder

The memory of the 4720 power meter can store a total of 36 cycles of waveform data for each input. This memory space can be configured to store single or multiple events. Choices are:

- Three 12-cycle events (3x12)
- Two 18-cycle events (2x18)
- One 36-cycle event (1x36)

You must program the WFR CONFIGURATION parameter via communications to select one of the options above.

Choosing either the 3x12 or 2x18 multiple waveform configuration allows the 4720 power meter to record many events that may be close together in time. In the case of the 3x12 option, up to three events could be stored until uploaded to the computer.

The 1x36 configuration is ideal for recording events of longer duration; however, it is recommended that this option not be used if events are expected to be close together. For example, a recloser activation may generate multiple, closely spaced contact closures.

9.3.2 Triggering From a Setpoint

Triggering can be performed by either a high-speed or standard type setpoint. You must set the programmable ACTION 1 or ACTION 2 parameter for the selected setpoint to WFR. This parameter option must be programmed via communications.

As described in **section 9.3.3**, the programmable TIME DELAY OPERATE parameter can be used to delay a setpoint from becoming active, thus delaying the triggering of the waveform recorder. The TIME DELAY RELEASE parameter can be used to delay when the setpoint becomes inactive, but this has no effect on waveform recorder triggering.

The waveform recorder runs continuously until it is triggered by the setpoint event. When the setpoint becomes active, the waveform recorder is triggered (following any programmed time delay) and the window of cycles (either 12, 18, or 36) of each input are captured and stored in memory along with a time stamp.

The waveform recorder is automatically re-armed so that successive recordings can occur until all of the recorder memory has been filled. This would occur after the third recording of 12 cycles for the 3x12 configuration, or after the second recording for the 2x18 configuration. The memory is always filled after the single recording for the 1x36 cycle configuration.

> **Note:** To avoid duplication of waveform data, recorder triggers must be at least two cycles apart. Following the initial trigger, all subsequent triggers within a two-cycle period will be ignored.

Once the recorder memory is filled, the recorder is disarmed. All subsequent setpoint triggers are ignored until the currently stored data is read via communications. Manual trigger commands can override this (see **section 9.3.4**). The recorder is re-armed automatically following transfer of the waveform recorder data.

Using WinPM software, the master station automatically identifies if the waveform recorder is currently storing one or more recorded events. If so, all recorded events for all inputs are uploaded to the computer along with their time stamp, and archived to the hard disk.

WinPM software's waveform recorder screen can be used to retrieve one or more channels of each recorder event from the hard disk and graphically display them.

9.3.3 Adjusting the Trigger Point Pre-Event and Post-Event Data

Using high-speed setpoints to trigger the waveform recorder, you can acquire both pre-event data and post-event data. If the programmable TIME DELAY OPERATE parameter is set at zero (the default), the time that the setpoint event occurred will exist within the window of cycles recorded by the waveform recorder (see **Figure 9.1**, Example 1).

The recorder exhibits an inherent trigger delay of up to two cycles between when the external or internal setpoint event occurs and the setpoint has been fully evaluated. The best case for this delay is one cycle. At this point, the setpoint performs the action of freezing the waveform recorder. This process exhibits an additional stop delay of up to two cycles. In total, this can provide up to four cycles of post-event data, without the addition of a user-programmable delay.

Using standard setpoints to trigger the waveform recorder provides a much slower response. This slower response allows the waveform recorder to provide only post-event data. The time that the event occurred could exist one to two seconds prior to the start of the window of cycles recorded by the waveform recorder.

> **Note:** When using high-speed or standard setpoints to trigger the waveform recorder, the actual trigger point depends on the type of setpoint parameter being monitored (for example, under voltage or status input

change) and the additional programmable delay that you define.

The TIME DELAY OPERATE parameter can be used to vary the amount of pre-event and post-event data recorded by the waveform recorder.

If a high-speed setpoint is being used to trigger the waveform recorder, the TIME DELAY OPERATE parameter can be used to provide additional cycles of post-event data. The setpoint event time will effectively be moved earlier within the window of recorded cycles, reducing the amount of pre-event data and increasing the amount of post-event data.

Figure 9.1, Example 2 shows how setting TIME DELAY OPERATE = 2 (cycles) can cause the trigger point to be displaced by two cycles later in time, making the location of the setpoint event two cycles earlier in the window of recorded cycles. Note that the time delay to operate is added to the four cycle (worst case) total inherent trigger and stop delay of the recorder.

Note: As mentioned in **section 9.3.2**, for a setpoint to become active, the active condition must exist for a period greater than the value of the TIME DELAY OPERATE parameter. Therefore, no additional programmable delays should be applied when using the waveform recorder to capture events of short duration (two to six cycles). Otherwise, the recorder may fail to trigger.

Adding a large delay causes the setpoint event time to exist outside of the window of recorded cycles, causing the recorder to provide only post-event data.

As mentioned previously, if a standard setpoint is being used to trigger the waveform recorder, the cycles recorded will always be post-event data. The TIME DELAY OPERATE parameter can be used to shift this window later in time, in increments of seconds.

9.3.4 Triggering Manually via Communications

You can manually trigger waveform recording via the communications port. Using Siemens WinPM software, you can manually initiate waveform recording from the master station. A command from the computer immediately initiates capture at the 4720 power meter, and the data is subsequently uploaded. The TIME DELAY OPERATE parameter has no effect on manual triggering.

Manual trigger commands override any currently active setpoint triggered waveform recording.

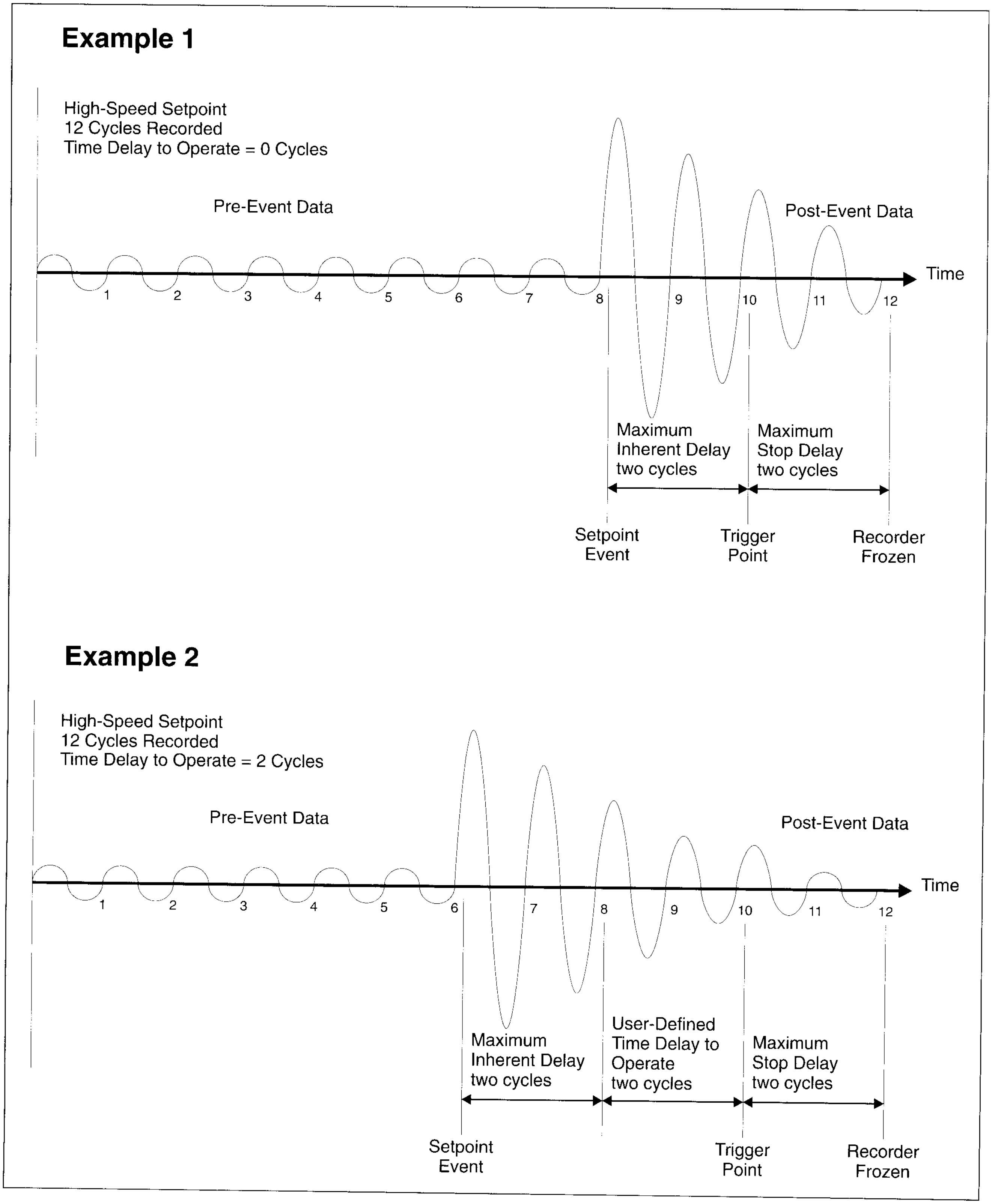


Figure 9.1 Waveform Recorder High-Speed Trigger Point Adjustment

10 Logging Data

Data logging can be extremely useful in the study of growth patterns, for scheduling loads and cost allocation, for isolating problem sources, or for analyzing a variety of power system operating conditions.

The 4720 power meter supports three types of data logs:

- Event Log
- Minimum/Maximum Logs
  - 1 Preset (Master)
  - 16 Programmable
- Programmable Snapshot Logs
  - 8 Standard, one of which can be assigned as High-Speed

All logged data is stored in internal nonvolatile memory and is accessible via the communications port. Measured values from the Preset Min/Max Log are also accessible from the front panel of the 4720 power meter. These parameters must be assigned to the Menu buttons as described in **section 5.2.9** in **Chapter 5**.

10.1 Event Log

The Event Log records automatically the 100 most recent events. A wide variety of event types are recorded by this log:

- Power-up and power-down activity
- Setpoint (alarm) conditions
- Relay activity. This includes operate/release actions triggered by setpoints or manually via communications
- Status input activity. If desired, the logging of status input activity can be enabled via communications
- Triggering of the waveform capture, waveform recorder, and snapshot logging features. This includes waveform functions and snapshot logging functions triggered by setpoints
- Changes made to the user-programmable parameters from the front panel or via communications
- Self-diagnostic events

The Event Log can be used to record a complete sequence-of-events record for breaker and transfer switch operations, alarm conditions, and equipment starts and stops.

Note that when a setpoint is programmed to trigger an action such as relay control or waveform recording, the setpoint activation and the subsequent setpoint action are logged separately.

Each event record stored in the Event Log includes:

Cause
: This identifies the condition that activated or deactivated a setpoint, a user action (such as device programming), or any other event type that occurred.

(Cause) Value
: If the event was a setpoint being activated or deactivated, the value of the measured parameter that triggered the setpoint is recorded. If a setpoint action is being logged, the new state of the setpoint is recorded.

Effect
: If the event was a setpoint being activated or deactivated, the setpoint is identified. If a setpoint action is being logged, the action taken is identified. If any other type of event occurred, it is described.

(Effect) Value
: If the event was a setpoint being activated or deactivated, the new state of the setpoint is recorded.

Date and Time
: The event is date and time-stamped. The date provides the year, month, and day. Event times are recorded in hours, minutes, seconds, and milliseconds. Logged time stamps are provided with millisecond resolution; however, time accuracies vary depending on the type of parameter being logged and other factors. Refer to **section 10.5** for more information.

10.2 Minimum/Maximum Logs

The 4700 power meter provides for both preset and programmable Minimum and Maximum (Min/Max) Logs. They are described below.

10.2.1 Preset Min/Max Log

The Preset Min/Max Log is a non-programmable log that automatically records the extreme values for all parameters measured by the 4720 power meter. This includes all voltage, current, power, frequency, power factor, harmonic distortion, and auxiliary input parameters. Minimum and maximum values are also provided for all demand measurement modes, including both thermal and user-defined sliding window parameters.

The 4720 power meter Preset Min/Max Log can be used to determine such values as the highest loading on a plant or feeder, peak demand, voltage operating ranges, worst case power factor, highest VAR loading for capacitor sizing, and so on.

Minimum and maximum values for each parameter are logged independently with date and time stamp. Each value in the Preset Min/Max Log can be accessed from the front panel of the 4720 power meter by assigning the MIN or MAX measurement mode for the desired parameter to one of the Menu buttons as described in **section 5.2.9** in **Chapter 5**.

10.2.2 Programmable Min/Max Logs

The 4720 power meter provides 16 Programmable Min/Max Logs. For each log, you can define up to 16 time-stamped parameters.

Each log is triggered by the first parameter in its list which is named the trigger parameter. When a new minimum for the trigger parameter is reached, the log simultaneously records:

- The trigger parameter's minimum value
- The date and time the minimum occurred
- All coincident real-time values for all other parameters in the list

Similarly, when a new maximum for the trigger parameter is recorded, the values for all other parameters are stored. This provides two lists of coincident values, one for the trigger parameter's minimum and one for its maximum.

The Programmable Min/Max Logs are ideal for analyzing overall power system characteristics on the occurrence of a specific load limit or fault condition. For example, you could program a log to record all per-phase kW, kVAR, and PF demand values when total kW demand peaks.

The Programmable Min/Max Logs may only be programmed via communications. Siemens WinPM software provides setup screens for programming all logs.

10.2.3 Resetting the Min/Max Logs

The minimum and maximum values in both the Preset and Programmable Min/Max Logs can be reset at the same time from either the front panel of the 4720 power meter or individually via communications. The logs can also be cleared automatically using setpoints (see **Chapter 8, Using Setpoints**).

From the front panel, set the CLEAR MIN/MAX? parameter to YES in programming mode. All values are reset when you advance to the next parameter or return to display mode.

10.3 Programmable Snapshot Logs

Snapshot Logs in the 4720 power meter are historical or trend logs. Up to eight standard logs may be defined. Snapshot Log 8 can be alternatively configured as a high-speed log. Each standard or high-speed log can record up to 12 channels of data. Each snapshot record is stored with a date and time-stamp to aid in isolating problem sources.

Each Snapshot Log can be independently triggered either on a user-defined time interval basis or from a setpoint.

Snapshot Logs can be used to replace traditional strip chart recorders. Data collected by the logs can be used to produce daily/weekly/monthly load profile graphs for power, demand, power factor, and so on. Data can also be used for time-of-use or billing calculations.

The following section describes the configuration and operation of standard and high-speed Snapshot Logs. All configuration must be performed via communications.

10.3.1 Memory Allocation

The large capacity of memory allocated to Snapshot Logs allows the partitioning of each individual Snapshot Log for programming.

The amount of memory space each Snapshot Log requires depends on the number of parameters (channels) being logged, the type of parameter being logged (some parameters are not compressible), the maximum number of snapshot records stored, and whether the log is triggered by time interval or setpoint. Triggering is described in the following sections. Setpoint-triggered snapshots require somewhat more memory than interval-triggered snapshots.

The number of Snapshot Logs, number of parameters per log, triggering method, time intervals (if interval-triggered) and total number of records per log can be set to make best use of the available memory for the specific application(s). **Table 10.1** illustrates this with a number of possible log assignments. All logs in the example are interval-triggered.

The parameters that cannot be compressed include kWH, kVAH, kVAR, time values, various status registers and scalable status input counters. All other parameters can be compressed. If the parameters you wish to log are compressible, you will be able to store more records. Note that compression is not used for the high-speed log.

10.3.2 Standard Snapshot Logs

Up to eight standard Snapshot Logs can be defined. Note that the high-speed feature parameter must be set to TOC for Snapshot Log 8 to be configured as a standard log. See **section 10.3.3** for more information.

Logged Parameters
The parameter recorded by each channel of a log is user-programmable. The values of any real-time parameter, energy parameter, or status parameter can be logged. **Chapter 7, Displaying Information**, lists these parameters. High-speed parameters can only be logged by a high-speed log (see **section 10.3.3**).

Time Interval Triggering
Time interval triggering allows a Snapshot Log to run continuously, automatically recording all channels of data at user-defined time intervals. To set a log for interval triggering, the programmable TRIGGER TYPE parameter must be set to INTERVAL. The user-defined time interval is set using the INTERVAL parameter. For a standard Snapshot Log, this can be set to a range between 1 second and 400 days.

This method of triggering a log is ideal for analyzing power usage trends for the study of growth patterns, or for scheduling loads. Historical data recorded using a time-interval triggered Snapshot Log can be graphically viewed in WinPM software using the Snapshot Viewer feature.

Table 10.1 Snapshot Log Capacity Examples

	Number of Logs	Parameters/Log	Parameter Type	Interval	Capacity
Single Log Example #1	1 Log	3	Non-compressible	15 minutes	30 days
Single Log Example #2	1 Log	3	Compressible	15 minutes	48 days
Single Log Example #3	1 Log	12	Compressible	15 minutes	17 days
Single Log Example #4	1 Log	3	1 Non-compressible 2 Compressible	15 minutes	40 days

Setpoint Triggering

Standard Snapshot Logs may also be triggered by any of the eleven standard setpoints. This method of triggering a log is ideal for analyzing system conditions that occur periodically due to faults, power fluctuations, or other events (breaker trip, and so on). Setpoint conditions can include harmonic distortion levels, status input changes, and more (see **Chapter 8, Using Setpoints**). High-speed setpoints cannot be used for this purpose.

To set a log for setpoint triggering, the programmable TRIGGER TYPE parameter must be set to SETPOINT. The ACTION 1 or ACTION 2 parameter used for the standard setpoint must be configured as SNAPSHOTx (where x = 1 to 8).

Logs can be triggered by setpoints in one of two ways:

One Shot
: If the programmable INTERVAL parameter is set to zero seconds, the Snapshot Log records once when the setpoint condition initially occurs.

Gated
: If the programmable INTERVAL parameter is set to a non-zero time interval, the Snapshot Log records once when the setpoint condition initially occurs, and continues to record at the specified intervals during the entire time that the setpoint remains in an active condition. This effectively produces a window of snapshot records. Subsequent triggers cause successive windows of snapshot records to be stored. This method makes very efficient use of the snapshot memory, since logging occurs only during periods of interest.

Wrap-Around Storage Method

For both interval and setpoint triggering, the internal logging function for a standard Snapshot Log fills all the available memory allocated for the log, then wraps around by writing new snapshot records over the earliest records in the memory.

10.3.3 High-Speed Snapshot Log

Snapshot Log 8 of the 4720 power meter can be configured as a high-speed log. The log can record two-cycle (or greater) intervals and is controlled by an additional user-defined STOP CONDITION. This log is ideal for analyzing short-term conditions such as motor start-up, system stability, or load switching response.

The High-Speed Snapshot Log (HSS) cannot be used concurrently with the Time-Overcurrent Curve (TOC) feature. Select which feature to enable by setting the HIGH SPEED FEATURE parameter via communications. This parameter must be set to HSS to enable the High-Speed Snapshot Log.

Logged Parameters

The parameter recorded by each channel of a log is user-programmable. The values of any high-speed measured or status parameter can be logged. See **Chapter 7, Displaying Information**, for a list of these parameters.

For the high-speed log, if the meter is configured in delta mode, all high-speed phase voltage line-to-neutral parameters produce line-to-line values. Conversely, line-to-line values produce line-to-neutral values when operating in wye mode.

Manual Triggering

To enable manual triggering, the TRIGGER TYPE parameter must be set to MANUAL. If the log has been set to SETPOINT, manual triggering is not possible.

Logging can be performed in one of two ways:

Interval
: The INTERVAL parameter should be set to any non-zero number. Interval values between two and 130,000 cycles (approx. 36 minutes) in two-cycle increments are possible. Following the manual trigger command, logging is performed at the specified intervals until the defined stop condition is encountered. LOG FULL or TIME OUT stop conditions must be used (see "Stop Condition" in this section).

Note: The high-speed log will not run continuously. A stop condition must be defined.

One Shot

This mode causes the Snapshot Log to record once when the manual trigger command initially occurs. This mode can be programmed in two ways.

1. Set the STOP CONDITION to TIMED OUT. Set the INTERVAL parameter to a value greater than the time out period.
2. Set the STOP CONDITION to TIMED OUT or LOG FULL. Set the INTERVAL parameter to zero (0).

Setpoint Triggering

The log can also be triggered by a high-speed setpoint. Standard setpoints cannot be used.

To enable setpoint triggering, the TRIGGER TYPE parameter must be set to SETPOINT. The ACTION 1 or ACTION 2 parameter for the high-speed setpoint used must be configured as SNAPSHOT 8 (high-speed log).

Logging can be performed in one of three ways:

Interval

Operation is similar to the interval mode described for manual triggering, except that an active setpoint condition triggers the log. LOG FULL or TIMED OUT stop conditions must be used (see below).

One Shot

Operation is similar to the one-shot mode described for manual triggering, except that an active setpoint condition triggers the log.

Gated

The programmable INTERVAL parameter must be set to a non-zero time interval. If the STOP CONDITION is set to SETPT OFF, the Snapshot Log records once when the setpoint condition initially occurs, and continues to record at the specified intervals during the entire time the setpoint remains in an active condition. Similar to gated logging with standard Snapshot Logs, this effectively produces a window of snapshot records. Subsequent triggers cause successive windows of snapshot records to be stored. If the data is not uploaded via communications, logging wraps around, writing new snapshot records over the earliest windows of records in the memory. Once uploaded, all previous data is cleared and the log is re-armed.

Stop Condition

One of the following stop conditions must always be specified for manual or setpoint-triggered high-speed Snapshot Logging:

Log Full

Logging is stopped when all memory space designated for the log has been filled up. This stop condition can be used with manual or setpoint triggering.

Timed Out

Logging is stopped after a user-specified duration (in cycles) has passed. This stop condition can be used with manual or setpoint triggering. The DURATION parameter is used to set the time out duration.

Setpoint Off

If the log is being triggered by a setpoint, logging is stopped when the setpoint goes inactive. This stop condition can be used only with setpoint triggering.

When the stop condition occurs, the log is frozen until the data is uploaded via communications. The system uploads all data and re-arms the log. In all cases, downloading cannot occur while the log is running.

Wrap-Around Recording

There are only two cases when high-speed snapshot logging wraps around by writing new snapshot records over the earliest records in the memory. These are as follows:

1. If triggering is manual or setpoint, interval logging is used, the stop condition is timed out, and the duration is set higher than the time needed to fill the memory.
2. Triggering is set to SETPOINT, gated logging is used by setting the STOP CONDITION to SETPT OFF, and the setpoint remains active for a duration longer than the time needed to fill the memory. Alternatively, repetitive setpoint triggers cause the log to wrap around prior to the data being uploaded.

The LOG FULL stop condition does not allow wrap-around to occur.

Ensure that critical data is not overwritten by wrap-around by selecting an appropriate stop condition for the application.

10.4 Retrieving Logged Data

The Event, Min/Max, and Snapshot Logs of the 4720 power meter are stored in nonvolatile memory and are accessible via communications. WinPM software can be used to read this data.

10.5 Time Stamp Accuracy

Time stamps for 4720 power meter logged parameters have an internal resolution of one microsecond. When using WinPM software to upload and display logged data, log records are displayed with time stamps of millisecond resolution.

The actual accuracy of the time stamp depends on the type of parameter being logged:

- Relay, Status Input, Waveform Capture, and Waveform Recorder Activity

These items are logged with a time stamp accuracy of ±1 millisecond. The fast sensing and accurate time stamping of the status inputs make them ideal for sequence-of-event recording using the Event Log.

Real-Time Measured Parameters
These measurements are updated once each second and therefore have a logged time stamp accuracy of ± 1 second.

High-Speed Setpoints
These use the internal high-speed measured parameters as trigger parameters, and therefore provide a time stamp accuracy of ± 2 cycles.

Standard Setpoints
These use the one second update measured parameters as trigger parameters, and therefore have a logged time accuracy of ± 1 second.

Meter-to-Meter Time Sync
Using the global time sync broadcast capability of WinPM software, the clocks of all 4720 power meter devices connected on the same RS-485 bus are time synchronized to a typical accuracy of ±1 millisecond (max. ±10 ms). This allows for one millisecond time stamp accuracy on waveform capture and recorder data, and status input or relay activity in the Event Log.

Note: Mechanical relay delay is not included in the above specification. As described in **Chapter 8**, **section 8.2.1**, this additional delay is typically between eight and fifteen milliseconds.

The clock of the 4720 power meter is battery-backed, allowing the clock to continue to run even in the event of a power failure.

11 Communications

11.1 General

The 4720 power meter is equipped with a communications port that allows the 4720 power meter to be integrated within large energy monitoring networks. The communications port is optically isolated and transient protected. It is field-configurable for EIA/TIA-232 (RS-232) or EIA/TIA-485 (RS-485) standards and can operate at data rates up to 19,200 baud.

The communications port provides you with access to the advanced features of the 4720 power meter not available from the device's front panel. These include waveform capture and recording, data logging, and many of the setup parameters for the setpoint system and other features.

The 4720 power meter is fully compatible with Siemens WinPM software. WinPM software can display all measured parameters and status information, waveform data, and data logs provided by the 4720 power meter. WinPM software can also be used to remotely program the setup parameters for all basic and advanced features.

The open communications protocol of the 4720 power meter allows access to all data and setup parameters by third-party systems.

This chapter provides additional information regarding remote communications connections, programming, and general operation.

11.2 RS-232 Communications

RS-232 is commonly used for short distance, point-to-point communications. Connection between a host computer (or PLC) and a single remote device must be less than 50 feet. **Figure 3.3** and **Figure 3.4** in **Chapter 3** provide wiring diagrams for direct RS-232 connection and the required wiring for the RS-232 interconnect cable(s).

Connection using modems via dedicated or dial-up telephone lines is also possible (see **Figure 11.1**).

When using a modem, it is important that the computer-to-modem and modem-to-4720 power meter cable connections illustrated in **Figure 3.4** in **Chapter 3** are used.

The RS-232 port RTS line is operational and can be used if required by any hardware device connected to the 4720 power meter. Siemens WinPM software does not require the use of the RTS line for direct RS-232 connections; however, some types of modems (for example, radio modems) may require its operation.

The RTS signal is asserted before the beginning of a transmission and remains asserted throughout the transmission. The time delay between the assertion of the RTS and the start of the transmission is controlled by the TRANSMIT DELAY parameter, which can be set from the front panel. The range is 0 to 999 milliseconds (with 0 (zero) as default).

The programmable RTS ACTIVE LVL parameter selects whether the RTS line is asserted HIGH or LOW during transmission.

11.3 RS-485 Communications

RS-485 is used when multiple devices are installed at a remote site. RS-485 communications can be used to concurrently connect up to thirty-two remote devices on a single communications loop. Each device is given a unique unit ID (identification number). In this way, each remote device may be monitored and controlled from one location by a single supervisory device.

The total distance limitation on a single RS-485 communications network is 4000 feet (1200 meters) using 22 AWG twisted pair shielded cable. **Figure 3.5** in **Chapter 3** provides a wiring diagram for RS-485 network connection.

Communication methods between the remote RS-485 site and the supervisory device can include a direct RS-485 connection, telephone lines with modems, fiber-optic and/or radio links. An RS-232 to RS-485 converter, such as the Isolated Multi-Drop converter, is required between the RS-232 port of the computer or modem and the RS-485 network as illustrated in **Figure 3.5** in **Chapter 3**.

11.4 Setting the Unit ID and Baud Rate

Before communication with the host computer/PLC is possible, ensure that the 4720 power meter, and all other connected devices, are configured for the required communications standard (RS-232 or RS-485). Instructions for the 4720 power meter communications card configuration are provided in **Figure 3.1** in **Chapter 3**.

The next step is to program the communication parameters of the 4720 power meter and all other connected devices. The UNIT ID and BAUD RATE parameters of the 4720 power meter can be programmed via the front panel. The unit ID must be set to a unique value between 1 and 254. The baud rate of each device on the network must be set to correspond with the baud rate selected for the computer. Options include 300, 1200, 2400, 4800, 9600 or 19,200 baud.

When using a modem interface between the host computer and any remote device(s), ensure that the host computer is not used to set the BAUD RATE parameter of any selected device outside the working range of the modem. Doing so will cause that meter to cease communicating. Re-establishing communications with that meter is then only possible through the following steps:

1. Reset the baud rate of the remote device from its front panel to a value within the working range of the modem.
2. Set the computer to communicate at the baud rate at which the remote device has been set to communicate.

11.5 Siemens WinPM Software

WinPM Electrical Distribution Communication software operates in the Microsoft® Windows™ 3.1 operating environment on a personal computer (PC). Through communications drivers, WinPM software collects and displays real-time data from Siemens ACCESS field devices, Siemens protective relays, and other field devices. WinPM software displays information and adds the capabilities of programming, monitoring alarms, and logging system events. WinPM software also monitors and displays historical data, minimum and maximum data, and waveform data. In addition, WinPM software can deliver its data to other compatible Windows applications, in real-time, through dynamic data exchange (DDE), a method of sharing information that is supported by Windows applications.

Your computer running WinPM software can be connected to intelligent field devices directly, or through a modem to the ACCESS system's SEAbus communications bus.

11.6 Third-Party System Compatibility

4720 power meter communications uses an advanced object and register based open protocol which supports an efficient exception reporting methodology. This allows the 4720 power meter to be easily adapted to third-party PLC, DCS, EMS, and SCADA systems.

All data and configuration registers are accessible via communications. All configuration and control operations have embedded password protection.

Contact Siemens for complete documentation on the 4720 power meter SEAbus communications protocol or to discuss a specific application.

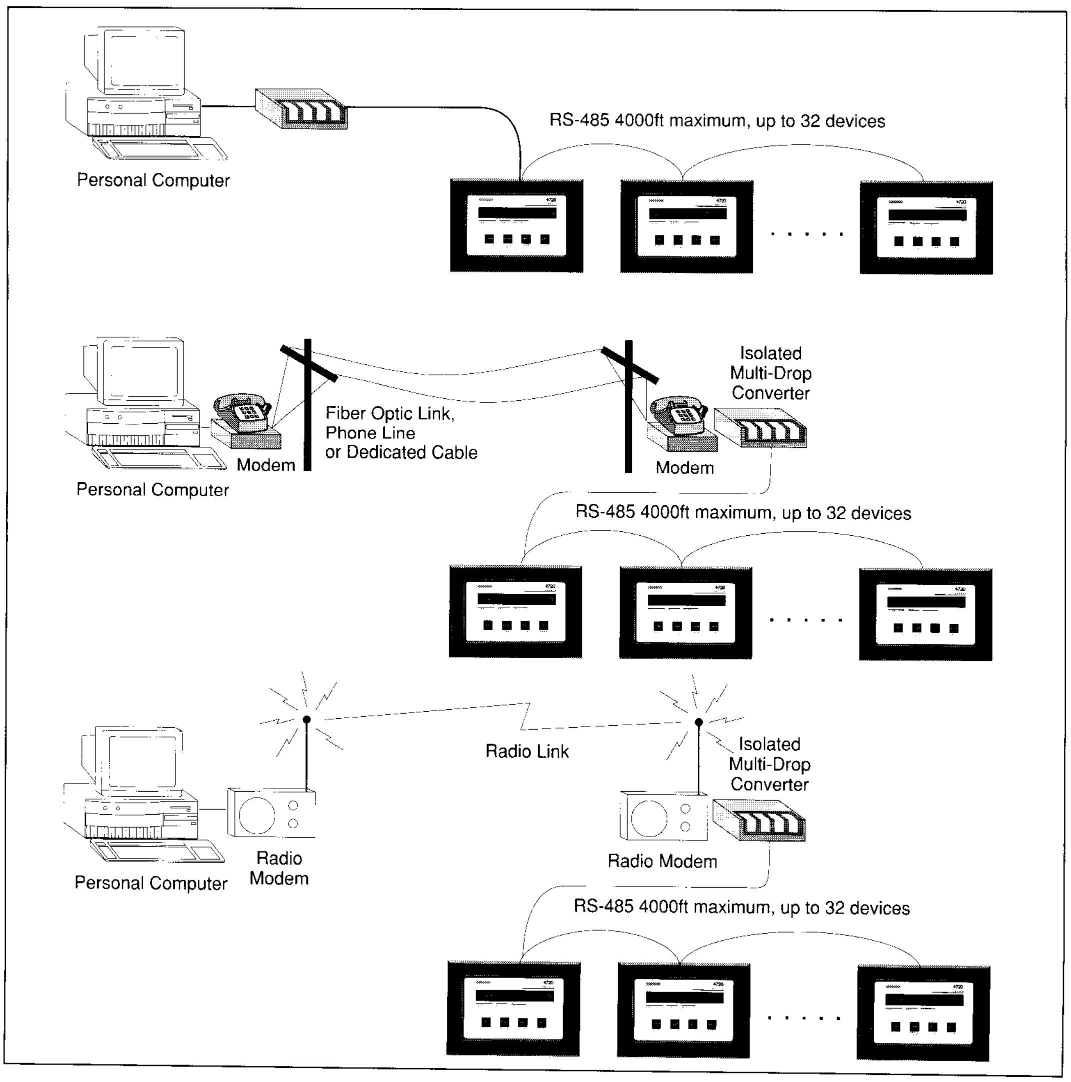


Figure 11.1 Remote Communications Methods

12 Maintenance

12.1 Maintenance

The following two circumstances describe the only regular maintenance that the 4720 power meter may require.

12.1.1 Battery Replacement

The 4720 power meter nonvolatile memory (NVRAM) and real-time clock (RTC) circuit contain integrated battery backup systems.

The rated life of the NVRAM battery is seventy years at 122°F (50°C), 28 years at 140°F (60°C), and 11 years at 158°F (70°C). If the unit operates at less than 122°F (50°C) for 60% of the time, less than 140°F (60°C) for 90% of the time, and less than 158°F (70°C) for 100% of the time, the expected life of the NVRAM battery is 35 years. If the meter is operating in an environment where the temperatures regularly exceed 140°F (60°C), the NVRAM battery should be replaced every ten years.

The battery system for the RTC may exhibit a somewhat shorter lifespan than the NVRAM backup because it remains active (that is, the clock continues to run) when the meter is off.

The present condition of the NVRAM and real-time clock batteries can be checked from the front panel of the 4720 power meter by viewing the extended diagnostics parameters. See **section 7.6.2** in **Chapter 7** for instructions. If remaining battery life is 10% or less, the NVRAM should be replaced.

Contact your local Siemens sales representative for information on replacement procedures.

Note: When the NVRAM is replaced, historic data may be lost. We recommend backing up critical logged data to the hard drive of a computer prior to servicing. Setup parameters and calibration of the unit are not affected.

12.1.2 Restore Display

The 4720 power meter front panel display is a vacuum-fluorescent type which exhibits high visibility due to its exceptional brightness. A natural buildup of internal residues may reduce the brightness of individual segments over extended periods when the display is not in use, such as when the display timeout feature is used.

The brightness and consistency of all display segments can be restored as follows:

1. Enter programming mode and set the RESTORE DISPLAY parameter (under DISPLAY) to YES.
2. Return to display mode. All segments of all characters in the display are lit.
3. Leave the display in this mode for an extended period of time. Twenty-four to 48 hours are recommended.
4. Press any button on the front panel to return to normal display mode.

12.2 Calibration

The calibration interval for the 4720 power meter depends on your accuracy requirements. The rated accuracy drift is 0.1% per year.

For information regarding the required calibration procedure, contact your local Siemens sales representative.

12.3 Field Service Considerations

In the unlikely event that the 4720 power meter unit should fail, servicing requires disconnection and removal of the unit from its mounting for the purpose of repair, or for exchange with a replacement unit. The initial installation should be done in a way which makes this as convenient as possible:

1. All power to the 4720 power meter should be removed and connections grounded.
2. Current transformer secondary leads should be short-circuited at the CT shorting block. Check to be sure that protective relaying is not affected.
3. All wiring should be routed to allow easy removal of the connections to the 4720 power meter terminal strips, the 4720 power meter rear cover, and the 4720 power meter itself.
4. If the control relays are used, a bypass mechanism should be installed (see **section 4.1** in **Chapter 4**).

13 Troubleshooting

A number of problems can cause the 4720 power meter not to function properly. This section lists possible problems and explains how to correct them.

1. If the display does not operate:

   a. check that there are at least 110 VAC available to the power supply (L and N connections on the terminal strip).

   b. confirm that the Chassis Ground Lug terminal is connected directly to ground.

   c. turn the power off for ten seconds, then turn it back on and check the display.

   If the above steps do not solve the problem, perform the following:

   a. As a diagnostic test, turn the unit off (disconnect power) for at least ten seconds. Apply power again and check if the unit powers up correctly.

   b. Contact Siemens and report the problem and results of the test.

2. If the voltage or current readings are incorrect:

   a. check that the voltage mode is properly set for the given wiring.

   b. check that the voltage and current scales are properly set.

   c. make sure the Chassis Ground Lug terminal is properly grounded.

   d. check the quality of the CTs and VTs being used.

   e. make the following voltage tests:

      - V1, V2, V3 to VREF should be 120 VAC for the standard voltage input option. This depends on whether or not the voltage input option is installed (either -277 or -347).
      - Chassis Ground Lug to switchgear earth ground should be 0 V.

3. If the kW or Power Factor readings are incorrect but voltage and current readings are correct:

   make sure that the phase relationship between voltage and current inputs is correct by comparing the wiring with the appropriate wiring diagram.

4. If RS-232-C or RS-485 communication does not work:

   a. check that the baud rate of the host computer/PLC is the same as that of the 4720 power meter.

   b. check that the communications mode (RS-232 or RS-485) set by the jumper on the communications card is correct for the type of standard being used (see **Chapter 3**, **section 3.1**).

   c. check all communications wiring (see **Chapter 3**, **Figure 3.3** through **Figure 3.4**).

   d. check that the number of data bits is set to 8, with one stop bit and no parity.

If the above steps do not solve the problem, perform the following:

   a. As a diagnostic test, turn both the 4720 power meter and the computer off (disconnect power) for at least ten seconds. Apply power again and check if the communications operate successfully.

   b. Contact Siemens and report the problem and results of the test.

If the problem persists after performing the specified steps, or if the problem is not listed above, contact Siemens.

A Technical Specifications

Parameter	Accuracy (% of full scale)			Front Panel Display	
	Basic Model	200%	500%	Resolution	Range
Current	0.2 %	0.3 %	0.8 %	0.1 %	0 - 30,000
Current Unbalance	1.0 %	1.0 %	2.0 %	1.0 %	0 - 100%
kW	0.4 %	0.5 %	1.0 %	0.1 %	0 - 999,999 (2)
kVAR	0.4 %	0.5 %	1.0 %	0	0 - 999,999 (2)
kVA	0.4 %	0.5 %	1.0 %	0.1 %	0 - 999,999 (2)
kWH	0.4 %	0.5 %	1.0 %	1 kWH	0 - 999,999,999
kVARH	0.4 %	0.5 %	1.0 %	1 kVARH	0 - 999,999,999
kVAH	0.4 %	0.5 %	1.0 %	1 kVAH	0 - 999,999,999
Voltage	0.2 %			0.1 %	0 - 999,999 (1)
Voltage Unbalance	1.0 %			1.0 %	0 - 100 %
Power Factor	1.0 %			1.0 %	-0.6 to 1.0 to +0.6
Frequency	0.05 Hz			0.01 Hz	20.00 to 75.00 Hz
Harmonic Distortion	1.0 %			0.1 %	0.0 to 1000.0 %
K-Factor	10.0 %			0.1	1.0 to 9999.9
I4	0.2 %			0.1%	0 - 9,999
VAux	0.25 %			0.1 %	0 - 999,999

(1) Reads in kV for voltages over 9,999

(2) Reads in MVA, MW, MVAR for readings over 9,999k

Current Overrange Options					
Option	Accuracy		Current Input Overrange		
	Amps	Power	% Full Scale	Amps	
				Basic	1 AMP
Basic	0.2 %	0.4 %	125%	6.25	1.25
200%	0.3 %	0.5 %	200%	10.00	2.00
500%	0.8 %	1.0 %	500%	25.00	5.00

Waveform Capture and Recording

Waveform Capture

Sampling Rate: approximately 128 times per cycle

Sampling Accuracy: 2% of full scale

Resolution: 10 bits (0.1 %)

Waveform Recording

Sampling Rate: approximately 16 times per cycle

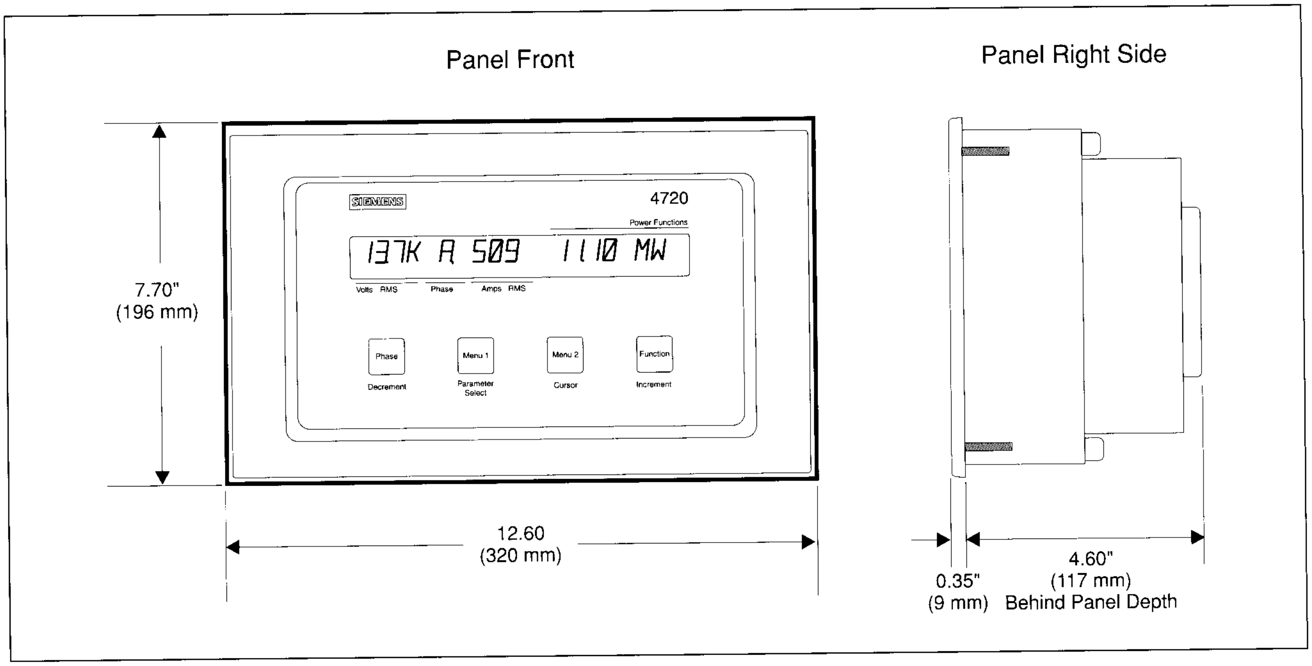
Sampling Accuracy: 2% of full scale

Resolution: 10 bits (0.1 %)

Technical Specifications

Input and Output Ratings		
Voltage Inputs:	Basic Model:	120 VAC nominal full scale input
	277 Option:	277 VAC nominal full scale input
	347 Option:	347 VAC nominal full scale input
	Overload withstand for all options:	1500 VAC continuous, 2500 VAC for 1 second
	Input impedance for all options:	2 MΩ
Current Inputs:	Basic Model:	5.000 A AC nominal full scale
	1 AMP Option:	1.000 A AC nominal full scale
	Overload withstand for all options:	15 A continuous, 300 A for 1 second
	Input impedance:	0.002 Ω, Burden: 0.05 VA
Aux. Voltage Input:	1.0 VAC/VDC nominal full scale input (1.25 VAC /VDC max.)	
	Overload withstand: 120 VAC/VDC continuous, 1000 VAC/VDC for 1 second	
	Input impedance: 10 KΩ	
Control Relays:	Basic Model:	Form C dry contact. 277 VAC / 30 VDC
		@ 10 A resistive
Aux. Current Output:	0 to 20 mA into max. 250Ω load. Accuracy: 2%	
Status Inputs:	+30 VDC differential SCOM output to S1, S2, S3, or S4 input	
	Min. Pulse Width: 40 ms	
Power Supply:	Basic Model:	85 to 264 VAC / 47 to 440 Hz or
		110 to 300 VDC @ 0.2 A
	20-60 VDC Power Supply Option:	20 to 60 VDC @ 10 W
Operating Temperature:	Basic Model:	32°F to 122°F (0°C to 50°C) ambient air
	Extended Temperature Range Option:	-4°F to +158°F (-20°C to +70°C)
Storage Temperature:	-22°F to +158°F (-30°C to +70°C)	
Humidity:	5 to 95%, non-condensing	
Shipping:	Weight: 8lbs. 10 oz. (3.9 kg)	
	Carton: 15" x 9.8" x 7.1" (38 x 25 x 18 cm)	
Voltage, Current, Status, Relay and Power inputs all pass the ANSI/IEEE C37.90A-1989 surge withstand and fast transient tests.		

B Dimensions



C Setpoint Parameter Form

Standard Setpoints							
Setpoint	**Trigger Parameter**	**High Limit**	**TD Operate**	**Low Limit**	**TD Release**	**Action 1**	**Action 2**
S01							
S02							
S03							
S04							
S05							
S06							
S07							
S08							
S09							
S10							
S11							
High-Speed Setpoints							
Setpoint	**Trigger Parameter**	**High Limit**	**TD Operate**	**Low Limit**	**TD Release**	**Action 1**	**Action 2**
H01							
H02							
H03							
H04							
H05							
H06							

D Firmware Revisions

The following table lists each firmware version release for the 4720 power meter and the new features or performance enhancements added with each release.

The version number can be viewed from the front panel in Programming Mode. If your 4720 power meter is currently using a firmware version older than the most recent version listed in the table below, you may upgrade the firmware in that unit by contacting Siemens.

The Siemens representative will need to know the serial number of the 4720 power meter and the firmware version number indicated on the rear cover label.

Most upgrades to the 4720 power meter require a simple replacement of the EPROM (integrated circuit chip) inside the unit which contains the operating firmware. Complete instructions for this procedure are provided with the replacement EPROM.

V1.3.x.x	December 1994	Initial Release

E Ordering Information

4720DRMC-□□-□□-□

Basic Display Unit with Communications

Power Supply	
85–264 VAC/110–300 VDC	1
20–60 VDC	3

Input Voltage	
120 VAC	1
277 VAC	2
347 VAC	3

Rated Input Current	
1 A	1
5 A	5

Overrange on Current Input	
125% full scale current	1
200%	2
500%	3

Extended Temperature Range	
(Standard Model, no suffix)	
-22°F to +158°F (-30C to + 70C)	T

R

S

T

U

V

W-Z

SIEMENS

Warranty

Company warrants that on the date of shipment to Purchaser the goods will be of the kind and quality described herein, merchantable, and free of defects in workmanship and material.

If within one year from date of initial operation, but not more than eighteen months from date of shipment by Company, of any item of the goods, Purchaser discovers that such item was not as warranted above and promptly notifies Company in writing thereof, Company shall remedy such defect by, at Company's option, adjustment, repair or replacement of the item and any affected part of the goods. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight in connection with the foregoing remedy. The same obligations and conditions shall extend to replacement items furnished by Company hereunder. Company shall have the right of disposal of items replaced by it. Purchaser shall grant Company access to the goods at all reasonable times in order for Company to determine any defect in the goods. In the event that adjustment, repair or replacement does not remedy the defect, the Company and Purchaser shall negotiate in good faith an equitable adjustment in the contract price.

The Company's responsibility does not extend to any item of the goods which has not been manufactured and sold by Company. Such item shall be covered only by the express warranty, if any, of the manufacturer thereof. The Company and its suppliers shall also have no responsibility if the goods have been improperly stored, handled, or installed; if the goods have not been operated or maintained according to their ratings or according to instructions in Company or supplier furnished manuals; or if unauthorized repairs or modifications have been made to the goods.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES (EXCEPT TITLE). INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, AND CONSTITUTES THE ONLY WARRANTY OF COMPANY WITH RESPECT TO THE GOODS.

The foregoing states Purchaser's exclusive remedy against Company and its suppliers for any defect in the goods or for failure of the goods to be as warranted, whether Purchaser's remedy is based on contract, warranty, failure of such remedy to achieve its essential purpose, tort (including negligence), strict liability, indemnity, or any other legal theory, and whether arising out of warranties, representations, instructions, installation or defects from any cause.

Form: SG6024-00 0296

Siemens Energy & Automation, Inc.

SIEMENS

Siemens Energy
& Automation, Inc.
Switchgear and Motor Control
Business
Customer Service
P.O. Box 29503
Raleigh, NC 27626

ACCESS Systems Service Request Form

To report problems with Siemens ACCESS systems and devices, make a copy of this form, complete it with as much information as you can, and contact your Siemens representative. You can also fax this form to Siemens Customer Service at 919-365-2830.
For emergency service call 1-800-347-6659.

Customer Information

Job site location and contact: ______________________________

____

____

Phone and fax number: ______________________________

Siemens sales order number: ______________________________

Siemens manufacturing order number (from drawing): ______________________________

System Information

Describe the number and type of devices on your ACCESS system.

Field Devices

Quantity	Device Type	Quantity	Device Type
	4300 power meter		SCOR relay
	4700 power meter		ISGS relay
	4720 power meter		7SA, 7SJ, or 7UT relay
	Static Trip IIIC trip unit		Multiplexer Translator
	Static Trip IIICP trip unit		Isolated Multi-Drop converter
	Sensitrip III trip unit		S7-I/O device
	SB breaker trip unit		PRM pulse reading meter
	SAMMS-LV device		Other:
	SAMMS-MV device		Other:

Supervisory Devices and Software

Quantity	Product	Quantity	Product
	WinPM software		Power Monitor Panel (PMP)
	Host PC software		PC32F power monitor
	Power Monitor PC software		Siemens PLC
	SIEServe software		Other hardware:
	Other software:		Other hardware:

Problem Description

Provide the following information on the affected device(s):

Device type: ____________________

Model or catalog number: ____________________

Part number: ____________________ Serial number: ____________________

Hardware version: ____________________ Software version: ____________________

Installed options: ____________________

Configuration information, including operational settings, parameters, wiring, type of system:

____

____

____

____

On what type of electrical equipment are the devices installed? (switchgear, motor control center, switchboard, and so on): ____________________

____

____

Provide a brief description of the problem: ____________________

____

____

____

____

Indicate what error messages, if any, are generated by the device or supervisory software. Include messages listed in the event log: ____________________

____

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____

____

To be completed by Siemens

Received by: ____________________ Date received: ____________________

Reviewed by: ____________________ Date reviewed: ____________________

Sales engineer: ____________________

Problem report tracking number: ____________________

Problem classification code: ____________________

Corrective action: ____________________

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Automation, Inc.
Switchgear and Motor Control
Business
P.O. Box 29503
Raleigh, NC 27626-0503

Manual No. SG6068-01 (Replaces SG-6068) 2M TD 0296
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