GE Power Management

PQM

Power Quality Meter™

INSTRUCTION MANUAL

Software Revision: 3.5x

Manual P/N: 1665-0003-CG
Manual Order Code: GEK-106296A

823787A3.CDR

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Manufactured under an
ISO9001 Registered system.

These instructions do not purport to cover all details or variations in equipment nor 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 purpose, the matter should be referred to the General Electric Company.

To the extent required the products described herein meet applicable ANSI, IEEE, and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

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C.1 PQM WARRANTY

1.1.1 DESCRIPTION

The GE Power Management PQM Power Quality Meter is an ideal choice for continuous monitoring of a single or three-phase system. It provides metering for current, voltage, real power, reactive power, apparent power, energy use, cost of power, power factor, and frequency. Programmable setpoints and four assignable output relays allow control functions to be added for specific applications. This includes basic alarm on over/under current or voltage, unbalance, demand based load shedding, and capacitor power factor correction control. More complex control is possible using the four switch inputs; these can also be used for status information such as breaker open/closed, flow information, etc.

As a data gathering device for plant automation systems that integrate process, instrument, and electrical requirements, all monitored values are available via one of two RS485 communication ports running the Modbus protocol. If analog values are required for direct interface to a PLC, any of the monitored values can output as a 4 to 20 mA (or 0 to 1 mA) signal to replace up to 4 separate transducers. A third RS232 communication port connects to a PC from the front panel for simultaneous access of information by other plant personnel.

With increasing use of electronic loads such as computers, ballasts, and variable frequency drives, the quality of the power system is important. With the harmonic analysis option, any phase current or voltage can be displayed and the harmonic content calculated. Knowledge of the harmonic distribution allows action to be taken to prevent overheated transformers, motors, capacitors, neutral wires, and nuisance breaker trips. Redistribution of system loading can also be determined. The PQM can also provide waveform and data printouts to assist in problem diagnosis.

Economical system monitoring or control is possible by selecting the non-display chassis model as a system component and adding required options to obtain the desired level of functionality.

1.1.2 FEATURE HIGHLIGHTS

- Monitor: A, V, VA, W, var, kWh, kvarh, kVAh, PF, Hz
- Demand metering: W, var, A, VA
- Setpoints for alarm or control from most measured values, including: unbalance, frequency, power factor, voltage, and current
- 4 output relays / 4 switch inputs for flexible control configuration
- 4 isolated analog outputs replace transducers for PLC interface
- 1 4-20 mA analog input
- Modbus communications
- Three COM ports (two rear RS485 ports and one front RS232 port) for access by process, electrical, maintenance, and instrument personnel
- Harmonic analysis for power quality review and problem correction
- 40-character display and keypad for local programming
- Free PQMPC software for setpoint entry or monitoring from a PC
- Simulation mode for testing and training
- Compact design for panel or chassis mount
- AC/DC control power

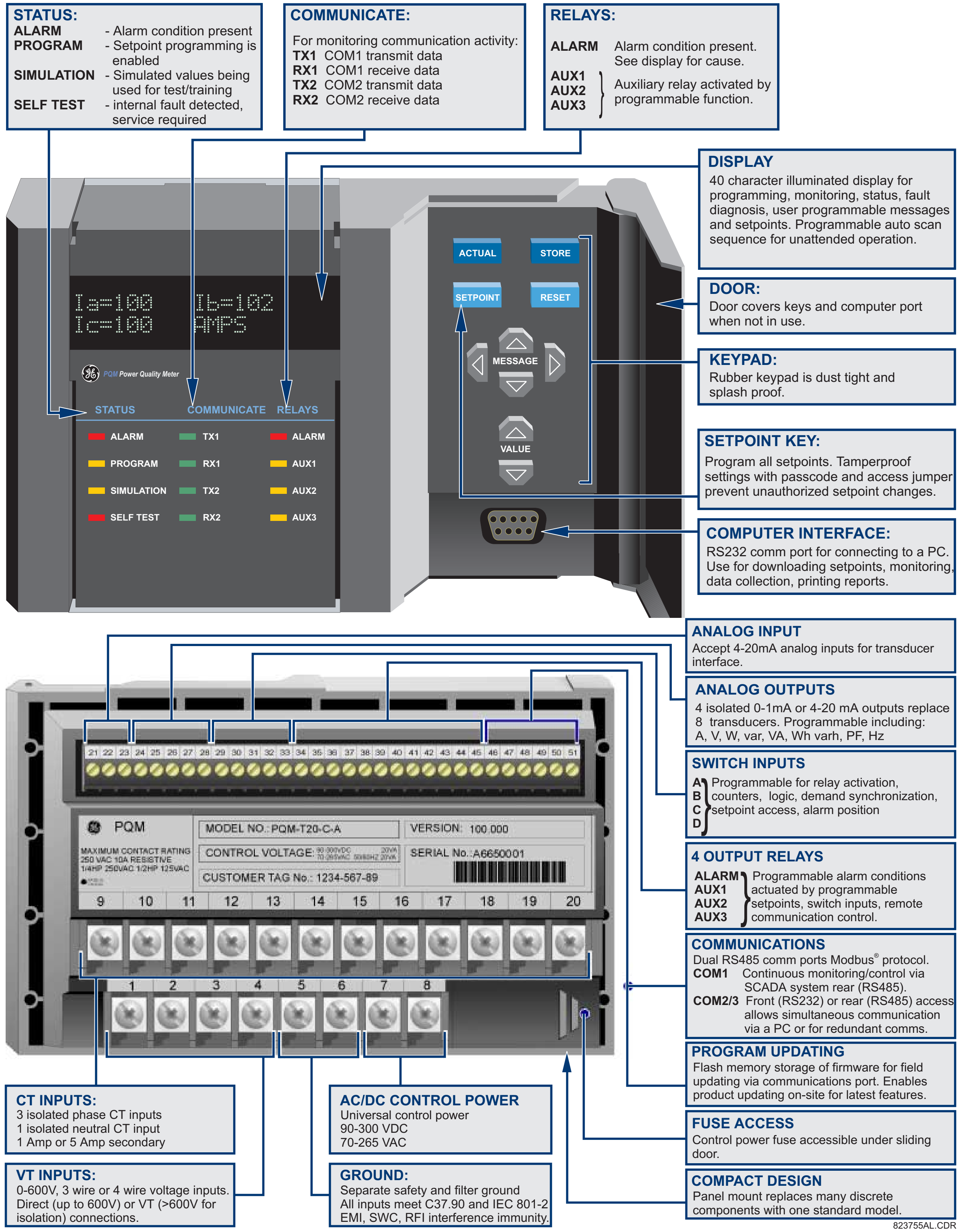

Figure 1–1: PQM FEATURE HIGLIGHTS

1.1.3 APPLICATIONS

- Metering of distribution feeders, transformers, generators, capacitor banks, and motors
- Medium and low voltage three-phase systems
- Commercial, industrial, utility
- Flexible control for demand load shedding, power factor, etc.
- Power quality analysis
- System debugging

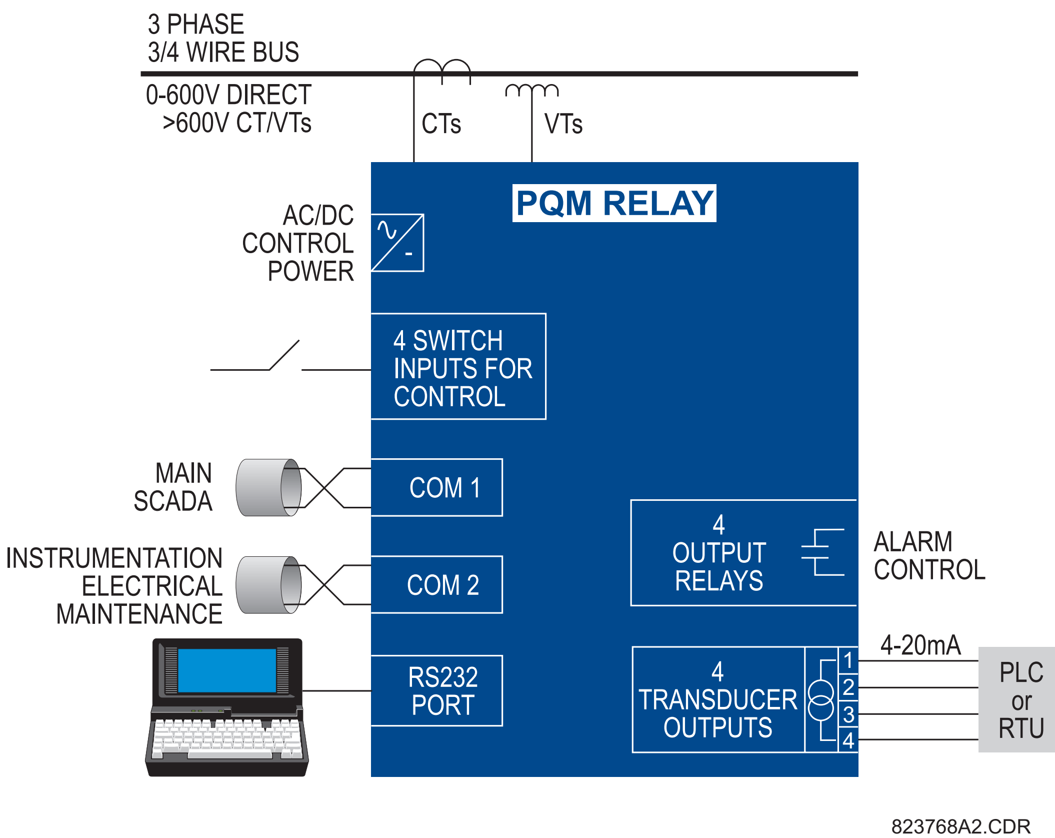

Figure 1–2: SINGLE LINE DIAGRAM

1.2.1 METERING

True RMS monitoring of I_a, I_b, I_c, I_n, V_{an}, V_{bn}, V_{cn}, V_{ab}, V_{bc}, V_{ca}, voltage/current unbalance, power factor, line frequency, watts, vars, VA, Wh, varh, VAh, and demand readings for A, W, vars, and VA. Maximum and minimum values of measured quantities are recorded and are date and time stamped.

A 40-character display with brightness control is used for programming setpoints and monitoring values and status.

a) ALARMS

Alarm conditions can be set up for all measured quantities. These include overcurrent, undercurrent, neutral current, current unbalance, voltage unbalance, phase reversal, overfrequency, underfrequency, power factor, switch inputs, etc. The alarm messages are displayed in a simple and easy to understand English format.

b) COMMUNICATION

The PQM is equipped with one standard RS485 port utilizing the Modbus or DNP 3.0 protocols. This can be used to integrate process, instrumentation, and electrical requirements in a plant automation system by connecting PQM meters together to a DCS or SCADA system. A PC running PQMPC can change system setpoints and monitor values, status, and alarms. Continuous monitoring minimizes process downtime by immediately identifying potential problems due to faults or changes from growth.

The PQM also includes a front RS232 port which may be employed to perform such tasks as:

- data monitoring
- problem diagnosis
- viewing event records
- trending
- printing settings and/or actual values
- loading new firmware into the PQM

1.2.2 FUTURE EXPANSION

Flash memory is used to store firmware within the PQM. This allows future product upgrades to be loaded via the serial port.

Figure 1–3: DOWNLOADING PRODUCT ENHANCEMENTS VIA THE SERIAL PORT

PQM units can initially be used as standalone meters. Their open architecture allows connection to other Modbus compatible devices on the same communication link. These can be integrated in a complete plant-wide system for overall process monitoring and control.

1.2.3 OPTIONAL FEATURES

a) TRANSDUCER OPTION

Four isolated 4 to 20 mA (or 0 to 1 mA depending on the installed option) analog outputs are provided that can replace up to eight transducers. The outputs can be assigned to any measured parameters for direct interface to a PLC.

One 4 to 20 mA analog input is provided to accept a transducer output for displaying information such as temperature or water level.

An additional rear RS485 communication port is provided for simultaneous monitoring by process, instrument, electrical, or maintenance personnel.

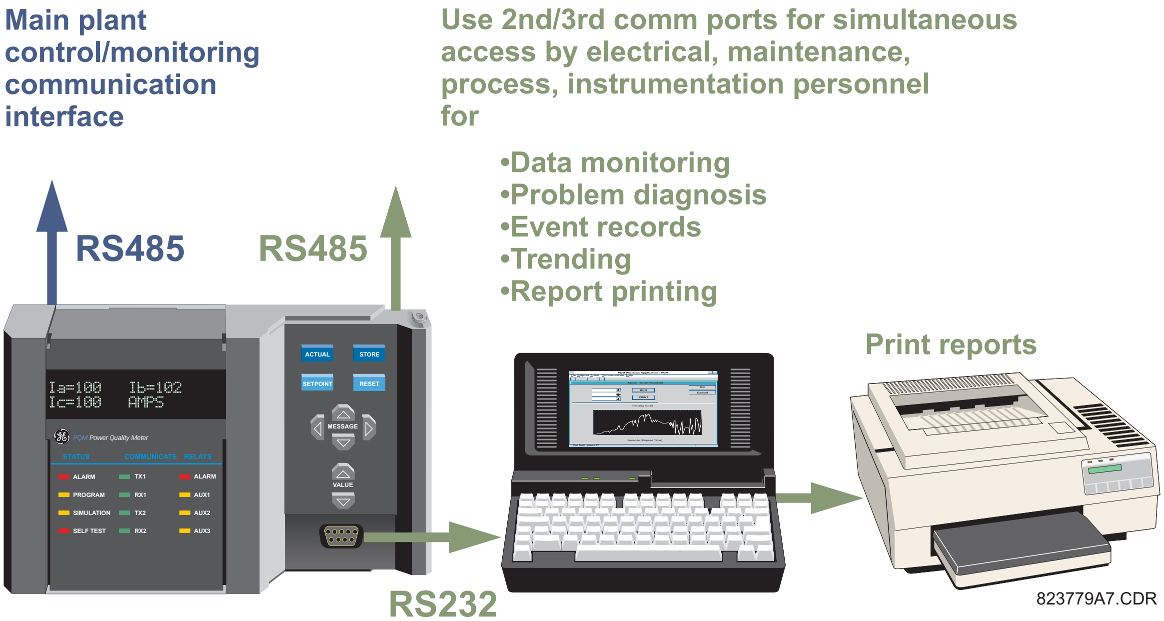

Figure 1–4: ADDITIONAL COMMUNICATION PORT

b) CONTROL OPTION

An additional three dry-contact form “C” output relays and four dry-contact switch inputs are provided. These additional relays can be combined with setpoints and inputs/outputs for control applications. Possibilities include:

- undercurrent alarm warnings for pump protection
- over/undervoltage for generators
- unbalance alarm warnings to protect rotating machines
- dual level power factor for capacitor bank switching
- underfrequency/demand output for load shedding resulting in power cost savings
- kWh, kvarh and kVAh pulse output for PLC interface
- Pulse input for totalizing quantities such as kWh, kvarh, kVAh, etc.

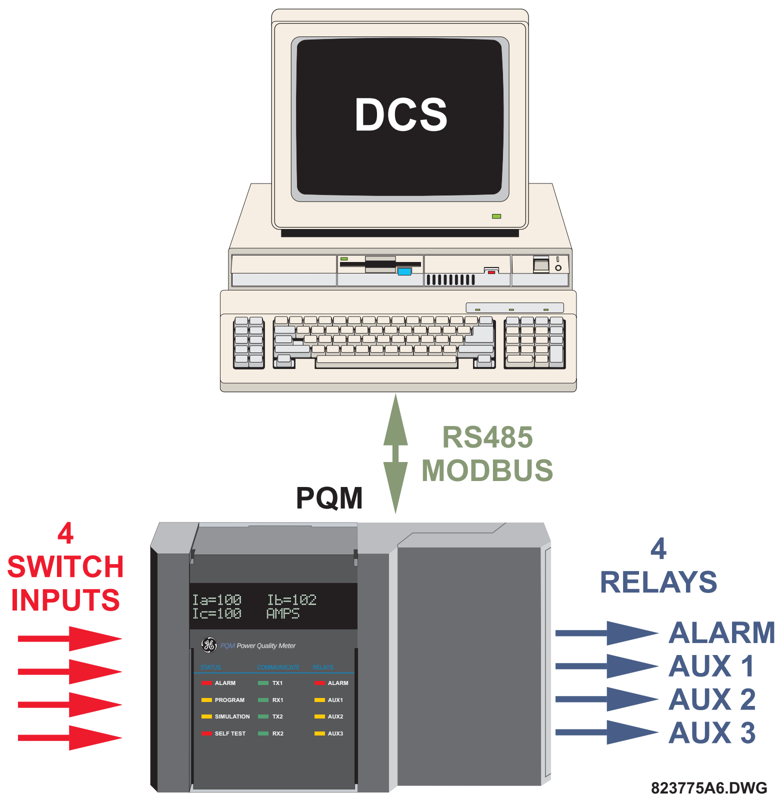

Figure 1–5: SWITCH INPUTS AND OUTPUTS RELAYS

c) POWER ANALYSIS OPTION

Non-linear loads (such as variable speed drives, computers, and electronic ballasts) can cause unwanted harmonics that may lead to nuisance breaker tripping, telephone interference, and transformer, capacitor or motor overheating. For fault diagnostics such as detecting undersized neutral wiring, assessing the need for harmonic rated transformers, or judging the effectiveness of harmonic filters, details of the harmonic spectrum are useful and available with the power analysis option.

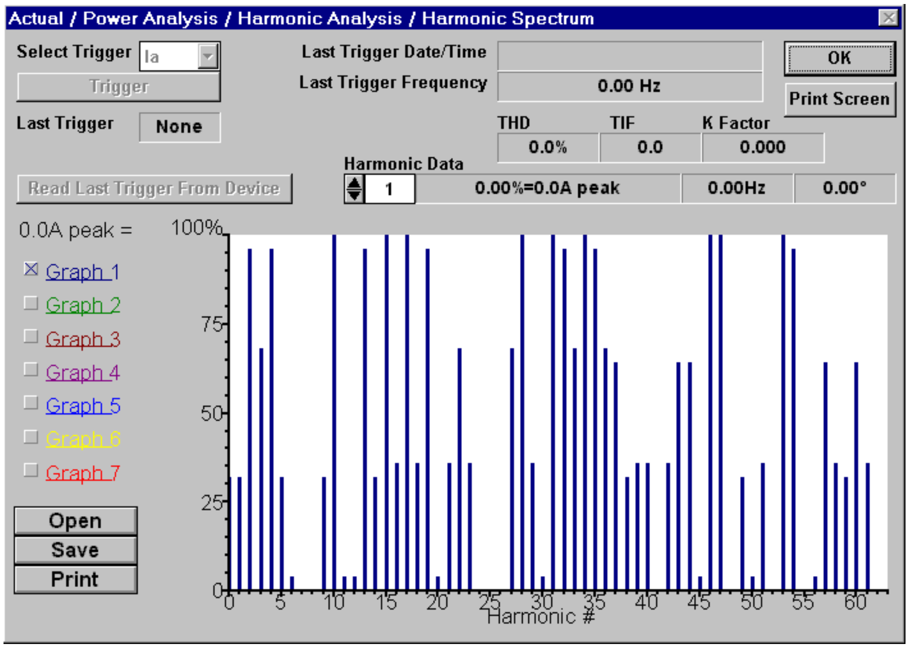

Figure 1–6: HARMONIC SPECTRUM

Voltage and current waveforms can be captured and displayed on a PC with PQMPC or third party software. Distorted peaks or notches from SCR switching provide clues for taking corrective action.

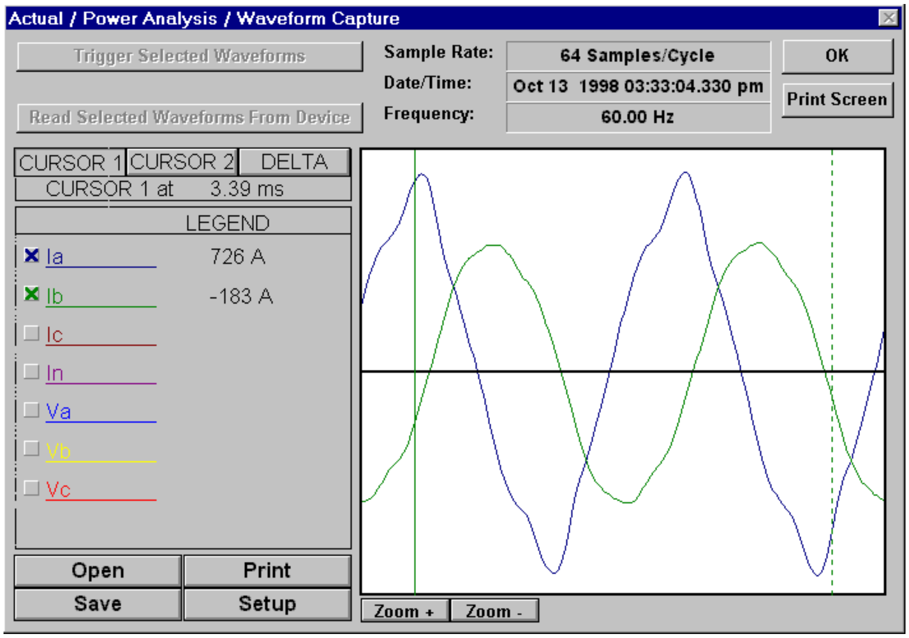

Figure 1–7: CAPTURED WAVEFORM

Alarms, setpoint triggers, and input and output events can be stored in a 40-event record and time/date stamped by the internal clock. This is useful for diagnosing problems and system activity. The event record is available through serial communication. Minimum and maximum values are also continuously updated and time/date stamped.

Routine event logs of all measured quantities can be created, saved to a file, and/or printed.

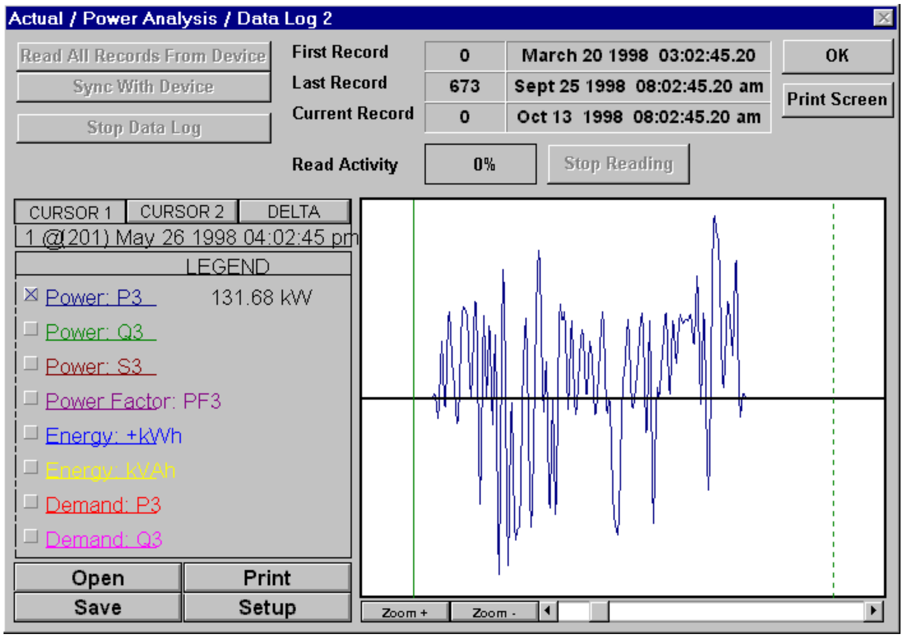

Figure 1–8: DATA LOGGER

The power analysis option also provides a Trace Memory feature. This feature can be used to record specified parameters based on the user defined triggers.

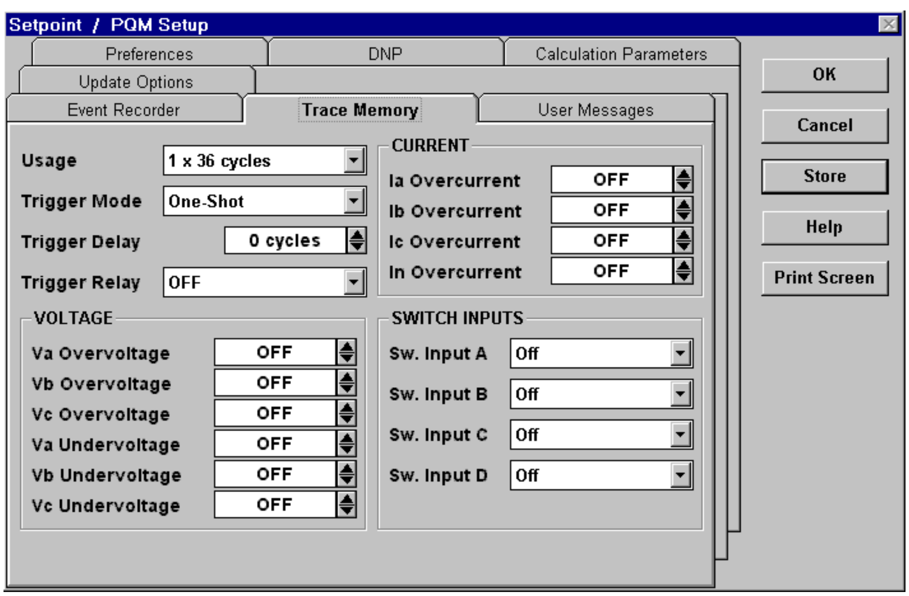

Figure 1–9: TRACE MEMORY TRIGGERS

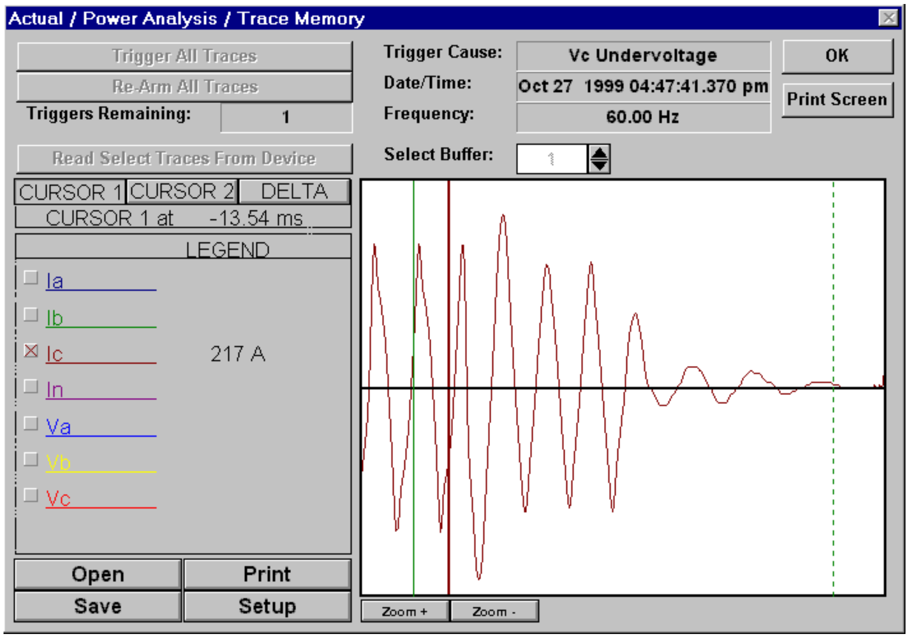

Figure 1–10: TRACE MEMORY CAPTURE

1.2.4 PQMPC SOFTWARE

All data continuously gathered by the PQM can be transferred to a third party software program for display, control, or analysis through the communications interface. The PQMPC software makes this data immediately useful and assists in programming the PQM. Some of the tasks that can be executed using the PQMPC software package are:

- read metered data
- monitor system status
- change PQM setpoints on-line
- save setpoints to a file and download into any PQM
- capture and display voltage and current wave shapes for analysis
- record demand profiles for various measured quantities
- troubleshoot communication problems with a built in communications debugging tool
- print all graphs, charts, setpoints, and actual data

The PQMPC software is fully described in Chapter 6: SOFTWARE.

1.2.5 ORDER CODES

The order code for all options is: **PQM-T20-C-A**

Table 1–1: ORDER CODES

	PQM	✳	✳	✳	
Basic Unit	**PQM**	|	|	|	Basic Unit with display, all current/voltage/power measurements, 1 RS485 communication port, 1 RS232 communication port
Transducer Option		**T20**	|	|	4 isolated analog outputs, 0-20 mA and 4-20 mA assignable to all measured parameters, 4-20 mA analog input, 2nd RS485 communication port
		T1	|	|	4 isolated analog outputs, 0-1 mA assignable to all measured parameters, 4-20 mA analog input, 2nd RS485 communication port
Control Option			**C**	|	3 additional programmable output relays (for a total of 4), 4 programmable switch inputs
Power Analysis Option				**A**	Harmonic analysis, triggered trace memory, waveform capture, event recorder, data logger

Modifications (consult the factory for any additional modification costs):

- MOD 500: Portable test/carrying case
- MOD 501: 20 to 60 V DC / 20 to 48 V AC control power
- MOD 502: Tropicalization
- MOD 504: Removable terminal blocks
- MOD 505: PQM Remote: Base Unit with Detachable Faceplate
- MOD 506: 4 Step Capacitor Bank Switching
- MOD 507: –40°C to +60°C Extended Temperature Operation
- MOD 508: 269/565 Communication Protocol
- MOD 513: Class 1, Division 2 Operation
- MOD 516: PQM Remote: Base Unit only
- MOD 517: PQM Remote: Detachable Faceplate only

Accessories (consult the factory for any additional accessory costs):

- PQMPC Windows software (free upon request)
- RS232 to RS485 converter (required to connect a PC to the PQM RS485 ports)
- 2.25” collar for limited depth mounting
- RS485 terminating network
- PQM mounting plate to replace MTM Plus

Control Power:

- 90 to 300 V DC / 70 to 265 V AC standard
- 20 to 60 V DC / 20 to 48 V AC (MOD 501)

1.3.1 PQM SPECIFICATIONS

CURRENT INPUTS

CONVERSION: true rms, 64 samples/cycle
CT INPUT: 1 A and 5 A secondary
BURDEN: 0.2 VA
OVERLOAD: 20 × CT for 1 sec.
100 × CT for 0.2 sec.
RANGE: 1 to 150% of CT primary
FREQUENCY: up to 32nd harmonic
ACCURACY: ±0.2% of full scale

VOLTAGE INPUTS

CONVERSION: true rms, 64 samples/cycle
VT PRI/SEC: direct or 120 to 72000:69 to 240
BURDEN: 2.2 MΩ
INPUT RANGE: 20 to 600 V AC
FULL SCALE: 150/600 V AC autoscaled
FREQUENCY: up to 32nd harmonic
ACCURACY: ±0.2% of full scale

TRACE MEMORY TRIGGER

INPUT 1 cycle of data (current, voltage)
TIME DELAY: 0 to 30 cycles

SAMPLING MODES

	SAMPLES /CYCLE	INPUTS SAMPLED AT A TIME	DURATION (cycles)
METERED VALUES	64	ALL	2
TRACE MEMORY	16	ALL	continuous
HARMONIC SPECTRUM	256	1	1

SWITCH INPUTS

TYPE: dry contacts
RESISTANCE: 1000 Ω max ON resistance
OUTPUT: 24 V DC @ 2 mA (pulsed)
DURATION: 100 ms minimum

ANALOG OUTPUTS

	OUTPUT	
	0-1 mA (T1 Option)	4-20 mA (T20 Option)
MAX LOAD	2400 Ω	600 Ω
MAX OUTPUT	1.1 mA	21 mA

ACCURACY: ±1% of full scale reading
ISOLATION: 50 V isolated, active source

ANALOG INPUT

RANGE: 4 to 20 mA
ACCURACY: ±1% of full scale reading
INTERNAL BURDEN
RESISTANCE: 250 Ω

OUTPUT RELAYS

VOLTAGE		MAKE/CARRY		BREAK
		continuous	0.1 sec.	
RESISTIVE	30 VDC	5 A	30 A	5 A
	125 VDC	5 A	30 A	0.5 A
	250 VDC	5 A	30 A	0.3 A
INDUCTIVE (L/R = 7ms)	30 VDC	5 A	30 A	5 A
	125 VDC	5 A	30 A	0.25 A
	250 VDC	5 A	30 A	0.15 A
RESISTIVE	120 VAC	5 A	30 A	5 A
	250 VAC	5 A	30 A	5 A
INDUCTIVE PF = 0.4	120 VAC	5 A	30 A	5 A
	250 VAC	5 A	30 A	5 A

CONFIGURATION: Form C NO/NC
CONTACT MATERIAL:Silver Alloy

1

MEASURED VALUES

PARAMETER	ACCURACY (% of full scale)	RANGE
VOLTAGE	±0.2%	20% to 100% of VT
CURRENT	±0.2%	1% to 150% of CT
V UNBALANCE	±1%	0 to 100%
I UNBALANCE	±1%	0 to 100%
kW	see Accuracy Details	0 to ±999,999.99 kW
kvar	see Accuracy Details	0 to ±999,999.99 kvar
kVA	see Accuracy Details	0 to 999,999.99 kVA
kWh	see Accuracy Details	2^{32} kWh
kvarh	see Accuracy Details	2^{32} kvarh
kVAh	see Accuracy Details	2^{32} kVAh
PF	±1.0%	±0.00 to 1.00
FREQUENCY	±0.02Hz	20.00 to 70.00 Hz
kW DEMAND	±0.4%	0 to ±999 999.99 kW
kvar DEMAND	±0.4%	0 to ±999 999.99 kvar
kVA DEMAND	±0.4%	0 to 999 999.99 kVA
AMP DEMAND	±0.2%	0 to 7500 A
AMPS THD	±2.0%	0.0 to 100.0%
VOLTS THD	±2.0%	0.0 to 100.0%
CREST FACTOR	±0.4%	1 to 9.99

UNDERVOLTAGE MONITORING

REQ'D VOLTAGE: > 20 V applied in all phases
PICKUP: 0.50 to 0.99 in steps of 0.01 × VT
DROPOUT: 103% of pickup
TIME DELAY: 0.5 to 600.0 in steps of 0.5 sec.
PHASES: Any 1 / Any 2 / All 3 (programmable) have to be ≤ pickup to operate
ACCURACY: Per voltage input
TIMING ACCURACY: –0 / +1 sec.

OVERVOLTAGE MONITORING

PICKUP: 1.01 to 1.25 in steps of 0.01 × VT
DROPOUT: 97% of pickup
TIME DELAY: 0.5 to 600.0 in steps of 0.5 sec.
PHASES: Any 1 / Any 2 / All 3 (programmable) must be ≥ pickup to operate
ACCURACY: Per voltage input
TIMING ACCURACY: –0 / +1 sec.

UNDERFREQUENCY MONITORING

REQ'D VOLTAGE: > 30 V applied in phase A
PICKUP: 20.00 to 70.00 in steps of 0.01 Hz
DROPOUT: Pickup + 0.03 Hz
TIME DELAY: 0.1 to 10.0 in steps of 0.1 sec.
ACCURACY: 0.02 Hz
TIMING ACCURACY: ±3 cycles

OVERFREQUENCY MONITORING

REQ'D VOLTAGE: > 30 V applied in phase A
PICKUP: 20.00 to 70.00 in steps of 0.01 Hz
DROPOUT: Pickup – 0.03 Hz
TIME DELAY: 0.0 to 10.0 in steps of 0.1 sec.
ACCURACY: 0.02 Hz
TIMING ACCURACY: ±3 cycles

POWER FACTOR MONITORING

REQ'D VOLTAGE: > 20 V applied in phase A
PICKUP: 0.50 lag to 0.50 lead step 0.01
DROPOUT: 0.50 lag to 0.50 lead step 0.01
TIME DELAY: 0.5 to 600.0 in steps of 0.5 sec.
TIMING ACCURACY: –0 / +1 sec.

DEMAND MONITORING

MEASURED VALUES: Phase A/B/C/N Current (A)
3ϕ Real Power (kW)
3ϕ Reactive Power (kvar)
3ϕ Apparent Power (kVA)
MEASUREMENT TYPE:
Thermal Exponential: 90% response time (programmable): 5 to 60 min. step 1
Block interval: (programmable): 5 to 60 min. step 1
Rolling Demand time interval: (programmable): 5 to 60 min. step 1
PICKUP: A: 10 to 7500 in steps of 1000
kW: 0.1 to 6500.0 in steps of 0.1
kvar: 0.1 to 6500.0 in steps of 0.1
kVA: 0.1 to 6500.0 in steps of 0.1

PULSE OUTPUT

PARAMETERS: +kWh, –kWh, +kvarh, –kvarh, kVAh
INTERVAL: 1 to 65000 in steps of 1
PULSE WIDTH: 100 to 2000 ms in steps of 10 ms
MIN. PULSE INTERVAL: 500 ms
ACCURACY: ±10 ms

PULSE INPUT

MAX INPUTS: 4
MIN PULSE WIDTH: 150 ms
MIN OFF TIME: 200 ms

COMMUNICATIONS

COM1/COM2 TYPE:	RS485 2-wire, half duplex, isolated
COM3 TYPE:	RS232 9-pin
BAUD RATE:	1200 to 19200
PROTOCOLS:	Modbus® RTU; DNP 3.0
FUNCTIONS:	Read/write setpoints Read actual values Execute commands Read Device Status Loopback Test

CLOCK

ACCURACY:	±1 minute / 30 days at 25°C ± 5°C
RESOLUTION:	1 sec.

CONTROL POWER

INPUT:	90 to 300 V DC or 70 to 265 V AC, 50/60 Hz
POWER:	nominal 10 VA maximum 20 VA
HOLDUP:	100 ms typical (@ 120 V AC / 125 V DC)

WARNING

IT IS RECOMMENDED THAT THE PQM BE POWERED UP AT LEAST ONCE PER YEAR TO AVOID DETERIORATION OF THE ELECTROLYTIC CAPACITORS IN THE POWER SUPPLY.

TYPE TESTS

DIELECTRIC STRENGTH:	
	2.0 kV for 1 minute to relays, CTs, VTs, power supply
INSULATION RESISTANCE:	IEC255-5, 500 V DC
TRANSIENTS:	ANSI C37.90.1 Oscillatory 2.5 kV/1 MHz ANSI C37.90.1 Fast Rise 5 kV/10 ns Ontario Hydro A-28M-82 IEC255-4 Impulse/High Frequency Disturbance Class III Level
IMPULSE TEST:	IEC 255-5 0.5 Joule 5kV
RFI:	50 MHz/15 W Transmitter
EMI:	C37.90.2 Electromagnetic Interference @ 150 MHz and 450 MHz, 10V/m
STATIC:	IEC 801-2 Static Discharge
HUMIDITY:	95% non-condensing
TEMPERATURE:	–10°C to +60°C ambient
ENVIRONMENT:	IEC 68-2-38 Temperature/Humidity Cycle

PACKAGING

SHIPPING BOX:	8½" × 6" × 6" (L×H×D) 21.5cm × 15.2cm × 15.2 cm (L×H×D)
SHIP WEIGHT:	5 lbs/2.3 kg

CERTIFICATION

ISO:	Manufactured under an ISO9001 registered program
UL:	recognized under E83849
CSA:	recognized under LR41286
CE:	Conforms to EN 55011 / CISPR 11, EN50082-2, IEC 947-1, IEC 1010-1

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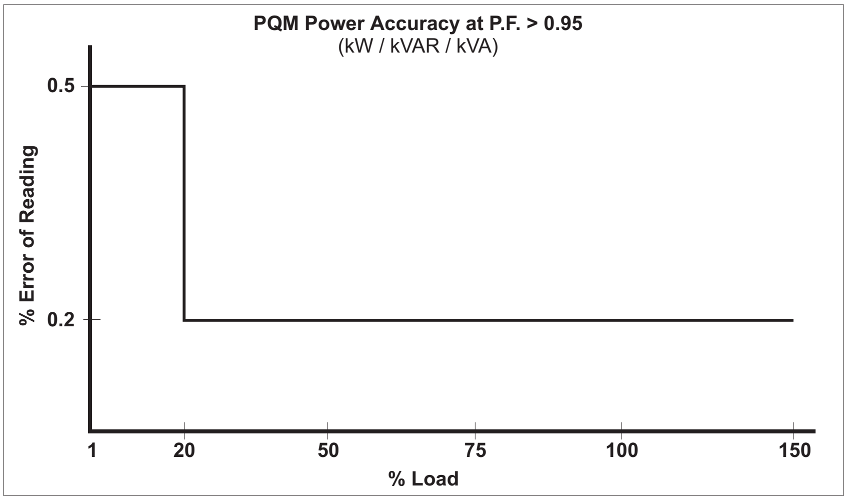
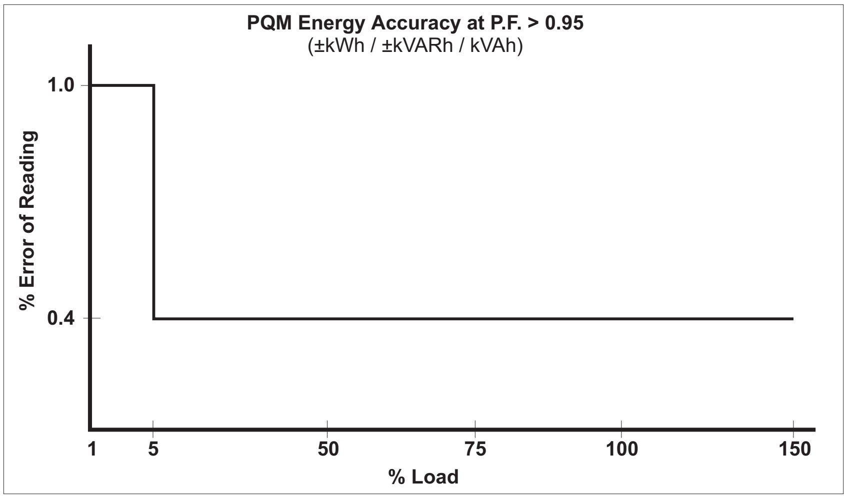
PQM POWER AND ENERGY ACCURACY

Accuracy is a per curves ±1 digit on PQM display.





NOTE

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

2.1.1 MOUNTING

Physical dimensions and required cutout dimensions for the PQM are shown below. Once the cutout and mounting holes are made in the panel, use the eight #6 self-tapping screws provided to secure the PQM. Mount the unit on a panel or switchgear door to allow operator access to the keypad and indicators.

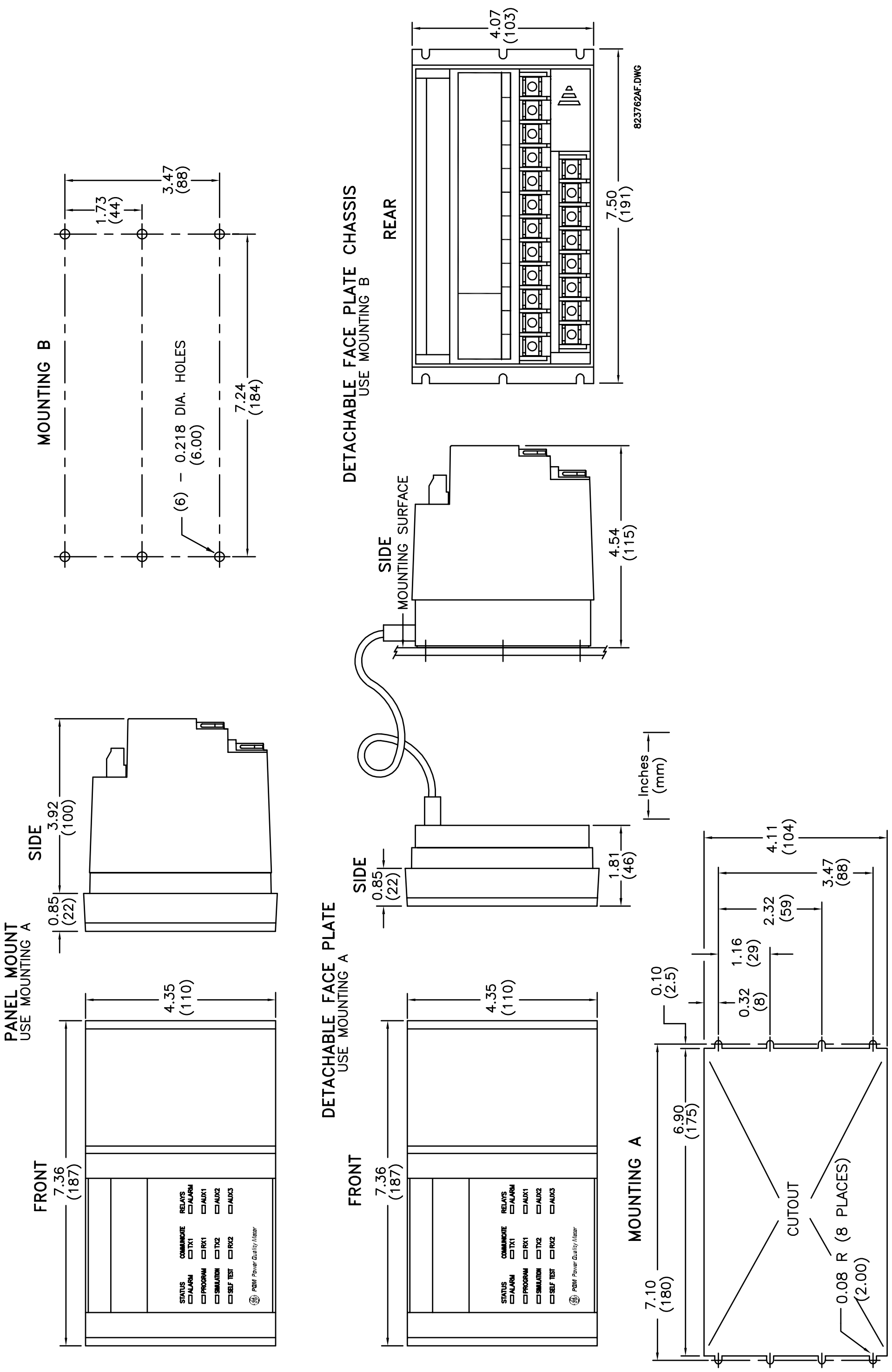


Figure 2–1: PHYSICAL DIMENSIONS

2.1.2 PRODUCT IDENTIFICATION

Product attributes vary according to the configuration and options selected on the customer order. Before applying power to the PQM, examine the label on the back and ensure the correct options are installed.

The following section explains the information included on the label shown below:

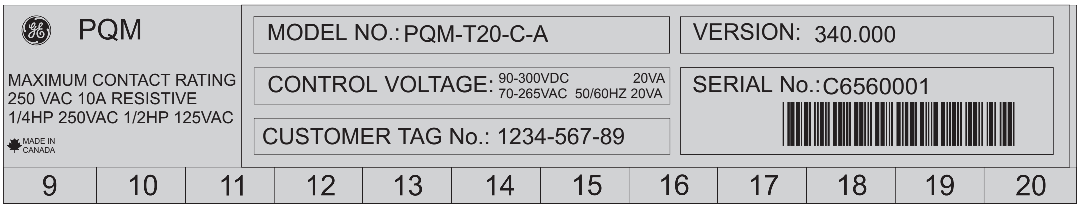


Figure 2–2: PRODUCT LABEL

1. **MODEL NO**: Shows the PQM configuration. The model number for a basic panel mount PQM is “PQM”. The model number for a basic chassis mount PQM is “PQM\ND”. T20, C, and A appear in the model number only if the Transducer, Control, or Power Analysis options are installed.
2. **SUPPLY VOLTAGE**: Indicates the power supply input configuration installed in the PQM. The PQM shown in this example can accept any AC 50/60Hz voltage from 70 to 265 V AC or DC voltage from 90 to 300 V DC.
3. **TAG#**: An optional identification number specified by the customer.
4. **MOD#**: Used if unique features have been installed for special customer orders. This number should be available when contacting GE Power Management for technical support.
5. **VERSION**: An internal GE Power Management number that should be available when contacting us for technical support.
6. **SERIAL NO**: Indicates the serial number for the PQM in numeric and barcode formats that should be available when contacting GE Power Management for technical support.

2.1.3 REVISION HISTORY

The following table shows the PQM revision history. Each revision of the instruction manual corresponds to a particular firmware revision. The manual revision is located on the title page as part of the manual part number (the format is 1665-0003-*revision*). The firmware revision is loaded in the PQM and can be viewed by scrolling to the **A4 PRODUCT INFO \ SOFTWARE VERSIONS \ MAIN PROGRAM VERSION** actual value message.

When using the instruction manual to determine PQM features and settings, ensure that the instruction manual revision corresponds to the firmware revision installed in the PQM using the table below.

Table 2–1: REVISION HISTORY TABLE

INSTRUCTION MANUAL P/N	MAIN PROGRAM VERSION
1665-0003-C1	0.10
1665-0003-C2	0.20
1665-0003-C3	1.00
1665-0003-C4	1.10
1665-0003-C5	1.20
1665-0003-C6	1.21, 1.22
1665-0003-C7	2.00
1665-0003-C8	2.01
1665-0003-C9	2.02
1665-0003-CA	3.00
1665-0003-CB	3.01
1665-0003-CC	3.10
1665-0003-CD	3.13
1665-0003-CE	3.2x, 3.3x
1665-0003-CF	3.4x
1665-0003-CG	3.5x

2.2.1 EXTERNAL CONNECTIONS

Signal wiring is to Terminals 21 to 51. These terminals accommodate wires sizes up to 12 gauge. *Please note that the maximum torque that can be applied to terminals 21 to 51 is 0.5 Nm (or 4.4 in ·lb.).* CT, VT, and control power connections are made using Terminals 1 to 20. These #8 screw ring terminals accept wire sizes as large as 8 gauge. Consult the wiring diagrams for suggested wiring. A minimal configuration includes connections for control power, phase CTs/VTs, and the alarm relay; other features can be wired as required. Considerations for wiring each feature are given in the sections that follow.

Table 2–2: PQM EXTERNAL CONNECTIONS

VT / CONTROL POWER ROW	
1	V1 Voltage input
2	V2 Voltage input
3	V3 Voltage input
4	Vn Voltage input
5	Filter ground
6	Safety ground
7	Control neutral (–)
8	Control live (+)

CT ROW	
9	Phase A CT 5A
10	Phase A CT 1A
11	Phase A CT COM
12	Phase B CT 5A
13	Phase B CT 1A
14	Phase B CT COM
15	Phase C CT 5A
16	Phase C CT 1A
17	Phase C CT COM
18	Neutral CT 5A
19	Neutral CT 1A
20	Neutral CT COM

SIGNAL UPPER ROW	
21	Analog shield
22	Analog in –
23	Analog in +
24	Analog out com
25	Analog out 4+
26	Analog out 3+
27	Analog out 2+
28	Analog out 1+
29	Switch 4 input
30	Switch 3 input
31	Switch 2 input
32	Switch 1 input
33	+24 V DC switch com
34	Aux3 relay NC
35	Aux3 relay COM
36	Aux3 relay NO
37	Aux2 relay NC
38	Aux2 relay COM
39	Aux2 relay NO
40	Aux1 relay NC
41	Aux1 relay COM
42	Aux1 relay NO
43	Alarm relay NC
44	Alarm relay COM
45	Alarm relay NO
46	Comm 1 COM
47	Comm 1 –
48	Comm 1 +
49	Comm 2 COM
50	Comm 2 –
51	Comm 2 +

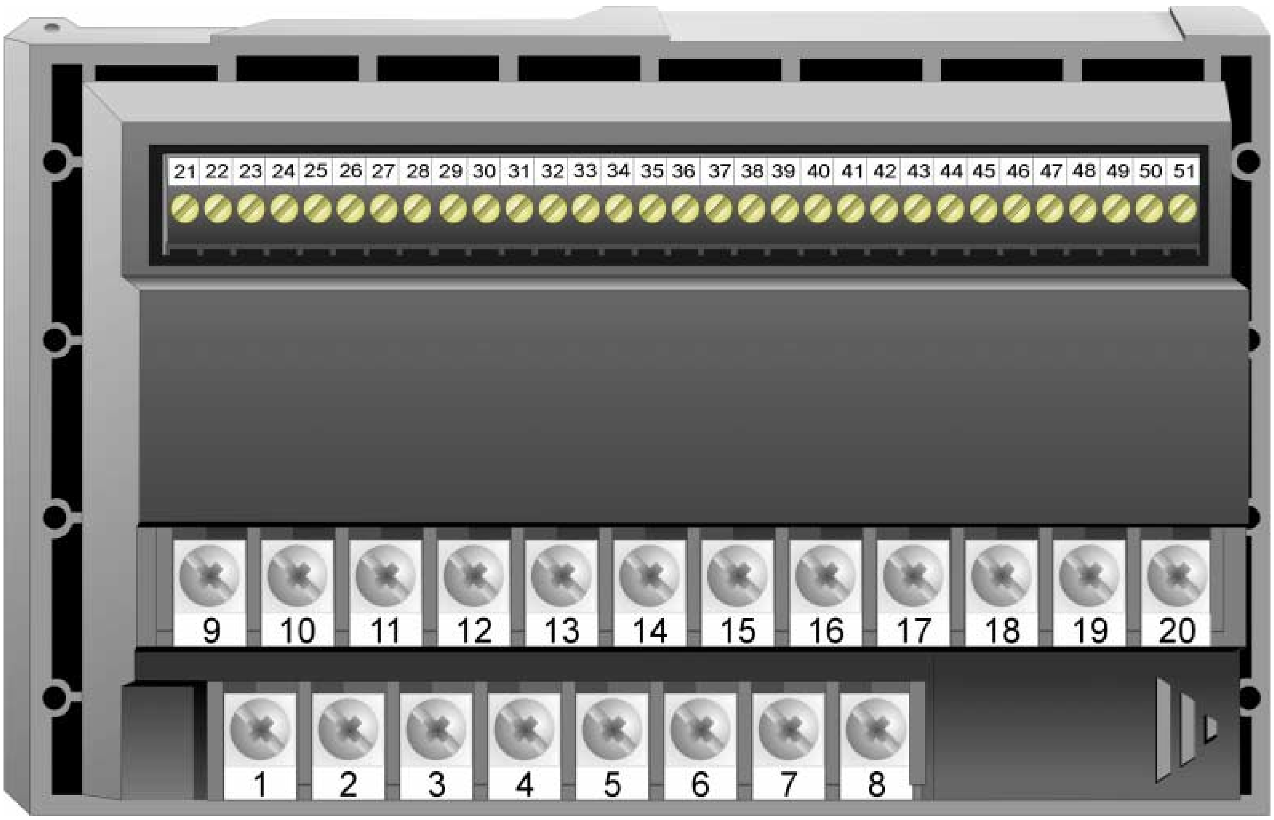


Figure 2–3: REAR TERMINALS

This wiring diagram shows the typical 4-wire wye connection which will cover any voltage range. Select the **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING:** 4 WIRE WYE (3 VTs) setpoint.

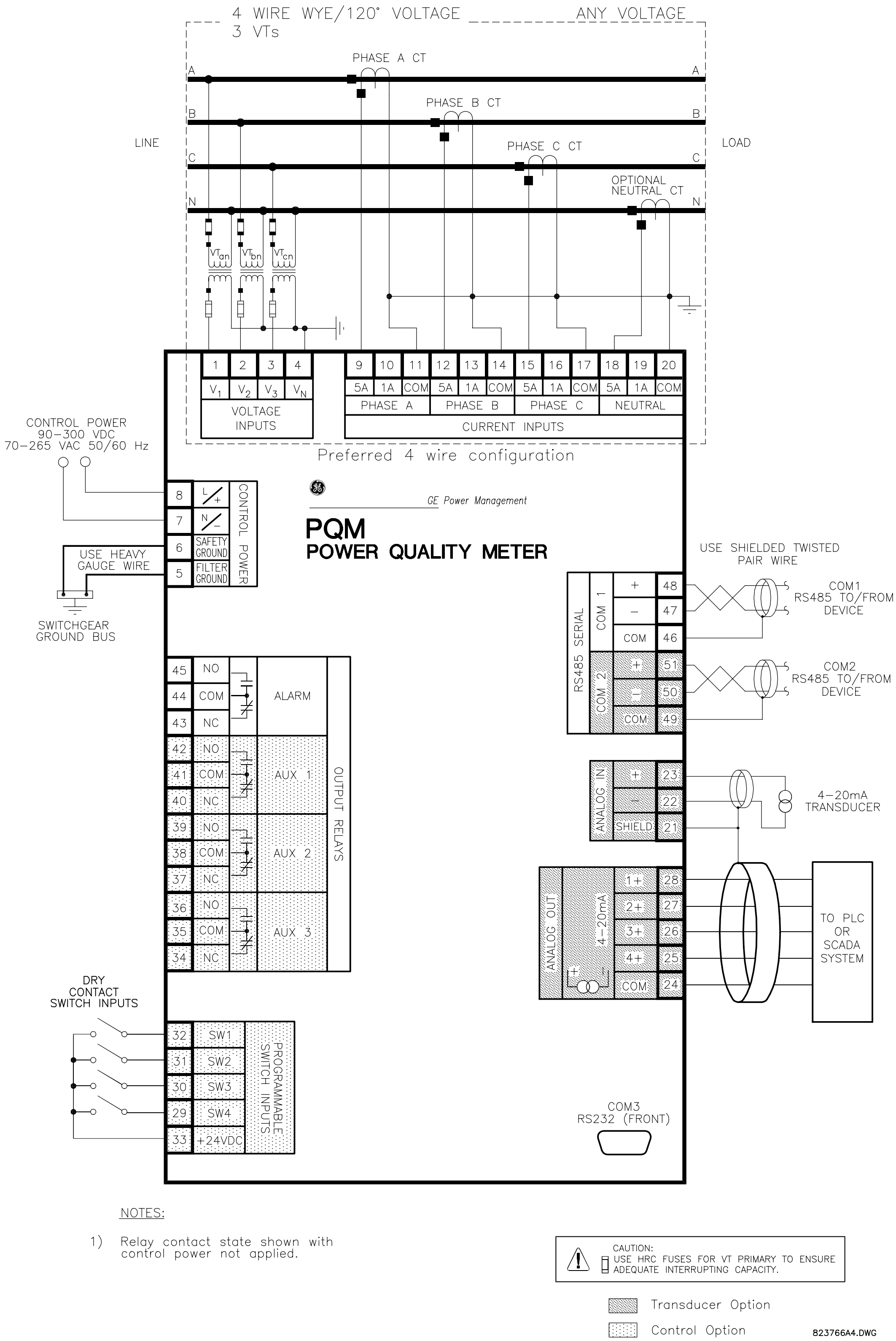


Figure 2–4: WIRING DIAGRAM 4-WIRE WYE (3 VTs)

The 2½ element 4 wire wye connection can be used for situations where cost or size restrictions limit the number of VTs to two. With this connection, Phase V_{bn} voltage is calculated using the two existing voltages. Select the **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING:** 4 WIRE WYE (2 VTs) setpoint.

NOTE

This wiring configuration will only provide accurate power measurements if the voltages are balanced.

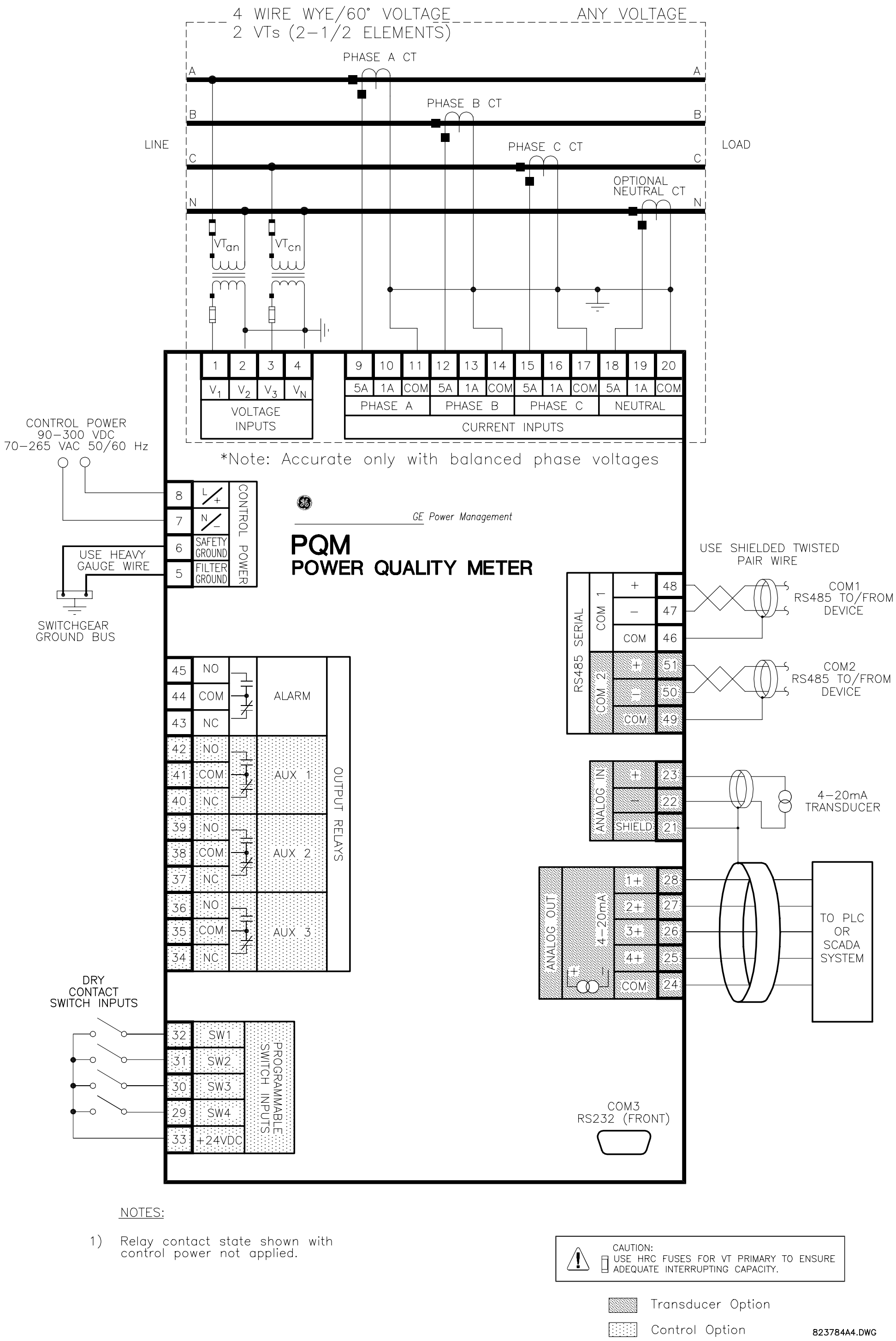


Figure 2–5: WIRING DIAGRAM 4-WIRE WYE (2 VTs)

Four-wire systems with voltages 347 V L-N or less can be directly connected to the PQM without VTs. Select the **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING:** 4 WIRE WYE DIRECT setpoint.

The PQM voltage inputs should be directly connected using HRC fuses rated at 2 A to ensure adequate interrupting capacity.

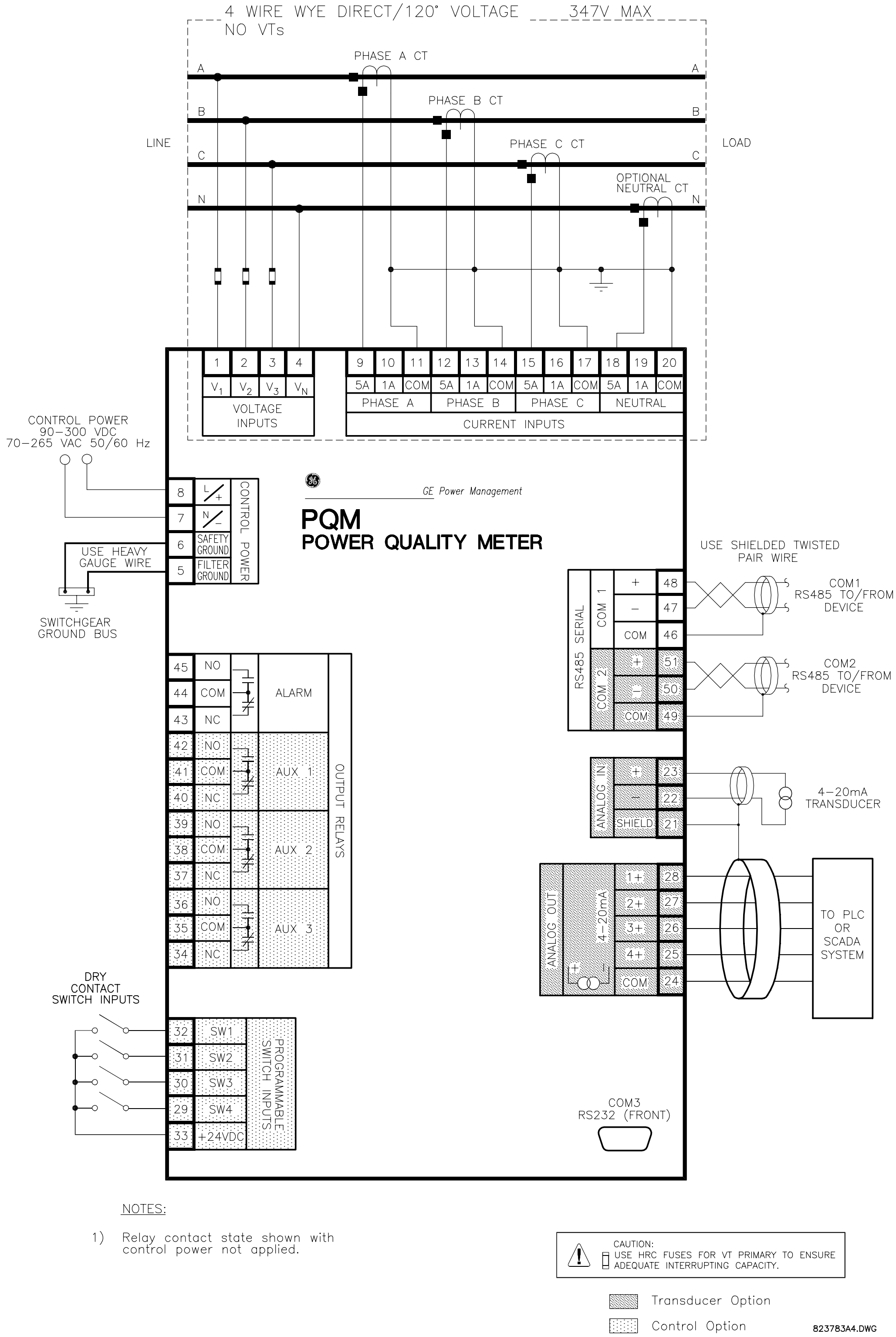


Figure 2–6: WIRING DIAGRAM 4-WIRE WYE DIRECT (NO VTs)

This diagram shows the typical 3-wire delta connection which will cover any voltage range. Select the **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING:** 3 WIRE DELTA (2 VTs) setpoint.

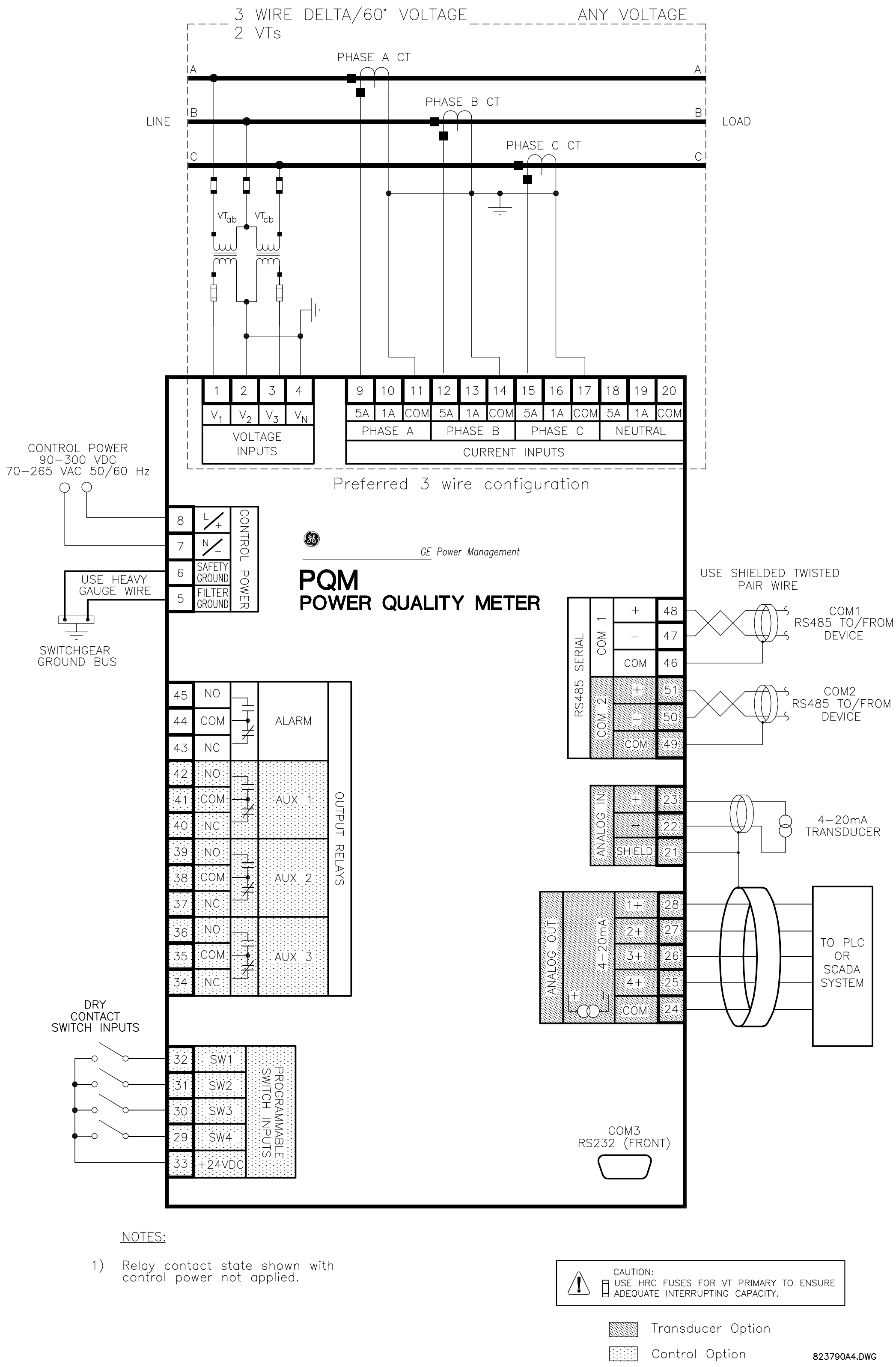


Figure 2–7: WIRING DIAGRAM 3-WIRE DELTA (2 VTs)

Three-wire systems with voltages 600 V (L-L) or less can be directly connected to the PQM without VTs. Select the **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING:** 3 WIRE DELTA DIRECT setpoint.

The PQM voltage inputs should be directly connected using HRC fuses rated at 2 amps to ensure adequate interrupting capacity.

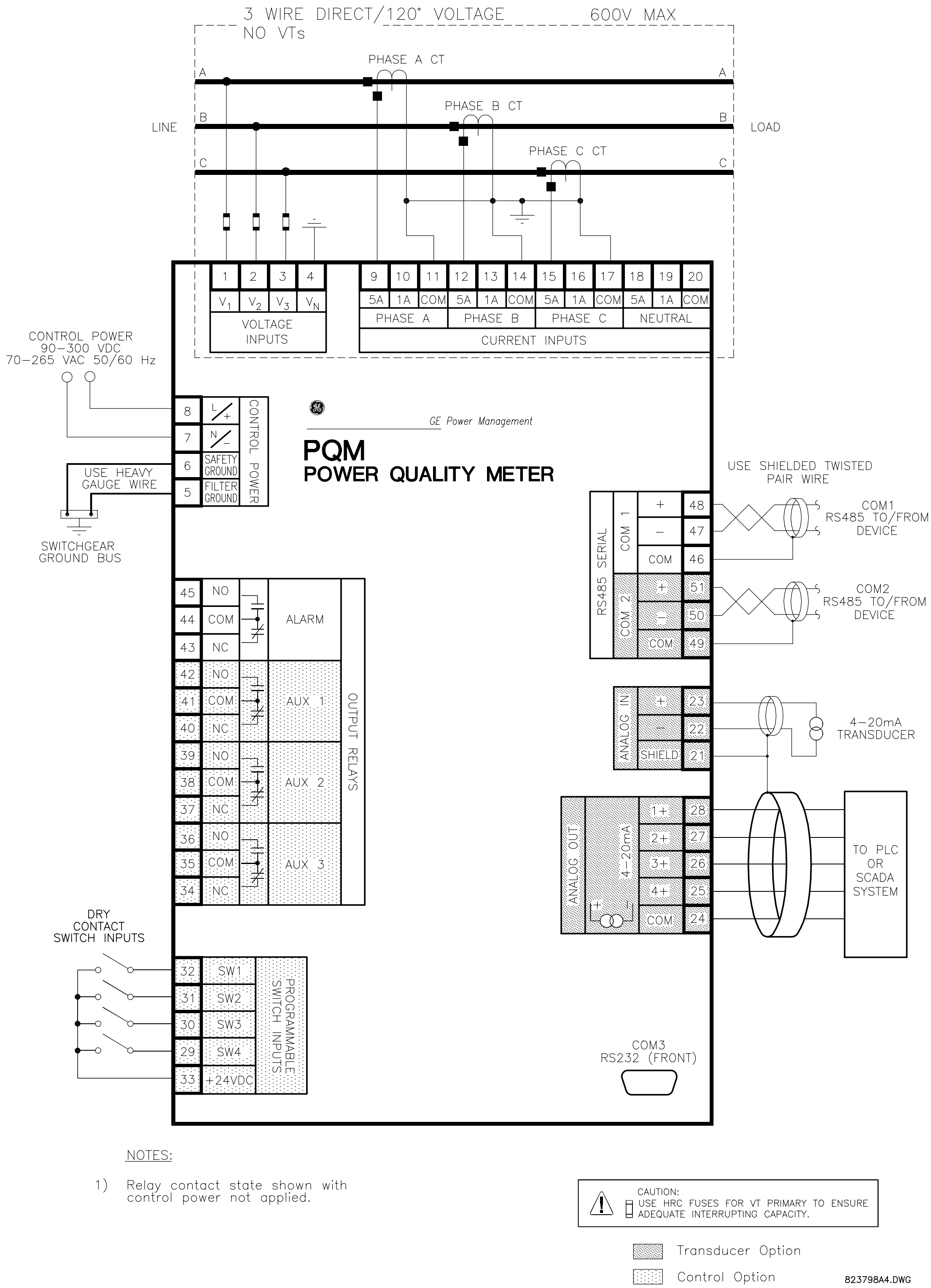


Figure 2–8: WIRING DIAGRAM 3-WIRE DIRECT (NO VTs)

For a single-phase connection, connect current and voltage to the phase A inputs only. All other inputs are ignored. Select the **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING:** SINGLE PHASE setpoint.

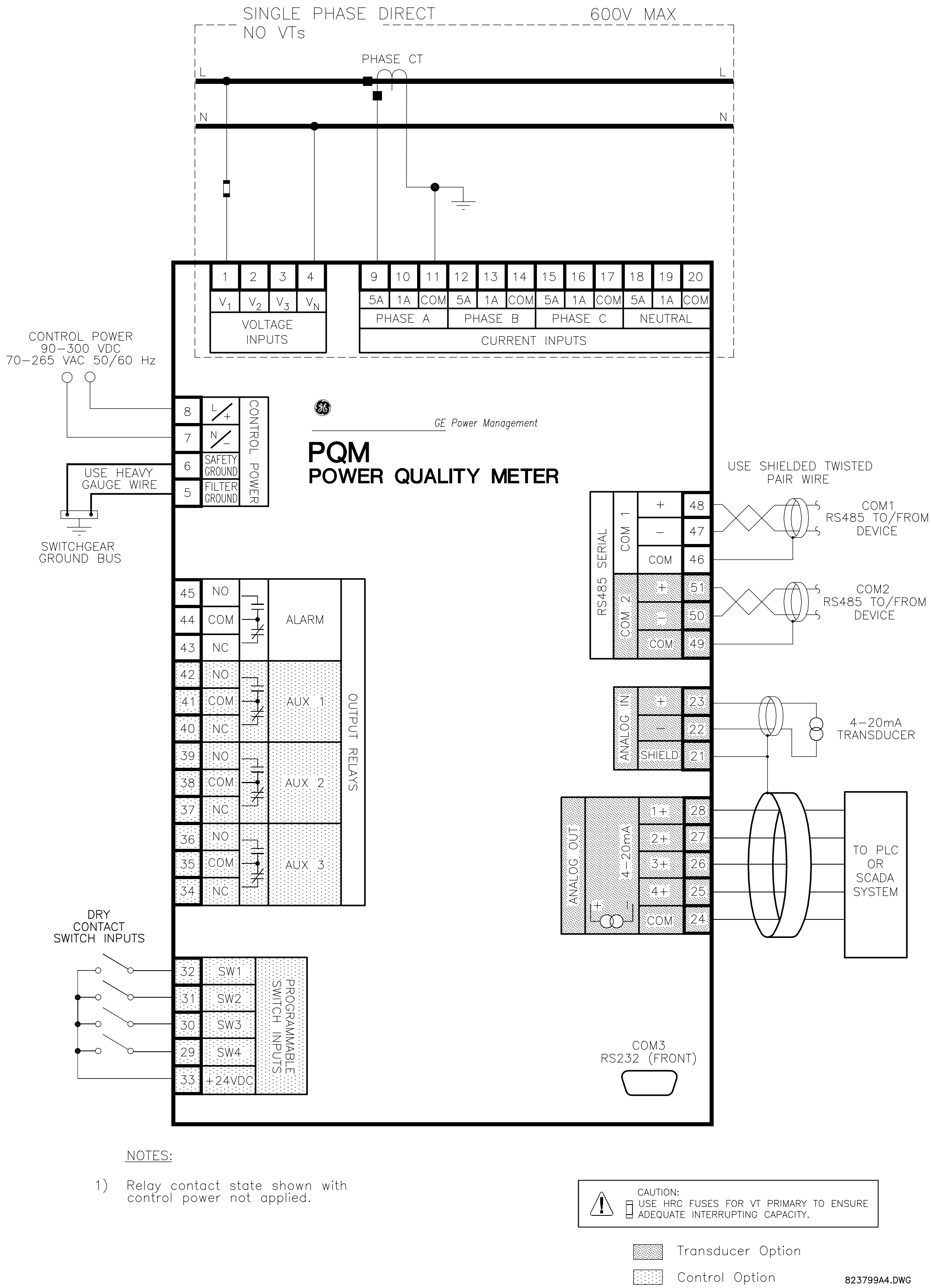


Figure 2–9: SINGLE PHASE CONNECTION

The figure below shows two methods for connecting CTs to the PQM for a 3-wire system. The top drawing shows the standard wiring configuration using three CTs. An alternate wiring configuration uses only two CTs. With the two CT method, the third phase is measured by connecting the commons from phase A and C to the phase B input on the PQM. This causes the phase A and phase C current to flow through the PQM's phase B CT in the opposite direction, producing a current equal to the actual phase B current.

$I_a + I_b + I_c = 0$ for a three wire system.
$I_b = -(I_a + I_c)$

NOTE

For the CT connections above, the **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ PHASE CT WIRING \ PHASE CT PRIMARY** setpoint must be set to PHASE A, B, AND C.

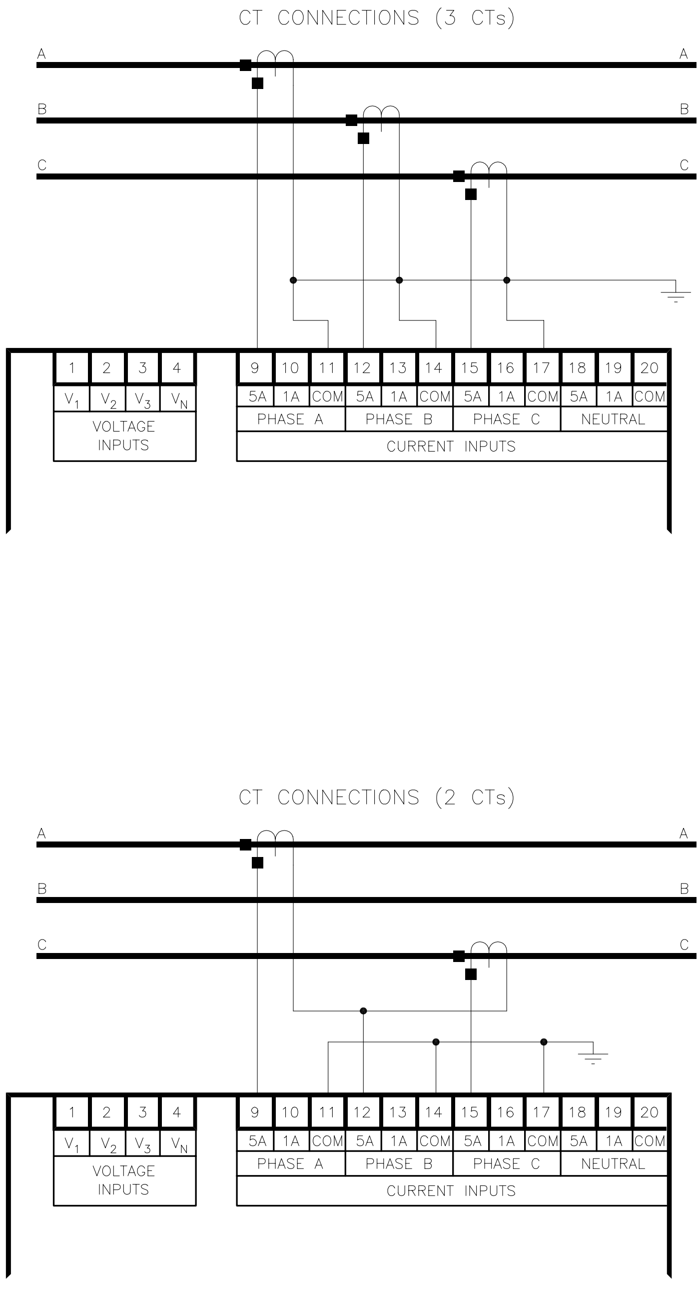


Figure 2–10: ALTERNATE CT CONNECTIONS FOR 3-WIRE SYSTEM

2.2.2 CONTROL POWER

CAUTION

The control power supplied to the PQM must match the installed power supply. If the applied voltage does not match, damage to the unit may occur. Check the product identification to verify the control voltage matches the intended application.

A universal AC/DC power supply is standard on the PQM. It covers the range 90 to 300 V DC and 70 to 265 V AC at 50/60 Hz. It is not necessary to adjust the PQM if the control voltage is within this range. A low voltage power supply is available as an option. It covers the range 20 to 60 V DC and 24 to 48 V AC at 50/60 Hz. Verify from the product identification label that the control voltage matches the intended application. Connect the control voltage input to a stable source for reliable operation. A 2.5 A HRC fuse is accessible from the back of the PQM via the fuse access door. Consult the factory for replacement fuses, if required. Using #12 gauge wire or ground braid, connect Terminals 5 and 6 to a solid system ground, typically a copper bus in the switchgear. The PQM incorporates extensive filtering and transient protection to ensure reliable operation under harsh industrial operating environments. Transient energy must be conducted back to the source through Filter Ground Terminal 5. The Filter Ground Terminal (5) is separated from the Safety Ground Terminal (6) to allow dielectric testing of switchgear with the PQM wired up. Filter Ground Terminal connections must be removed during dielectric testing.

When properly installed, the PQM meets the interference immunity requirements of IEC 801 and ANSI C37.90.1.

2.2.3 VT INPUTS

The PQM accepts input voltages from 0 to 600 V AC between the voltage inputs (V_1, V_2, V_3) and voltage common (V_n). These inputs can be directly connected or supplied through external VTs. If voltages greater than 600 V AC are to be measured, external VTs are required. When measuring line-to-line quantities using inputs V_1, V_2, and V_3, ensure that the voltage common input V_n is grounded. This input is used as a reference for measuring the voltage inputs.

CAUTION

All connections to the PQM voltage inputs should be connected using HRC fuses rated at 2 Amps to ensure adequate interrupting capacity.

2.2.4 CT INPUTS

Current transformer secondaries of 1 A or 5 A can be used with the PQM for phase and neutral sensing. Each current input has 3 terminals: 5 A input, 1 A input, and common. Select either the 1 A or 5 A terminal and common to match the phase CT secondary. Correct polarity as indicated in the wiring diagrams is essential for correct measurement of all power quantities.

The CTs selected should be capable of supplying the required current to the total secondary load, including the PQM burden of 0.1 VA at rated secondary current and the connection wiring burden.

NOTE

All PQM internal calculations are based on information measured at the CT and VT inputs. The accuracy specified in this manual assumes no error contribution from the external CTs and VTs. To ensure the greatest accuracy, Instrument class CTs and VTs are recommended.

2.2.5 OUTPUT RELAYS

The basic PQM comes equipped with one output relay; the control option supplies three additional output relays. The PQM output relays have form C contacts (normally open (NO), normally closed (NC), and common (COM)). The contact rating for each relay is 5 A resistive and 5 A inductive at 250 V AC. Consult Section 1.3: SPECIFICATIONS on page 1–11 for contact ratings under other conditions. The wiring diagrams show the state of the relay contacts with no control power applied; that is, when the relays are not energized. Relay contact wiring depends on how the relay operation is programmed in the **S3: OUTPUT RELAYS** setpoint group (see Section 4.4: S3 OUTPUT RELAYS on page 4–34).

- **ALARM RELAY (Terminals 43 / 44 / 45):** A selected alarm condition activates the alarm relay. Alarms can be enabled or disabled for each feature to ensure only desired conditions cause an alarm. If an alarm is required when control power is not present, indicating that monitoring is not available, select FAIL-SAFE operation for the alarm relay through the **S3: OUTPUT RELAYS \ ALARM RELAY \ ALARM OPERATION** setpoint. The NC/COM contacts are normally open going to a closed state on an alarm. If UNLATCHED mode is selected with setpoint **S3: OUTPUT RELAYS \ ALARM RELAY \ ALARM ACTIVATION**, the alarm relay automatically resets when the alarm condition disappears. For LATCHED mode, the RESET key must be pressed (or serial port reset command received) to reset the alarm relay. Refer to Section 5.3.1: ALARMS on page 5–20 for all the displayed alarm messages.
- **AUXILIARY RELAYS 1,2,3 (OPTION) (Terminals 34 to 42):** Additional output relays can be configured for any of the alarms listed in Section 5.3.1: ALARMS on page 5–20. When an alarm feature is assigned to an auxiliary relay, it acts as a control feature. When the setpoint is exceeded for a control feature, the output relay changes state and the appropriate AUX LED lights but no indication is given on the display. The auxiliary relays can also be programmed to function as kWh, kvarh, and kVAh pulse outputs.

2.2.6 SWITCH INPUTS (OPTIONAL)

The PQM has four programmable switch inputs that can be used for numerous functions. The figure below shows the internal circuitry of the switches.

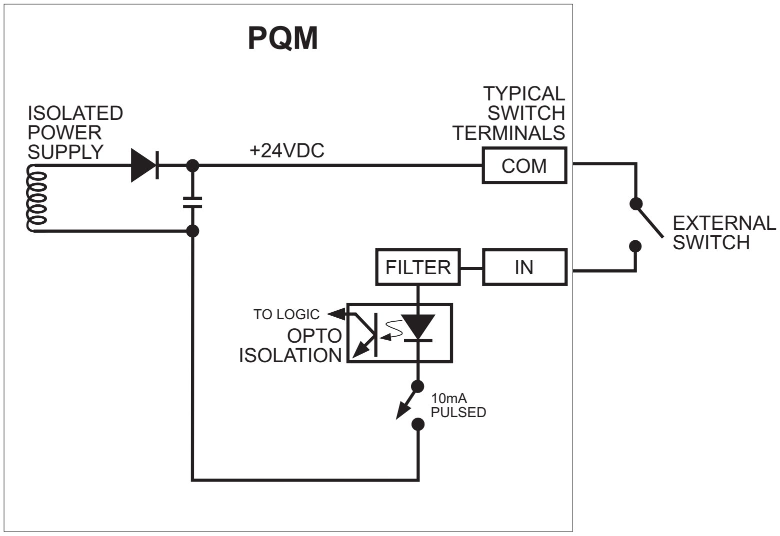


Figure 2–11: SWITCH INPUT CIRCUIT

Each switch input can be programmed with a 20-character user defined name and can be selected to accept a normally open or normally closed switch. A list various functions that are assignable to switches is shown below, followed by a description of each function.

OFF	ALARM RELAY	NEW DEMAND PERIOD
SETPOINT ACCESS	SELECT ANALOG OUTPUT	SELECT ANALOG INPUT
AUX1 RELAY	AUX2 RELAY	AUX3 RELAY
PULSE INPUT 1	PULSE INPUT 2	PULSE INPUT 3
PULSE INPUT 4	CLEAR ENERGY	CLEAR DEMAND

- **ALARM RELAY:** When a switch input is assigned to the alarm relay, a change in the switch status produces an alarm condition and the alarm relay activates.
- **PULSE INPUT 1 / 2 / 3 / 4:** When a switch input is assigned as a pulse input counter, the PQM counts the number of transitions from open to closed when the input is configured as normally open and closed to open when the input is configured as normally closed. The minimum pulse width required for the PQM to read the switch is 150 ms. Therefore, for the PQM to read one pulse, the switch input must be in its inactive state (closed/open) for a minimum of 150 ms then in its active state (open/closed) for another 150 ms. See Section 1.3: SPECIFICATIONS on page 1–11 for more details.
- **NEW DEMAND PERIOD:** The PQM can be used for load shedding by assigning a switch input to a new demand period. This allows the PQM demand period to be synchronized with the utility meter. One of the billing parameters used by a utility is peak demand. By synchronizing the PQM to the utility meter, the PQM can monitor the demand level read by the utility meter and perform load shedding to prevent the demand from reaching the penalty level. The utility meter provides a dry contact output which can be connected to one of the PQM switch inputs. When the PQM senses a contact closure, it starts a new demand period (with Block Interval Demand calculation only).
- **SETPOINT ACCESS:** The access terminals must be shorted together in order for the faceplate keypad to have the ability to store new setpoints. Typically the access terminals are connected to a security keyswitch to allow authorized access only. Serial port commands to store new setpoints operate even if the

access terminals are not shorted. When the access terminals are open, all actual and setpoint values can still be accessed for viewing; however, if an attempt is made to store a new setpoint value, the message SETPOINT ACCESS DISABLED is displayed and the previous setpoint remains intact. In this way, all of the programmed setpoints remain secure and tamper proof.

- **SELECT ANALOG OUTPUT:** This switch selection allows each analog output to be multiplexed into two outputs. If the switch is active, the parameter assigned in setpoint **S2 SYSTEM SETUP \ ANALOG OUTPUT 1 \ ANALOG OUTPUT 1 ALT** determines the output level. If the switch is not active, the parameter assigned in setpoint **S2 SYSTEM SETUP \ ANALOG OUTPUT 1 \ ANALOG OUTPUT 1 MAIN** is used. See Sections 2.2.7: ANALOG OUTPUTS (OPTIONAL) below and 4.3.2: ANALOG OUTPUTS on page 4–21 for additional details.
- **SELECT ANALOG INPUT:** This switch selection allows the analog input to be multiplexed into two inputs. If the switch is active, the parameter assigned in setpoint **S2 SYSTEM SETUP \ ANALOG INPUT ALT** is used to scale the input. If the switch is not active, the parameter assigned in setpoint **S2 SYSTEM SETUP \ ANALOG INPUT \ ANALOG INPUT MAIN** is used. If a relay is assigned in **S2 SYSTEM SETUP \ ANALOG INPUT \ ANALOG IN MAIN/ALT SELECT RELAY**, that relay energizes when the switch is active and de-energizes when the switch is not active, thus providing the ability to feed in analog inputs from two separate sources as shown in the figure below. See Sections 2.2.8: ANALOG INPUT (OPTIONAL) below and 4.3.3: ANALOG INPUT on page 4–25 for additional details.

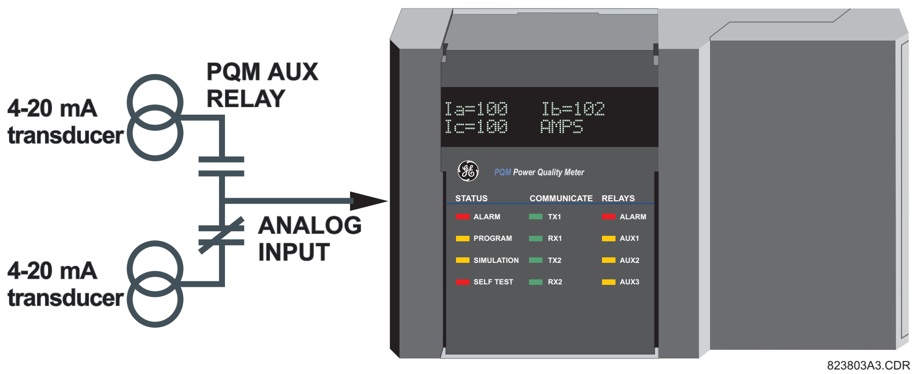


Figure 2–12: ANALOG INPUT MULTIPLEXING

- **AUX 1 / 2 / 3 RELAY**: When a switch input is assigned to an AUX relay, a closure on the switch input causes the programmed auxiliary relay to change state. This selection is available only if the Control (C) option is installed.
- **CLEAR ENERGY**: When a switch input is assigned to CLEAR ENERGY, a closure on the switch input will clear all Energy data within the PQM.
- **CLEAR DEMAND**: When a switch input is assigned to CLEAR DEMAND, a closure on the switch input will clear all Demand data within the PQM.

2.2.7 ANALOG OUTPUTS (OPTIONAL)

The PQM has four current outputs when the transducer option is installed (T20 = 4 to 20 mA, T1 = 0 to 1 mA in the order code). These outputs can be multiplexed to produce 8 analog transducers. This output is a current source suitable for connection to a remote meter, chart recorder, programmable controller, or computer load. Use the 4 to 20 mA option with a programmable controller that has a 2 to 40 mA current input. If only a voltage input is available, use a scaling resistor at the PLC terminals to scale the current to the equivalent voltage. For example, install a 500 Ω resistor across the terminals of a 0 to 10 V input to make the 4 to 20 mA output correspond to 2 to 10V (R = V / I = 10 V / 0.02 A = 500 Ω). Current levels are not affected by the total lead and load resistance which must not exceed 600 Ω for the 4 to 20 mA range and 2400 Ω for the 0 to 1 mA range. For readings greater than full scale the output will saturate at 22 mA (4 to 20 mA) or 1.1 mA (0 to 1 mA). These analog outputs are isolated and since all output terminals are floating, the connection of the analog output to a process input will not introduce a ground loop. Part of the system should be grounded for safety, typically at the programmable controller. For floating loads (such as a meter), ground Terminal 24 externally.

The outputs for these transducers can be selected from any of the measured parameters in the PQM. The choice of output is selected in the **S2 SYSTEM SETUP \ ANALOG OUTPUT 1-4** setpoints group. See Section 4.3.2: ANALOG OUTPUTS on page 4–21 for a list of available parameters. Each analog output can be assigned two parameters: a main parameter and an alternate parameter. Under normal operating conditions, the main parameter will appear at the output terminals. To select the alternate parameter, one of the switch inputs must be assigned to SELECT ANALOG OUT and the switch input must be closed (assuming normally closed activation). By opening and closing the switch input, two analog output parameters can be multiplexed on one output. This effectively achieves 8 analog outputs for the PQM.

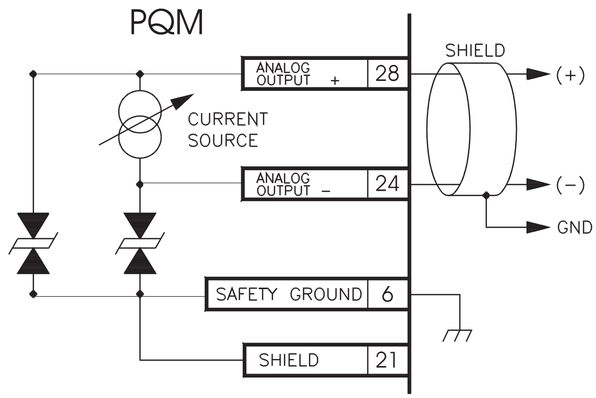


Figure 2–13: ANALOG OUTPUT

As shown in wiring diagrams on pages 2–6 to 2–11, these outputs are at Terminals 25 to 28 and share Terminal 24 as their common. Shielded cable should be used, with only one end of the shield grounded, to minimize noise effects.

Signals and power supply circuitry are internally isolated, allowing connection to devices (PLCs, computers, etc.) at ground potentials different from the PQM. Each terminal, however, is clamped to ±36 V to ground.

2.2.8 ANALOG INPUT (OPTIONAL)

Terminals 22(–) and 23(+) are provided for a current signal input. This current signal can be used to monitor any external quantity, such as transformer winding temperature, battery voltage, station service voltage, transformer tap position, etc. Any transducer output ranges within the range of 0 to 20 mA can be connected to the analog input terminals of the PQM. See Section 4.3.3: ANALOG INPUT on page 4–25 for details on programming the analog input.

2.2.9 RS485 SERIAL PORTS

A fully loaded PQM is equipped with three serial ports. COM1 is a RS485 port available at the rear terminals of the PQM which is normally used as the main communications interface to the system. COM2, which is also a rear RS485 port, can be used for data collection, printing reports, or problem analysis without disturbing the main communications interface. COM3 is a front panel RS232 port that can be used for setpoint programming or recording using the PQMPC software.

A serial port provides communication capabilities between the PQM and a remote computer, PLC, or distributed control system (DCS). Up to thirty-two PQMs can be daisy chained together with 24 AWG stranded, shielded, twisted-pair wire on a single communication channel. Suitable wire should have a characteristic impedance of 120 Ω (such as Belden #9841). These wires should be routed away from high power AC lines and other sources of electrical noise. The total length of the communications wiring should not exceed 4000 feet for reliable operation. Correct polarity is essential for the communications port to operate. Terminal (485+) of every PQM in a serial communication link must be connected together. Similarly, terminal (485–) of every PQM must also be connected together. These polarities are specified for a 0 logic and should match the polarity of the master device. If the front panel RX1 or RX2 lights are flashing, this indicates that the PQM is receiving data. If the front panel TX1 or TX2 lights are flashing, this indicates that the PQM is transmitting data. Each PQM must be daisy-chained to the next one as shown in Figure 2–14: RS485 COMMUNICATION WIRING. Avoid star or stub connected configurations. If a large difference in ground potentials exists, communication on the serial communication link will not be possible. Therefore, it is imperative that the serial master and PQM are both at the same ground potential. This is accomplished by joining the 485 ground terminal (Terminal 46 for COM1; Terminal 49 for COM2) of every unit together and grounding it at the master only.

The last PQM in the chain and the master computer require a terminating resistor and terminating capacitor to ensure proper electrical matching of the loads and prevent communication errors. Using terminating resistors on all the PQMs would load down the communication network while omitting them at the ends could cause reflections resulting in communication errors. Install the 120 Ω, ¼ watt terminating resistor and 1 nF capacitor externally. Although any standard resistor and capacitor of these values are suitable, these components can also be ordered from GE Power Management as a combined terminating network.

Each communication link must have only one computer (PLC or DCS) issuing commands called the master. The master should be centrally located and can be used to view actual values and setpoints from each PQM called the slave device. Other GE Power Management relays or devices using the Modbus RTU protocol can be connected to the communication link. Setpoints in each slave can also be changed from the master. Each PQM in the link must be programmed with a different slave address prior to running communications using the **S1 PQM SETUP \ COM1 RS485 SERIAL PORT \ MODBUS COMMUNICATION ADDRESS** setpoint. The PQMPC software, a communications program developed by GE Power Management, may be used to view status, actual values, and setpoints. See Chapter 6 for more information on the PQMPC software.

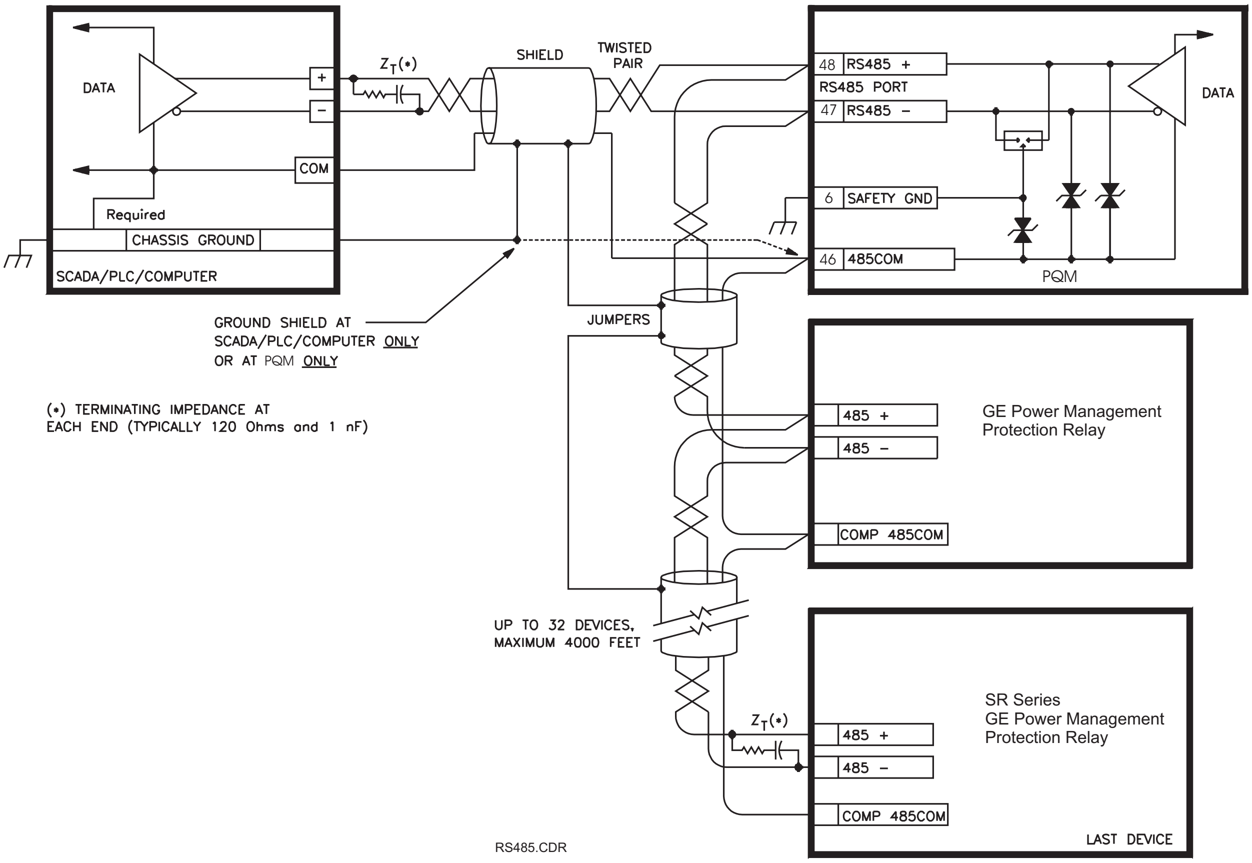


Figure 2–14: RS485 COMMUNICATION WIRING

2.2.10 RS232 FRONT PANEL PORT

A 9-pin RS232C serial port provided on the front panel allows the user to program the PQM with a personal computer. This port uses the same communication protocol as the rear terminal RS485 ports. To use this interface, the personal computer must be running the PQMPC software provided with the relay. Cabling to the RS232 port of the computer is shown below for both 9-pin and 25-pin connectors.

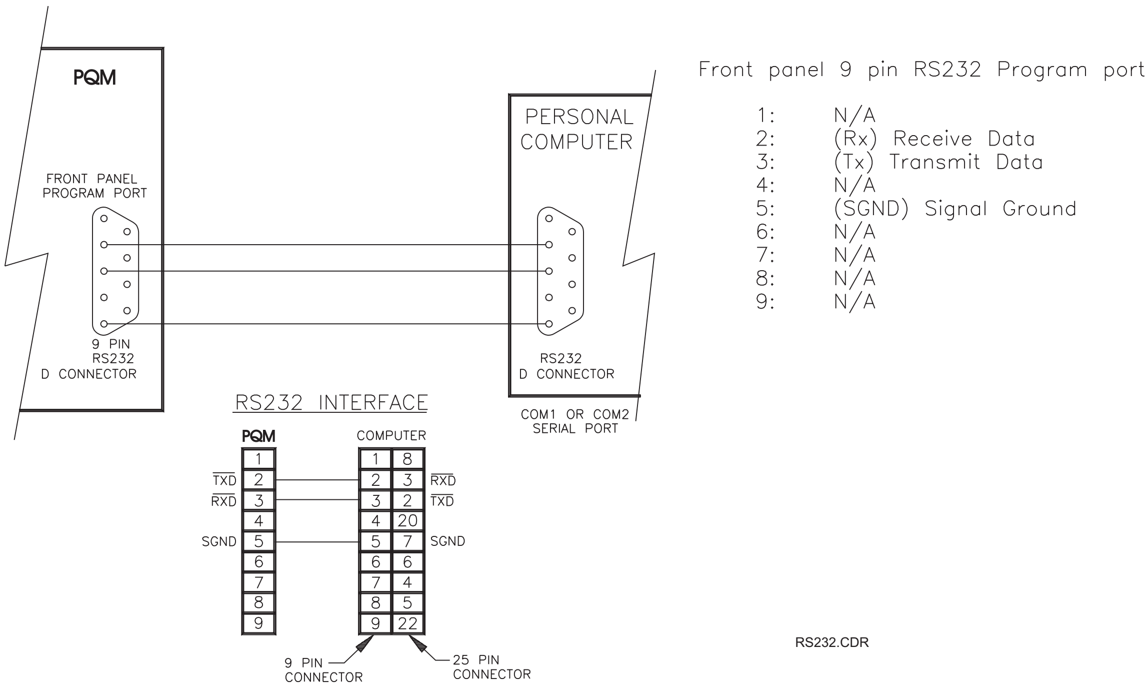


Figure 2–15: RS232 CONNECTION

NOTE

The RS232 port is only available with the display version. See Section 1.2.5: ORDER CODES on page 1–10 for further details.

2.2.11 DIELECTRIC STRENGTH TESTING

It may be required to test the complete switchgear for dielectric strength with the PQM installed. This is also known as "flash" or "hipot" testing. The PQM is rated for 1500 V AC isolation between relay contacts, CT inputs, VT inputs, control power inputs and Safety Ground Terminal 6. Some precautions are necessary to prevent damage to the PQM during these tests.

Filter networks and transient protection clamps are used between the control power, serial port, switch inputs, analog outputs, analog input, and the filter ground terminal 5 to filter out high voltage transients, radio frequency interference (RFI) and electromagnetic interference (EMI). The filter capacitors and transient absorbers could be damaged by the continuous high voltages relative to ground that are applied during dielectric strength testing. Disconnect the Filter Ground Terminal 5 during testing of the control power inputs. Relay contact and CT terminals do not require any special precautions. ***Do not perform dielectric strength testing on the serial ports, switch inputs, analog input or analog output terminals or the PQM internal circuitry will be damaged.***

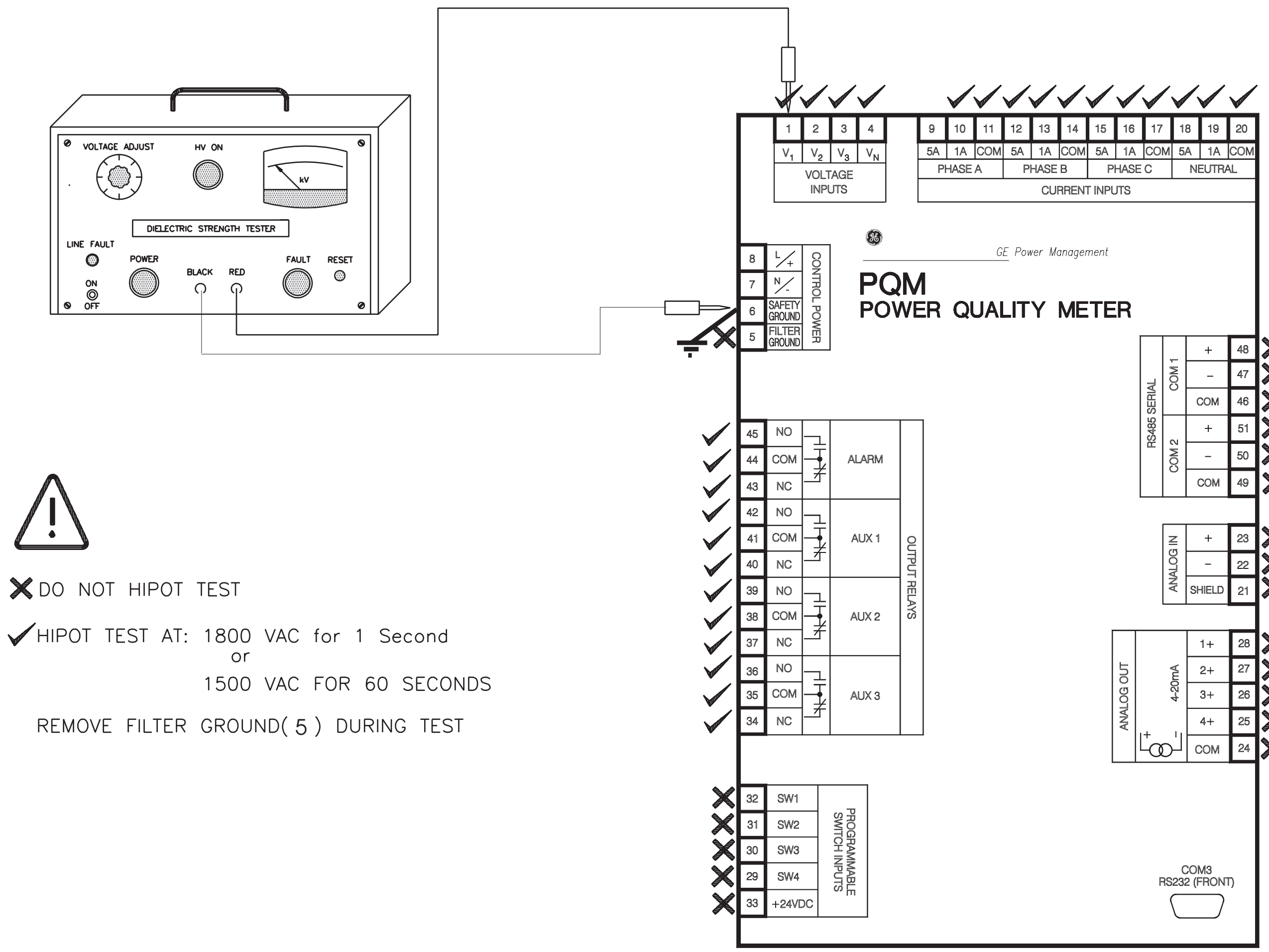


Figure 2–16: HI-POT TESTING

3.1.1 FRONT PANEL

The local operator interface for setpoint entry and monitoring of measured values is through the front panel as shown in the figure below. Control keys are used to select the appropriate message for entering setpoints or displaying measured values. Alarm and status messages are automatically displayed when required. Indicator LEDs provide important status information at all times. An RS232 communications port is also available for uploading or downloading information to the PQM.

Figure 3–1: FRONT PANEL

3.1.2 DISPLAY

All messages are displayed in English on the 40-character vacuum fluorescent display. This display is visible under varied lighting conditions. When the keypad and display are not actively being used, the screen displays a default status message. This message appears if no key has been pressed for the time programmed in the **S1 PQM SETUP \ PREFERENCES \ DEFAULT MESSAGE TIME** setpoint. Note that alarm condition messages automatically override the default messages.

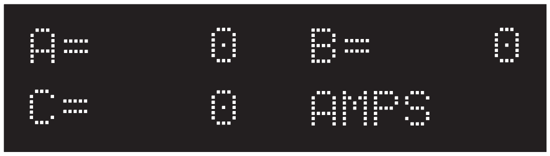


Figure 3–2: DISPLAY

3.2.1 DESCRIPTION

The status indicators provide a quick indication of the overall status of the PQM. These indicators illuminate if an alarm is present, if setpoint access is enabled, if the PQM is in simulation mode, or if there is a problem with the PQM itself.

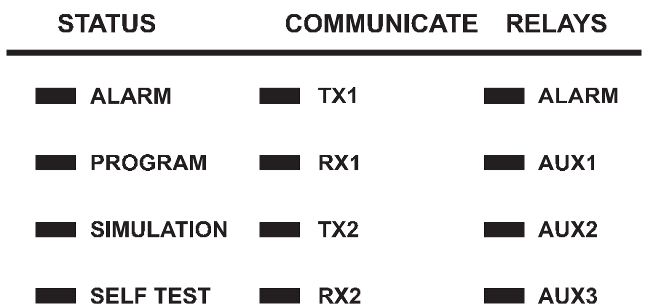


Figure 3–3: STATUS INDICATORS

3.2.2 STATUS

- **ALARM**: When an alarm condition exists, the ALARM indicator will be on.
- **PROGRAM**: The PROGRAM indicator will be on when setpoint access is enabled.
- **SIMULATION**: The SIMULATION indicator will be on when the PQM is using simulated values for current, voltage, analog input, switches and analog outputs. While in simulation mode, the PQM will ignore the measured parameters detected at its inputs and will use the simulated values stored in the **S5 TESTING \ SIMULATION** setpoints group.
- **SELF TEST**: Any abnormal condition detected during PQM self-monitoring, such as a hardware failure, causes the SELF TEST indicator to be on. Loss of control power to the PQM also causes the SELF TEST indicator to turn on, indicating that no metering is present.

3.2.3 COMMUNICATE

The COMMUNICATE indicators monitor the status of the RS485 communication ports. When no serial data is being received through the rear serial ports terminals, the RX1/2 indicators are off. This situation occurs if there is no connection, the serial wires become disconnected, or the master computer is inactive. If there is activity on the serial port but the PQM is not receiving valid messages for its internally programmed address, the TX1/2 indicators remain off. This condition can be caused by incorrect message formats (such as baud rate or framing), reversed polarity of the two RS485 twisted-pair connections, or the master not sending the currently programmed PQM address. If the PQM is being periodically addressed with a valid message, the RX1/2 indicator will turn on followed by the TX1/2 indicator.

- **TX1**: The PQM is transmitting information via the COM1 RS485 communications port when lit.
- **RX1**: The PQM is receiving information via the COM1 RS485 communications port when lit.
- **TX2**: The PQM is transmitting information via the COM2 RS485 communications port when lit.
- **RX2**: The PQM is receiving information via the COM2 RS485 communications port when lit.

3.2.4 RELAYS

The status of the output relays is displayed with these indicators.

- **ALARM**: The ALARM relay is intended for general purpose alarm outputs. This indicator is on while the ALARM relay is operating. If the ALARM is programmed as unlatched, this indicator flashes as long as the alarm condition persists. When the condition clears, the ALARM indicator turns off. If the alarm relay has been programmed as latched, the alarm condition can only be cleared by pressing the RESET key or by issuing a computer reset command.
- **AUX1**: The AUX 1 relay is intended for control and customer specific requirements. The AUX 1 indicator is on while the AUXILIARY 1 relay is operating.
- **AUX2**: The AUX 2 relay is intended for control and customer specific requirements. The AUX 2 indicator is on while the AUXILIARY 2 relay is operating.
- **AUX3**: The AUX 3 relay is intended for control and customer specific requirements. The AUX 3 indicator is on while the AUXILIARY 3 relay is operating.

3.3.1 DESCRIPTION

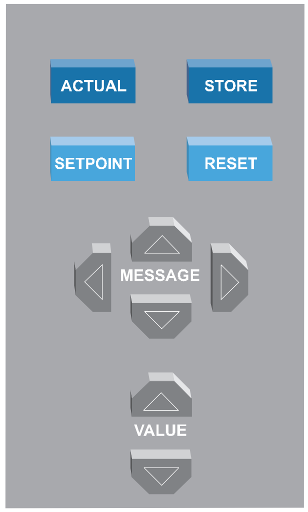


Figure 3–4: FRONT PANEL KEYS

3.3.2 SETPOINT KEY

Setpoints are arranged into groups of related messages called setpoint pages. Each time the SETPOINT key is pressed, the display advances to the first message of the next page of setpoints. Pressing SETPOINT while in the middle of a setpoints page advances the display to the beginning of the next page. The MESSAGE △ and MESSAGE ▽ keys move between messages within a page.

3.3.3 ACTUAL KEY

Measured values and collected data messages are arranged into groups of related messages called actual values pages. Each time the ACTUAL key is pressed, the display advances to the first message of the next page of actual values. Pressing ACTUAL while in the middle of a page of actual values advances the display to the beginning of the next page. The MESSAGE △ and MESSAGE ▽ keys move between messages within a page.

3.3.4 STORE KEY

When programming setpoints, enter the new value using the VALUE △ and VALUE ▽ keys, followed by the STORE key. Setpoint programming must be enabled for the STORE key to store the edited value. An acknowledgment message will flash if the new setpoint is successfully saved in non-volatile memory. The STORE key is also used to add and remove user defined default messages. Refer to Section 3.4: DEFAULT MESSAGES on page 3–8 for further details.

3.3.5 RESET KEY

The RESET key is used to clear the latched alarm and/or auxiliary conditions. Upon pressing the key, the PQM will perform the appropriate action based on the condition present as shown in the table below.

Table 3–1: RESET KEY ACTIONS

CONDITION PRESENT	MESSAGE DISPLAYED	PQM ACTION PERFORMED
None		No action taken
Alarm	**RESET NOT POSSIBLE ALARM STILL PRESENT**	ALARM indicators and alarm relay remain on because condition is still present
Aux Relay	**RESET NOT POSSIBLE AUX CONDITION EXISTS**	AUXILIARY indicator(s) and aux relay(s) remain on because condition is still present
Alarm and Aux Relay	**RESET NOT POSSIBLE AUX CONDITION EXISTS**	AUXILIARY and ALARM indicators and alarm and aux relays remain on because condition is still present
Latched Alarm (condition no longer exists)		No message displayed, and ALARM indicators and the alarm relay turned off
Latched Aux Relay (condition no longer exists)		No message displayed, and AUXILIARY indicator and the appropriate aux relay(s) turned off
Alarm and Latched Aux Relay (Aux condition no longer exists)		No message displayed, and appropriate AUXILIARY indicator(s) and aux relay(s) turned off
Aux Relay and Latched Alarm (alarm condition no longer exists)		No message displayed, and ALARM indicators and alarm relay turned off

The RESET key, along with the STORE key, is also used to remove user defined default messages. Refer to Section 3.4: DEFAULT MESSAGES on page 3–8 for further details.

3.3.6 MESSAGE KEYS

To move between message groups within a page use the MESSAGE △ and MESSAGE ▽ keys. The MESSAGE ▽ key moves toward the end of the page and the MESSAGE △ key moves toward the beginning of the page. A page header message will appear at the beginning of each page and a page footer message will appear at the end of each page. To select messages within a subgroup press MESSAGE ▷. To back out of the subgroup, press ◁ MESSAGE to access the previous message or MESSAGE ▽ to go to the next subgroup.

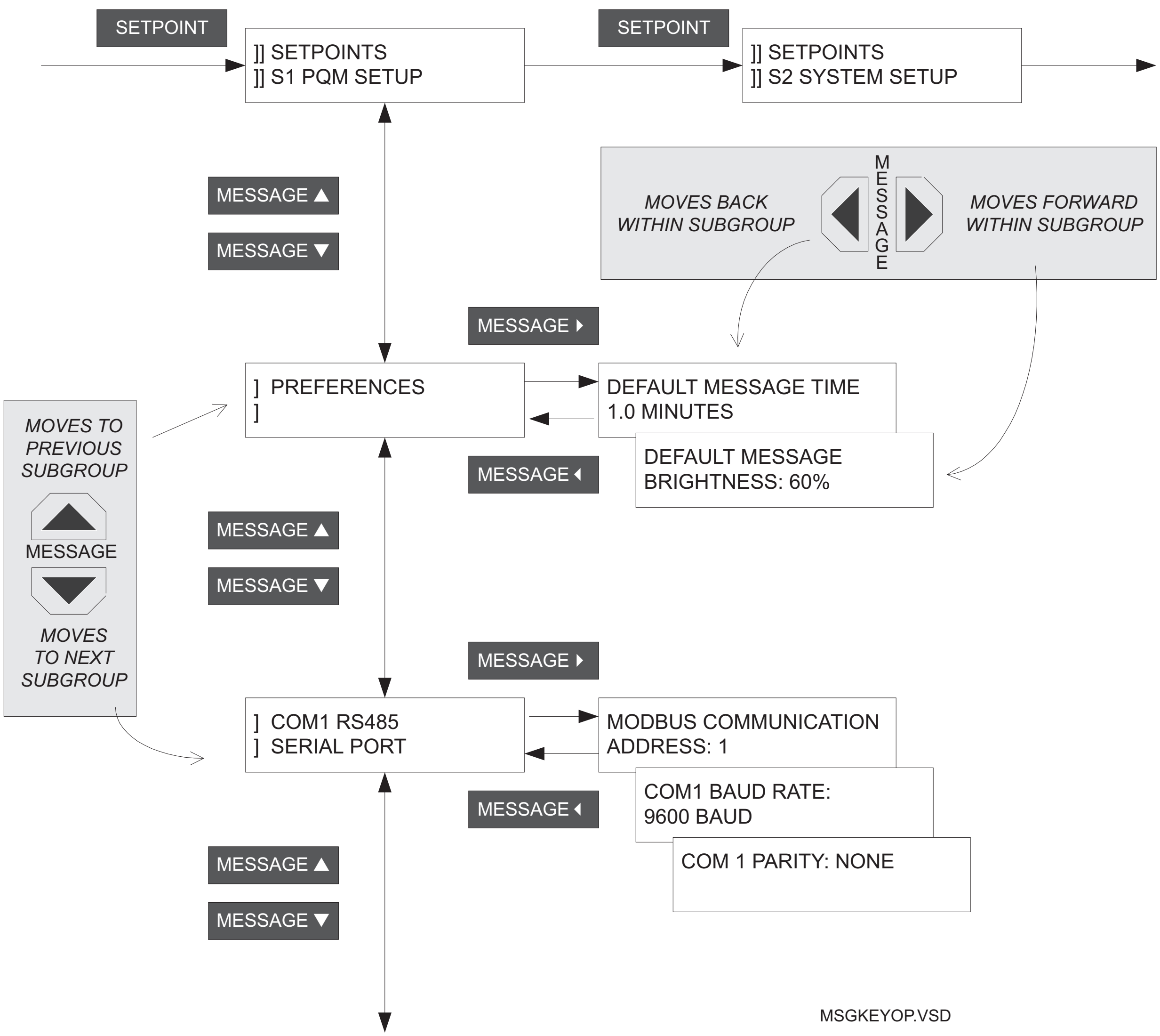


Figure 3–5: MESSAGE KEY OPERATION

3.3.7 VALUE KEYS

Setpoint values are entered using the VALUE △ and VALUE ▽ keys. When a setpoint is displayed calling for a yes/no response, each time VALUE ▽ or VALUE △ is pressed, the "Yes" becomes a "No," or the "No" becomes a "Yes." Similarly, for multiple choice selections, each time VALUE △ or VALUE ▽ is pressed, the next choice is displayed. When numeric values are displayed, each time VALUE △ is pressed, the value increases by the step increment, up to the maximum. Hold the key down to rapidly change the value.

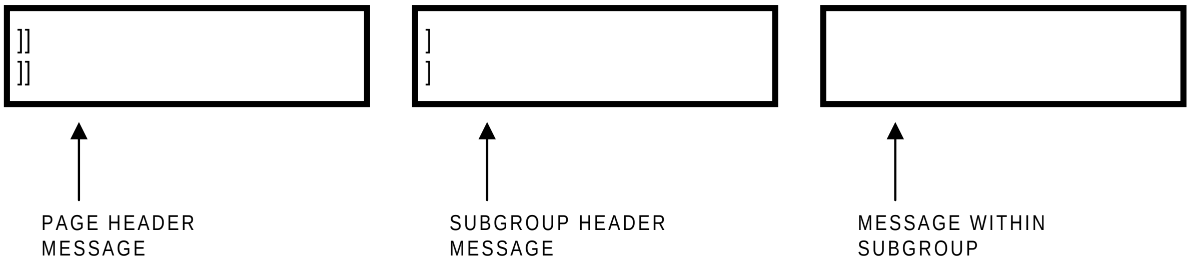
3.3.8 DATA ENTRY METHODS

a) KEYPAD ENTRY

Press the SETPOINT key once and the first page of setpoints is displayed. Press SETPOINT several times to move to the top of successive pages. A header message with two bars in the first two character positions is the start of a new page. The page number and page title appear on the second line. All setpoint page headers are numbered with an 'S' prefix. Actual value page headers are numbered with an 'A' prefix.

The messages are organized into logical subgroups within each Setpoints and Actual Values page as shown below.

Press the ◁ MESSAGE / MESSAGE ▷ key when displaying a subgroup to access messages within that subgroup. Otherwise select the MESSAGE △ and MESSAGE ▽ keys to display the next subgroup.



b) COMPUTER ENTRY

When running PQMPC, setpoint values are grouped together on a screen. The data is organized in a system of menus. See Chapter 6: SOFTWARE for further details.

c) SCADA ENTRY

Details of the complete communication protocol for reading and writing setpoints are given in Chapter 7: MODBUS COMMUNICATIONS. A SCADA system connected to the RS485 terminals can be custom programmed to make use of any of the communication commands for remote setpoint programming, monitoring, and control.

3.3.9 SETPOINT ACCESS SECURITY

The PQM incorporates software security to provide protection against unauthorized setpoint changes. A numeric access code must be entered to program new setpoints using the front panel keys. To enable the setpoint access security feature, the user must enter a value in the range of 1 to 999. The factory default access code is 1. If the switch option is installed in the PQM, a hardware jumper access can be assigned to a switch input. Setpoint access can then only be enabled if the switch input is shorted and the correct software access code entered. Attempts to enter a new setpoint without the electrical connection across the setpoint access terminals or without the correct access code will result in an error message. When setpoint programming is via a computer, no setpoint access jumper is required. If a SCADA system is used for PQM programming, it is up to the programmer to design in appropriate passcode security.

3.4.1 DESCRIPTION

Up to 10 default messages can be selected to display sequentially when the PQM is left unattended. If no keys are pressed for the default message time in the **S1 PQM SETUP \ PREFERENCES \ DEFAULT MESSAGE TIME** setpoint, then the currently displayed message will automatically be overwritten by the first default message. After three seconds, the next default message in the sequence will display if more than one is selected. Alarm messages will override the default message display. Any setpoint or measured value can be selected as a default message.

Messages are displayed in the order they are selected.

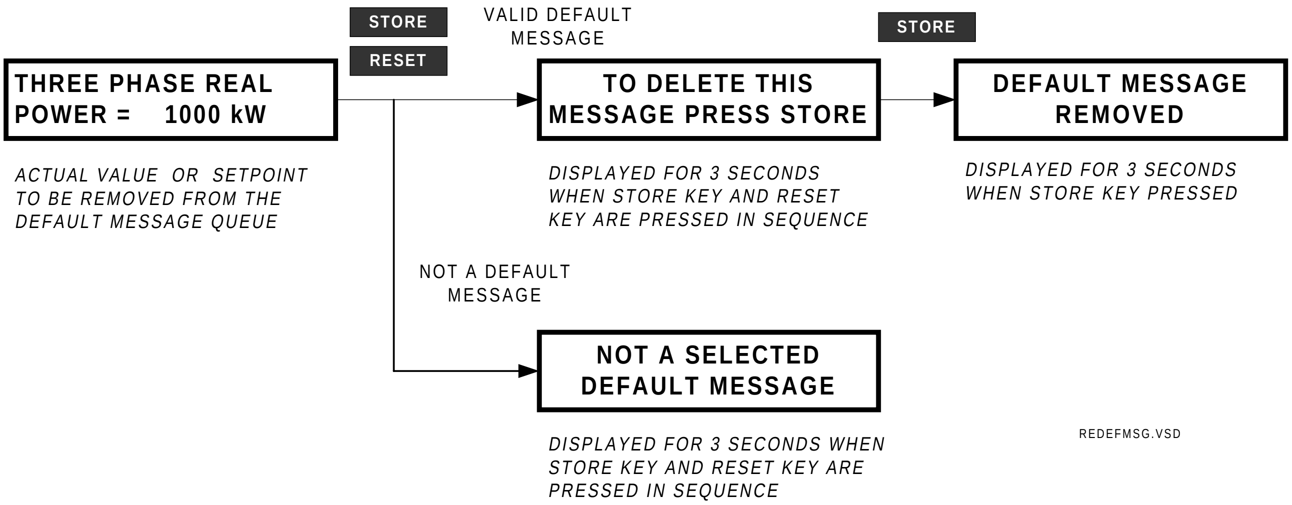
3.4.2 ADDING A DEFAULT MESSAGE

Use the MESSAGE ▲ and MESSAGE ▼ keys to display any setpoint or actual value message to be added to the default message queue and follow the steps shown below. When selecting a setpoint message for display as a default, **do not** modify the value using the VALUE ▲ and VALUE ▼ keys or the PQM will recognize the STORE key as storing a setpoint instead of selecting a default message

If 10 default messages are already selected, the first message is erased and the new message is added to the end of the queue.

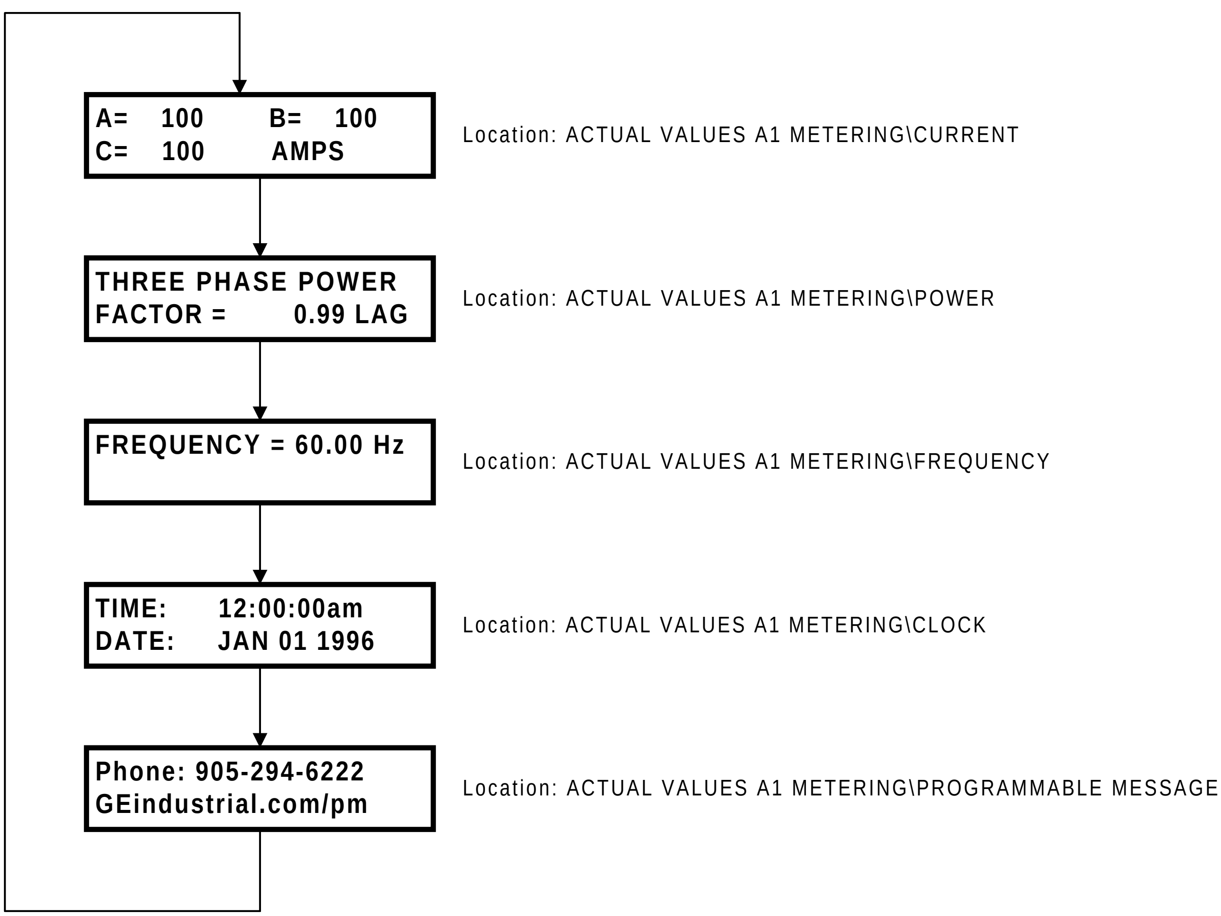
3.4.3 DELETING A DEFAULT MESSAGE

Use the MESSAGE ▲ / MESSAGE ▼ keys to display the default message to be erased. If default messages are not known, wait until the PQM starts to display them and then write them down. If no default messages have been programmed, the PQM will remain on the current message and the display dims to the level assigned in **S1 PQM SETUP \ PREFERENCES \ DEFAULT MESSAGE BRIGHTNESS** after the **DEFAULT MESSAGE TIME** delay expires. Use the MESSAGE ▲ / MESSAGE ▼ keys to display the setpoint or actual value message to be deleted from the default message queue and follow the steps below.



Each PQM is pre-programmed with five default messages as shown below. Note, each time the factory setpoints are reloaded the user programmed default messages are overwritten with these messages.

The PQM will scroll through the default messages in the sequence shown.



4.1.1 SETPOINT ENTRY METHODS

Prior to operating the PQM, it is necessary to enter setpoints defining system characteristics and alarm settings via one of the following methods:

1. Front panel, using the keys and display.
2. Rear terminal RS485 port COM1 or COM2, or front RS232 port and a computer running the PQMPC communication program available from GE Power Management or from a SCADA system running user-written software.

Any of the above methods can be used to enter the same information. However, a computer makes entry considerably easier. Moreover, a computer allows setpoint files to be stored and downloaded for fast, error-free entry. To facilitate this process, the PQMPC programming software is available from GE Power Management. With this software installed on a portable computer, all setpoints can be downloaded to the PQM. Refer to Chapter 6 for additional details.

Setpoint messages are organized into logical groups or pages for easy reference. Messages may vary somewhat from those illustrated because of installed options. Also, some messages associated with disabled features are hidden. This context sensitive operation eliminates confusing detail. Before accurate monitoring can begin, the setpoints on each page should be worked through, entering values either by local keypad or computer.

The PQM leaves the factory with setpoints programmed to default values. These values are shown in all the setpoint message illustrations. Many of these factory default values can be left unchanged. At a minimum however, setpoints that are shown shaded in Section 4.3.1: CURRENT/VOLTAGE CONFIGURATION on page 4–19 must be entered for the system to function correctly. In order to safeguard against the installation of a PQM whose setpoints have not been entered, the PQM will alarm and lock out until the values have been entered for these setpoints. The CRITICAL SETPOINTS NOT STORED alarm message is present until the PQM is programmed with these critical setpoints.

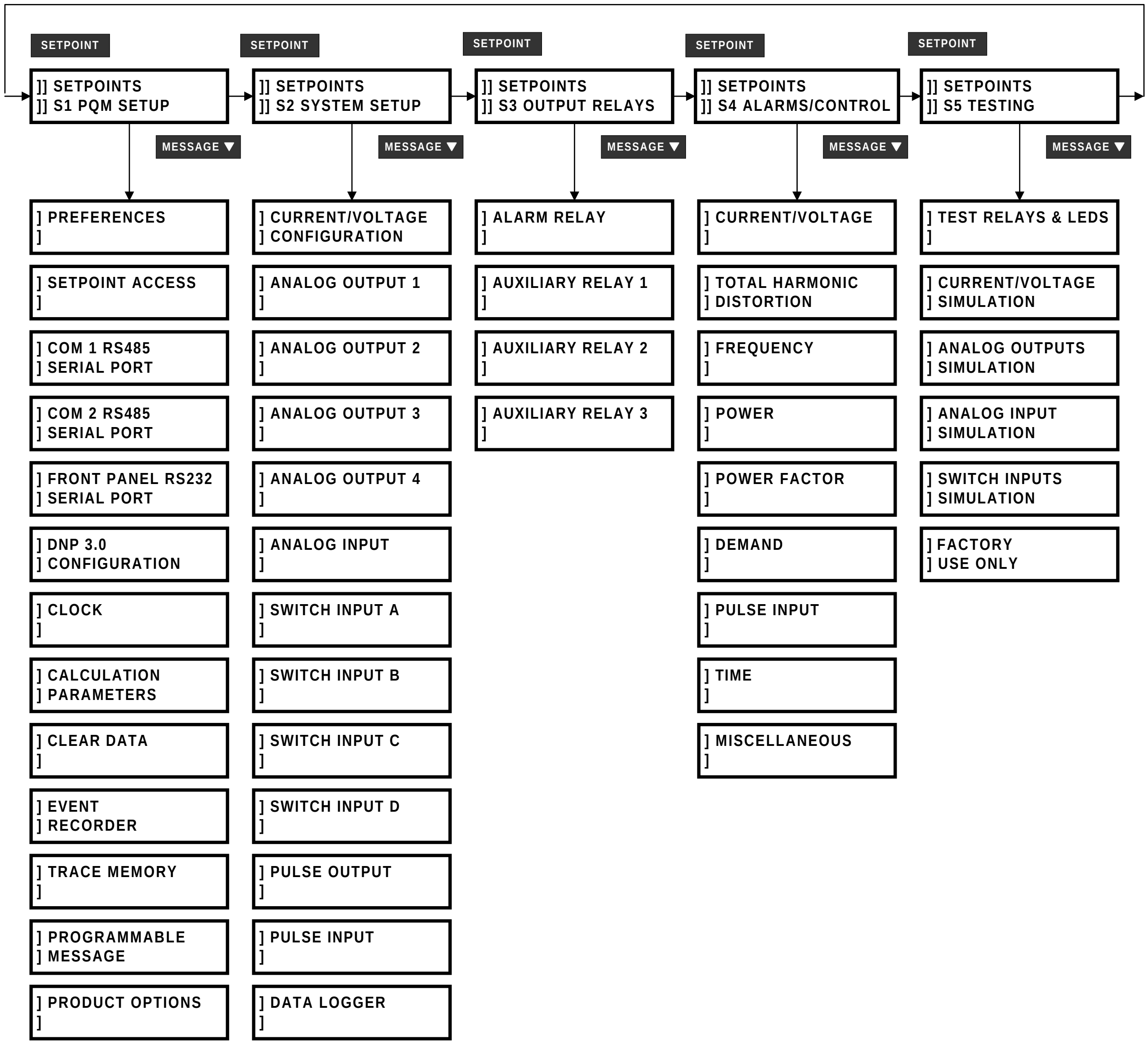


Figure 4–1: SETPOINT MESSAGE ORGANIZATION

4

4.2.1 DESCRIPTION

Settings to configure the PQM itself are entered on this page. This includes user preferences, the RS485 and RS232 communication ports, loading of factory defaults, and user programmable messages.

4.2.2 PREFERENCES

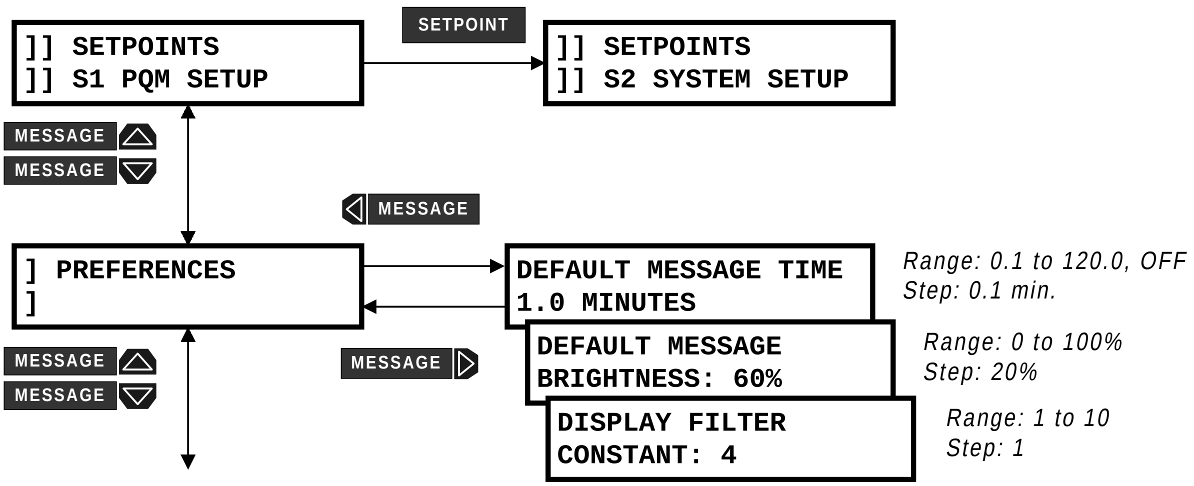


Figure 4–2: SETPOINTS PAGE 1 – PQM SETUP \ PREFERENCES

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- **DEFAULT MESSAGE TIME:** Up to 10 default messages can be selected to automatically scan sequentially when the PQM is left unattended. If no keys are pressed for the default message time set with this setpoint, then the currently displayed message is automatically overwritten by the first default message. After 3 seconds, the next default message in the sequence displays if more than one is selected. Alarm messages always override the default message display. Note that any setpoint or measured value can be selected as a default message.
- **DEFAULT MESSAGE BRIGHTNESS:** The brightness of the displayed messages can be varied with this setpoint. This brightness will be used when the default messages are being displayed. The brightness defaults back to 100% when:
  - an alarm is present
  - any one of the keys on the PQM keypad is pressed
  - the PQM is turned off and on
  - a text display message is sent through the serial port.

  When **DEFAULT MESSAGE TIME** is set to OFF, the brightness adjusts to the programmed level after 5 minutes have elapsed, since the PQM keys were last pressed assuming no alarm is present. If no default messages are programmed, the currently message remains displayed and the display brightness adjusts to the programmed level after the programmed time in the **DEFAULT MESSAGE TIME** setpoint has elapsed.
- **DISPLAY FILTER CONSTANT:** Display filtering may be required in applications where large fluctuations in currents and/or voltages are normally present. This setpoint allows the user to enter the PQM filter constant to average all metered values. If the **DISPLAY FILTER CONSTANT** setpoint is set to 1, the PQM updates the displayed metered values approximately every 400 ms. Therefore, the display updating equals **DISPLAY FILTER CONSTANT** $\times$ 400 ms.

4.2.3 SETPOINT ACCESS

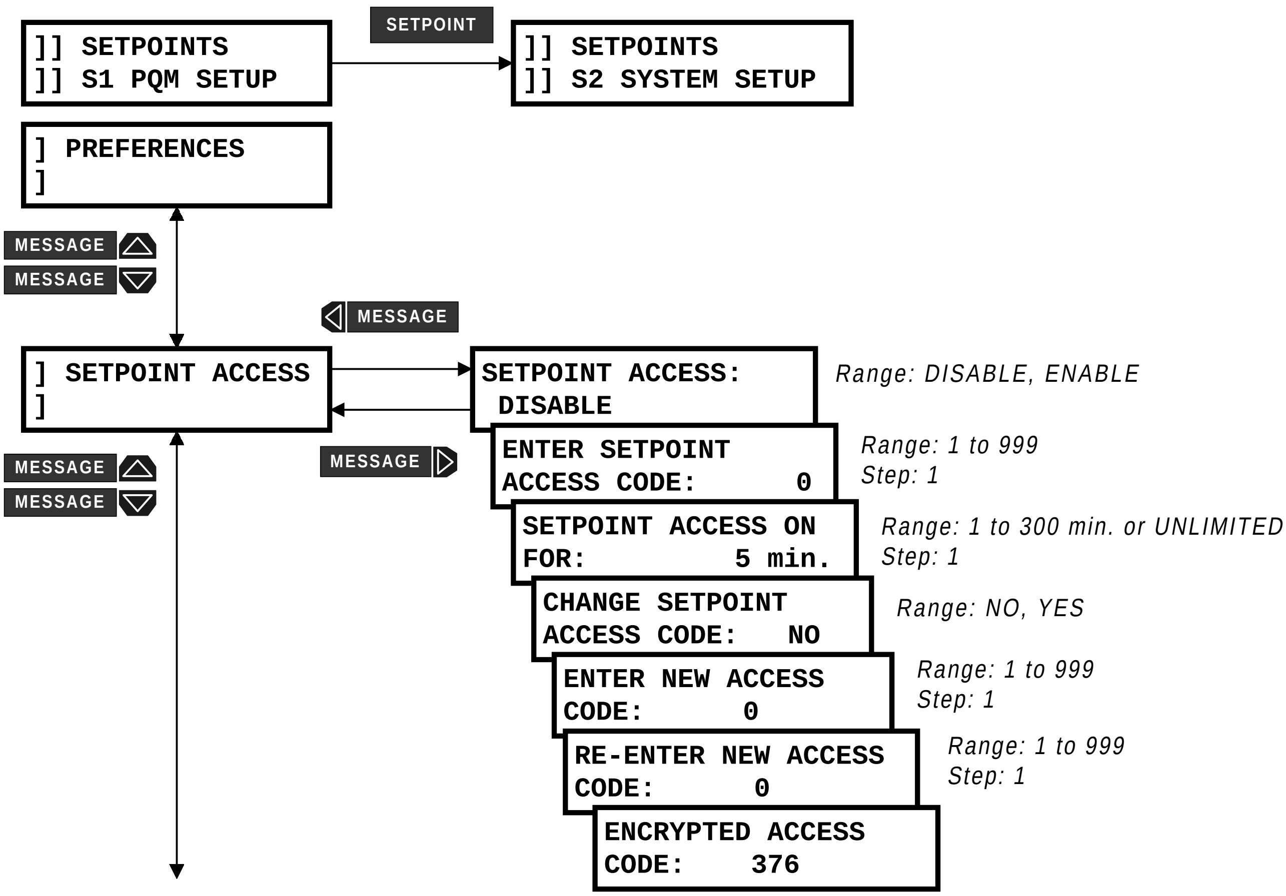
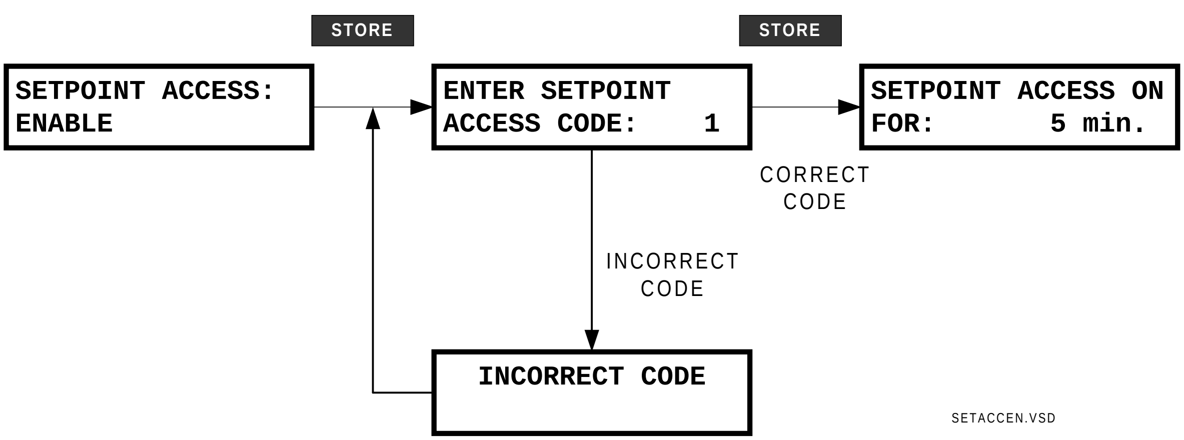


Figure 4–3: SETPOINTS PAGE 1 – PQM SETUP / SETPOINT ACCESS

To enable setpoint access, follow the steps outlined in the diagram below:



The factory default access code for the PQM is 1.

If three attempts are made to enable setpoint access with an incorrect code, the value of the **SETPOINT ACCESS** setpoint changes to DISABLED and the above procedure must be repeated.

Once setpoint access is enabled, the PROGRAM status indicator turns on. Setpoint alterations are allowed as long as the PROGRAM status indicator remains on. Setpoint access is be disabled and the PROGRAM status indicator turns off when:

- The time programmed in **S1 PQM SETUP \ SETPOINT ACCESS \ SETPOINT ACCESS ON FOR** is reached
- The control power to the PQM is removed
- The factory setpoints are reloaded

To permanently enable the setpoint access feature, enable setpoint access and then set **SETPOINT ACCESS ON FOR** to UNLIMITED. Setpoint access remains enabled even if the control power is removed from the PQM.

NOTE: Setpoints can be changed via the serial ports regardless of the state of the setpoint access feature or the state of an input switch assigned to setpoint access.

To change the setpoint access code, enable setpoint access and perform the steps as outlined below:

If an attempt is made to change a setpoint when setpoint access is disabled, the SETPOINT ACCESS: DISABLED message is displayed to allow setpoint access to be enabled. Once setpoint access has been enabled, the PQM display will return to the original setpoint message.

If the control option is installed and one of the switches is assigned to **SETPOINT ACCESS**, the setpoint access switch and the software setpoint access will act as a logic AND. That is, both conditions must be satisfied before setpoint access will be enabled. Assuming the setpoint access switch activation is set to closed, the following flash messages will appear depending upon the condition present when the store key is pressed.

Table 4–1: SETPOINT ACCESS CONDITIONS

CONDITION		DISPLAYED MESSAGE
ACCESS CODE	SWITCH INPUT	
INCORRECT	OPEN	SETPOINT ACCESS OFF ENTER ACCESS CODE
INCORRECT	CLOSED	SETPOINT ACCESS OFF ENTER ACCESS CODE
CORRECT	OPEN	CANNOT ALTER SETTING ACCESS SW. DISABLED
CORRECT	CLOSED	NEW SETPOINT STORED

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4.2.4 RS485/RS232 SERIAL PORTS

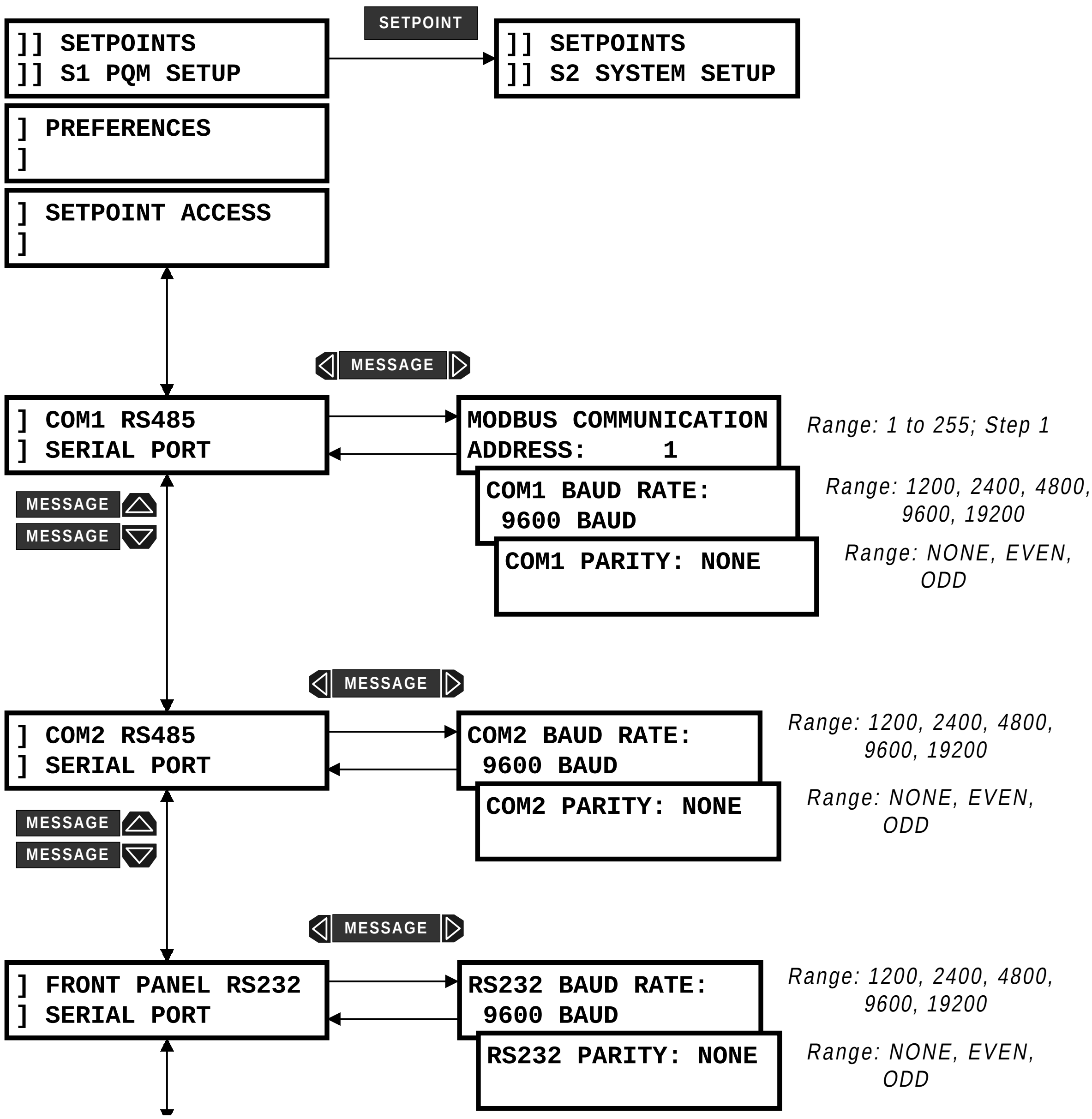


Figure 4–4: SETPOINTS PAGE 1 – PQM SETUP / COMMUNICATION PORTS

- **MODBUS COMMUNICATION ADDRESS:** Enter a unique address from 1 to 255 for the PQM. The selected address is used for all three serial communication ports. A message sent with address 0 is a broadcast message to which all PQMs will listen but not respond. Although addresses do not have to be sequential, no two PQMs can have the same address or there will be conflicts resulting in errors. Generally, each PQM added to the link will use the next higher address, starting from address 1.
- **BAUD RATE:** Enter the baud rate for each port: 1200, 2400, 4800, 9600, or 19200 baud. All PQMs and the computer on the RS485 communication link must run at the same baud rate. The fastest response is obtained at 19200 baud. Use slower baud rates if noise becomes a problem. The data frame consists of 1 start bit, 8 data bits, 1 stop bit and a programmable parity bit. The **BAUD RATE** default setting is 9600.
- **PARITY:** Enter the parity for each communication port: EVEN, ODD, or NONE. All PQMs on the RS485 communication link and the computer connecting them must have the same parity.

4.2.5 DNP 3.0 CONFIGURATION

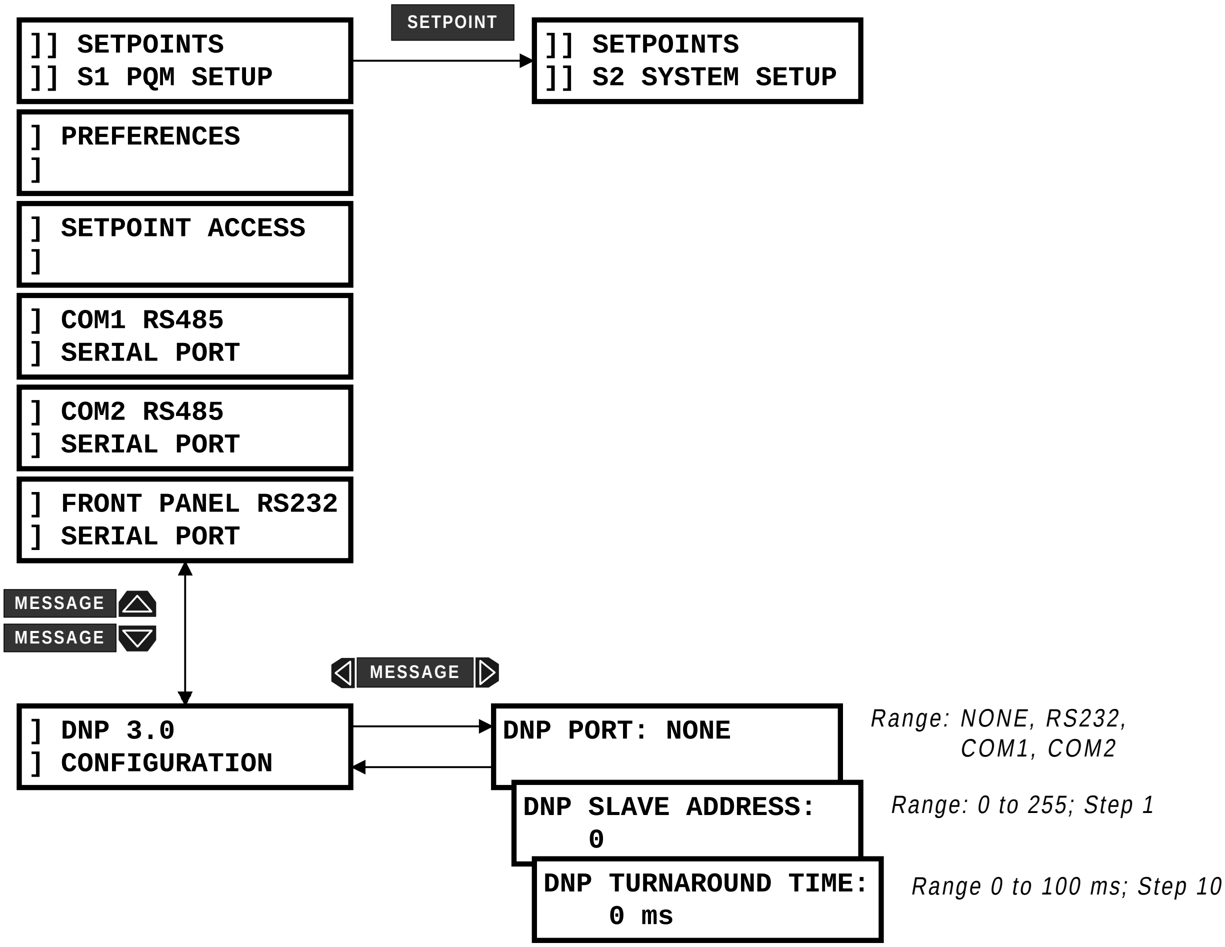


Figure 4–5: SETPOINTS PAGE 1 – PQM SETUP / DNP COMMUNICATIONS

- **DNP PORT:** Select the appropriate PQM port to be used for DNP protocol. The COM2 selection is only available if T1 or T20 option is installed in the PQM. Each port is configured as shown in Figure 4–4: SETPOINTS PAGE 1 – PQM SETUP / COMMUNICATION PORTS on page 4–6.
- **DNP SLAVE ADDRESS:** Enter a unique address from 0 to 255 for this particular PQM. The address selected is applied to the PQM port currently assigned to communicate using the DNP protocol. Although addresses do not have to be sequential, no two PQMs that are daisy chained together can have the same address or there will be conflicts resulting in errors. Generally each PQM added to the link will use the next higher address.
- **DNP TURNAROUND TIME:** Set the turnaround time to zero if the RS232 port is being used. The turnaround time is useful in applications where the RS485 converter without RTS or DTR switching is being employed. A typical value for the delay is 30 ms to allow the transmitter to drop in the RS485 convertor.

4.2.6 CLOCK

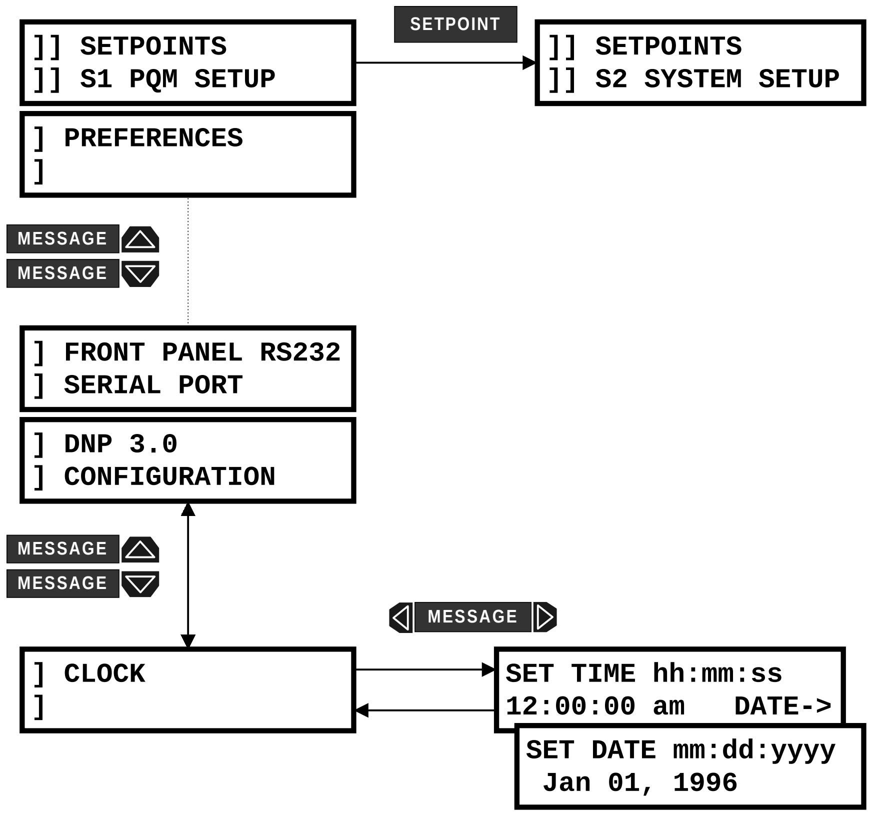
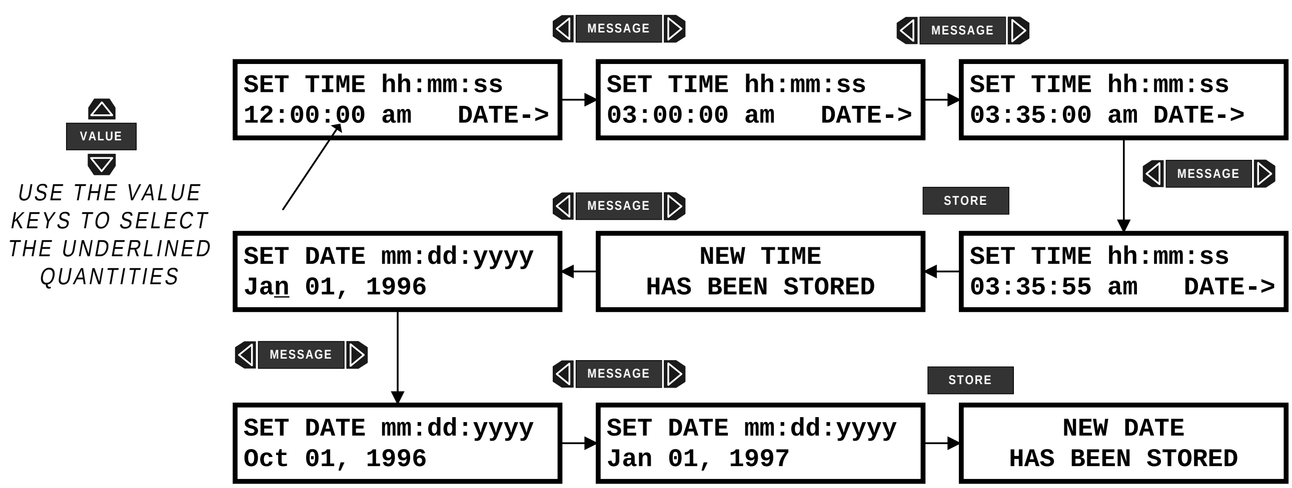


Figure 4–6: SETPOINTS PAGE 1 – PQM SETUP / CLOCK

- **SET TIME/DATE:** These messages are used to set the time and date for the PQM software clock.

The PQM software clock retains an accurate time for power interruptions lasting up to one hour. A CLOCK NOT SET alarm can be enabled so that an alarm will occur on the loss of clock data. The time and date are used for all time-stamped data. If the clock has not been set, a ? will appear on the right-hand side of the displayed time for all time-stamped data. Follow the steps shown below to set the new time and date.



4.2.7 CALCULATION PARAMETERS

The PQM can be programmed to calculate metering quantities and demand by various methods.

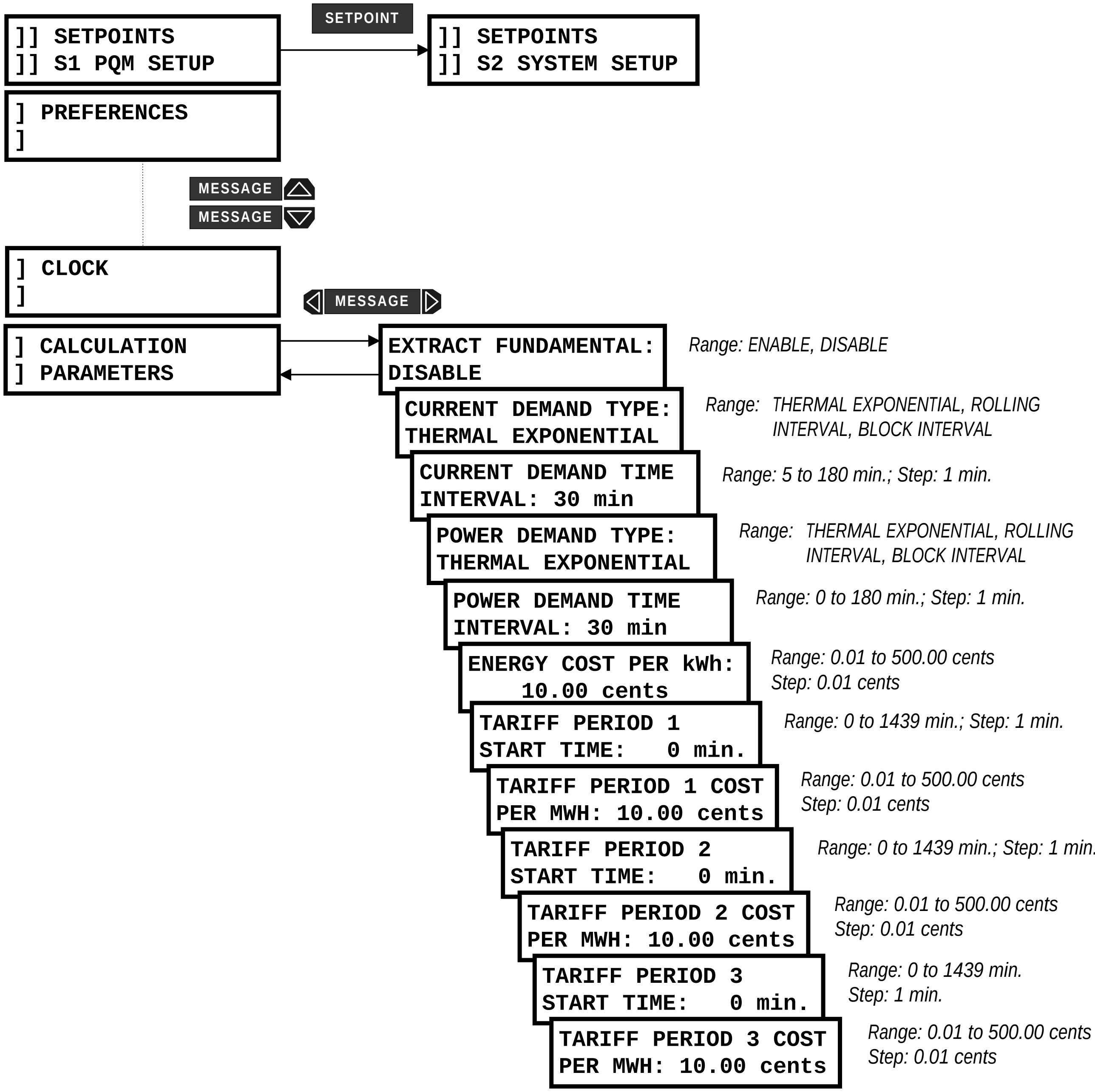
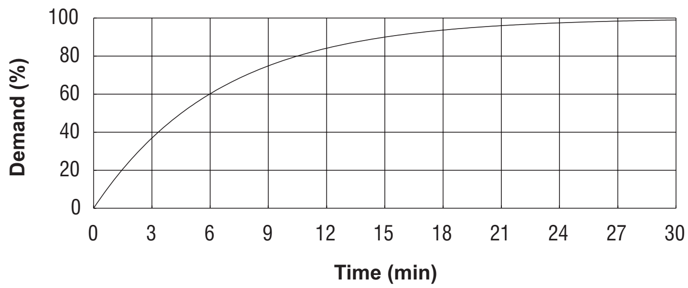


Figure 4–7: SETPOINTS PAGE 1 – PQM SETUP / CALCULATION PARAMETERS

- **EXTRACT FUNDAMENTAL**: The PQM can be programmed to calculate all metering quantities using true RMS values or the fundamental component of the sampled data. When this setpoint is set to DISABLE, the PQM will include all harmonic content, up to the 32nd harmonic, when making metering calculations. When this setpoint is set to ENABLE, the PQM will extract the fundamental contribution of the sampled data only and use this contribution to calculate all metering quantities. Many utilities base their metering upon fundamental, or displacement, values. Using the fundamental contribution allows one to compare the quantities measured by the PQM with the local utility meter.

- **DEMAND:** The PQM calculates demand using the three methods described in the table below.

METHOD	DESCRIPTION
Thermal Exponential	This selection emulates the action of an analog peak-recording thermal demand meter. The PQM measures the average quantity (RMS current, real power, reactive power, or apparent power) on each phase every minute and assumes the circuit quantity remains at this value until updated by the next measurement. It calculates the "thermal demand equivalent" based on the following equation: $d(t) = D(1 - e^{-kt})$ d = demand value after applying input quantity for time t (in min.) D = input quantity (constant) k = 2.3 / thermal 90% response time  The above graph shows the thermal response characteristic for a thermal 90% response time of 15 minutes. A setpoint establishes the time to reach 90% of a steady-state value, just as the response time of an analog instrument (a steady-state value applied for twice the response time will indicate 99% of the value).
Block Interval	This selection calculates a linear average of the quantity (RMS current, real power, reactive power, or apparent power) over the programmed demand TIME INTERVAL. Each new value of demand becomes available at the end of each time interval.
Rolling Demand	This selection calculates a linear average of the quantity (RMS current, real power, reactive power, or apparent power) over the programmed demand TIME INTERVAL (in the same way as Block Interval). The value is updated every minute and indicates the demand over the time interval just preceding the time of update.

- **CURRENT DEMAND TYPE:** Three current demand calculation methods are available: thermal exponential, block interval, and rolling demand (see the table above). The current demand for each phase and neutral is calculated individually.
- **CURRENT DEMAND TIME INTERVAL:** Enter the time period over which the current demand calculation is to be performed.
- **POWER DEMAND TYPE:** Three phase real/reactive/apparent power demand calculation methods are available: thermal exponential, block interval, and rolling demand (see the table above). The three phase real/reactive/apparent power demand is calculated.
- **POWER DEMAND TIME INTERVAL:** Enter the time period over which the power demand calculation is to be performed.
- **ENERGY COST PER kWh:** Enter the cost per kWh that is charged by the local utility.
- **TARIFF PERIOD START TIME:** Enter the start time for each of the three tariff period calculations.
- **TARIFF PERIOD COST PER MWH:** Enter the cost per MWh for each of the three tariff periods.

4.2.8 CLEAR DATA

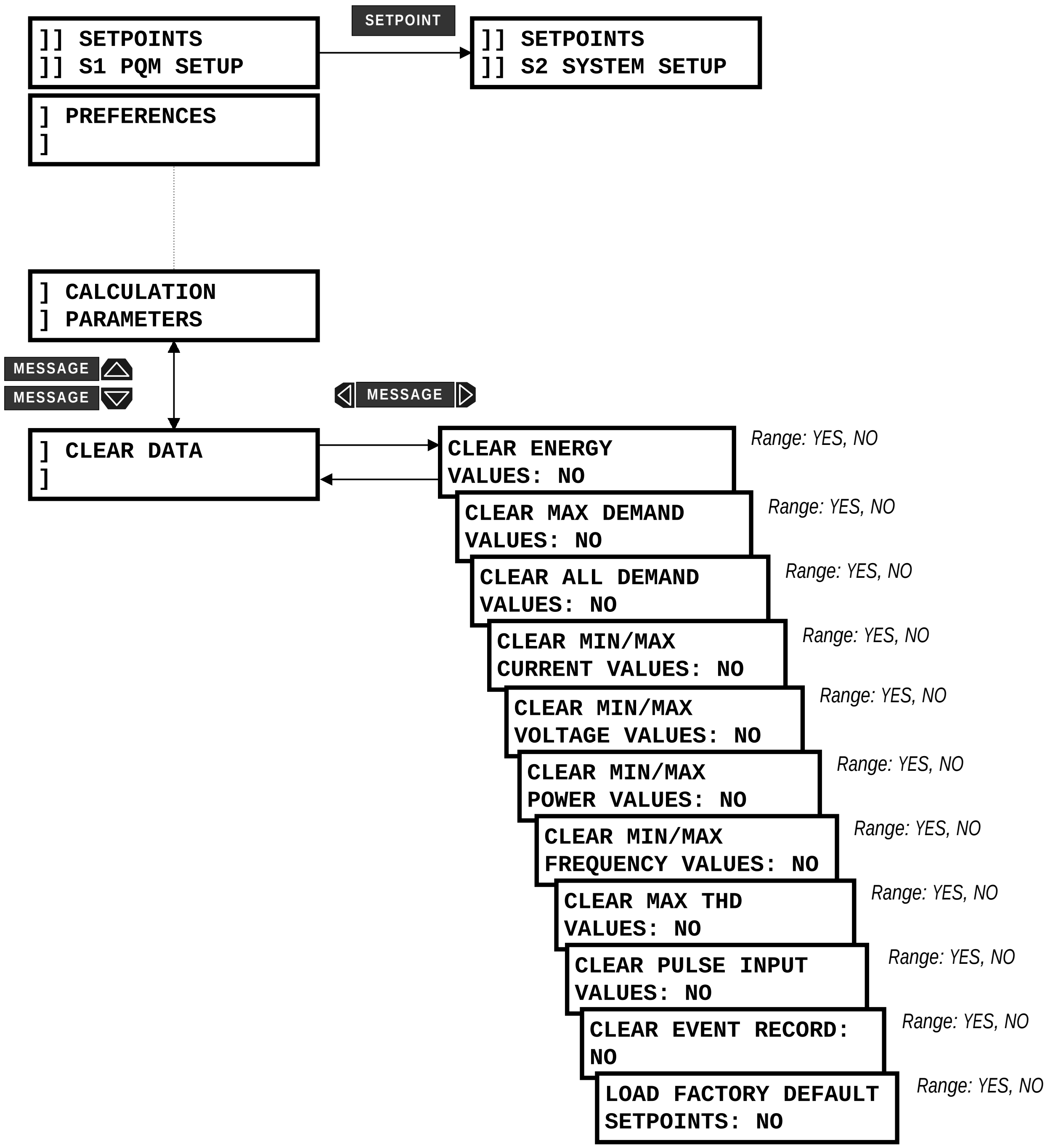


Figure 4–8: SETPOINTS PAGE 1 – PQM SETUP / CLEAR DATA

- **CLEAR ENERGY VALUES:** Enter YES to clear all the energy used data under the actual values subgroup **A1 METERING \ ENERGY**. The **TIME OF LAST RESET** date under the same subgroup is updated to the current date upon issuing this command.
- **CLEAR MAX DEMAND VALUES:** Enter YES to clear all the max power and current demand data under the actual values subgroup **A1 METERING \ DEMAND**. The time and date associated with each message will be updated to the current date upon issuing this command.

- **CLEAR ALL DEMAND VALUES:** Enter YES to clear all the power and current demand data under the actual values subgroup **A1 METERING \ DEMAND**. The time and date associated with each message will be updated to the current date upon issuing this command.
- **CLEAR MIN/MAX CURRENT VALUES:** Enter YES to clear all the min./max current data under the actual values subgroup **A1 METERING \ CURRENT**. The time and date associated with each message will be updated to the current date upon issuing this command.
- **CLEAR MIN/MAX VOLTAGE VALUES:** Enter YES to clear all the min./max voltage data under the actual values subgroup **A1 METERING \ VOLTAGE**. The time and date associated with each message will be updated to the current date upon issuing this command.
- **CLEAR MIN/MAX POWER VALUES:** Enter YES to clear all the min./max power data under the actual values subgroup **A1 METERING \ POWER**. The time and date associated with each message will be updated to the current date upon issuing this command.
- **CLEAR MIN/MAX FREQUENCY VALUES:** Enter YES to clear all the min./max frequency data under the actual values subgroup **A1 METERING \ FREQUENCY**. The time and date associated with each message will be updated to the current date upon issuing this command.

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- **CLEAR MAX THD VALUES:** Enter YES to clear all the max THD data under the actual values subgroup **A3 POWER ANALYSIS \ TOTAL HARMONIC DISTORTION**. The time and date associated with each message will be updated to the current date upon issuing this command.
- **CLEAR PULSE INPUT VALUES:** Enter YES to clear all the pulse input values under the actual values subgroup **A1 METERING \ PULSE INPUT**. The time and date associated with this message will be updated to the current date upon issuing this command.
- **CLEAR EVENT RECORD:** Enter YES to clear all of the events in the Event Record. This will eliminate all previous events from the Event Record and create a CLEAR EVENTS event as the new event number 1. The Event Recorder can be cleared only if it is enabled in **S1 PQM SETUP \ EVENT RECORDER \ EVENT RECORDER OPERATION**.
- **LOAD FACTORY DEFAULT SETPOINTS:** When the PQM is shipped from the factory all setpoints will be set to factory default values. These settings are shown in the setpoint message reference figures. To return a PQM to these known setpoints select YES and press the STORE key while this message is displayed. The display will then warn that all setpoints will be lost and will ask whether to continue. Select yes again to reload the setpoints. It is a good idea to first load factory defaults when replacing a PQM to ensure all the settings are defaulted to reasonable values.

4.2.9 EVENT RECORDER

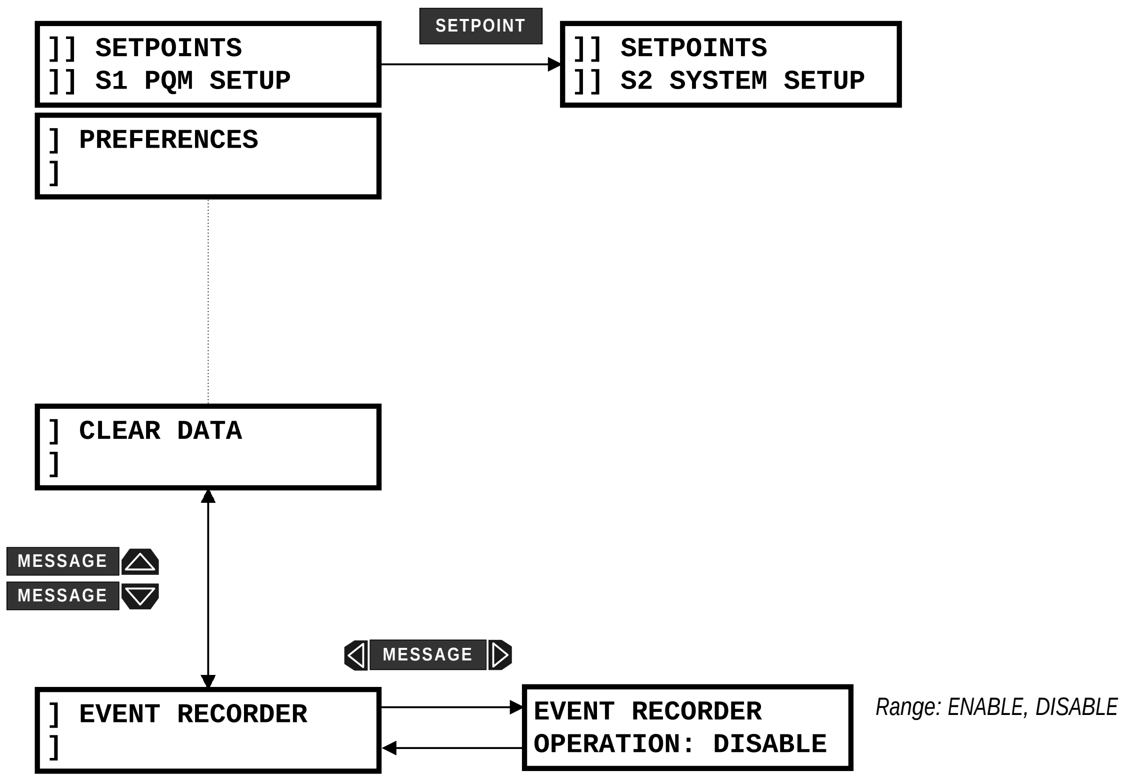

Figure 4–9: SETPOINTS PAGE 1 – PQM SETUP / EVENT RECORDER

- **EVENT RECORDER OPERATION**: The Event Recorder can be disabled or enabled using this setpoint. When the Event Recorder is disabled no new events are recorded. When the Event Recorder is enabled new events are recorded with the 40 most recent events displayed in **A3 POWER ANALYSIS \ EVENT RECORDER**. Refer to Section 5.4.4: EVENT RECORDER on page 5–27 for the list of possible events. All data within the Event Recorder is stored in non-volatile memory.

4.2.10 TRACE MEMORY

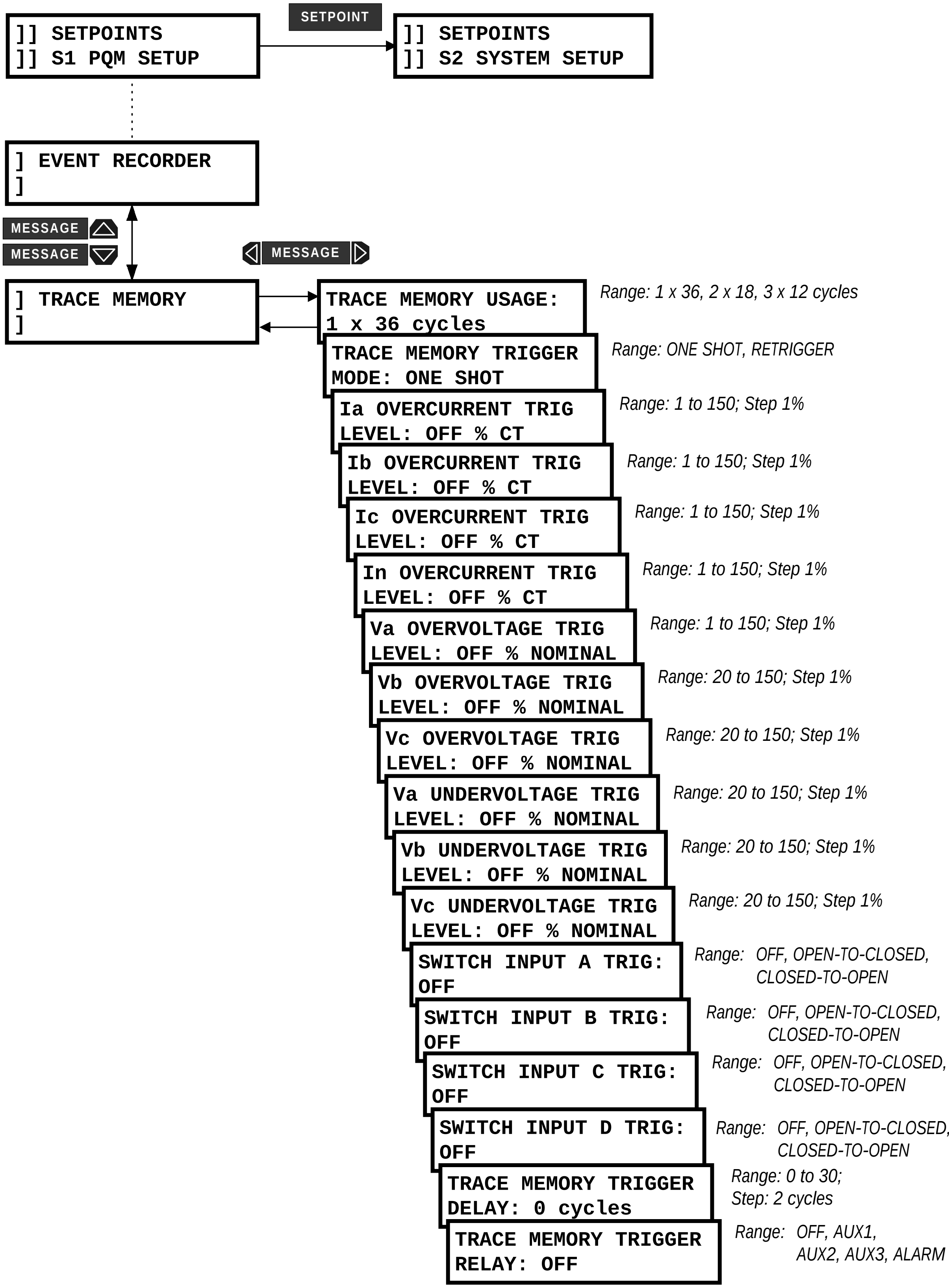

Figure 4–10: SETPOINTS PAGE 1 – PQM SETUP / TRACE MEMORY

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This feature involves a separate sampling data stream. All input channels are sampled continuously at a rate of 16 times per cycle. Using a single-cycle block interval, the input samples are checked for trigger conditions as per the trigger setpoints below. Note that the normal sampling burst (64 samples/cycle, 2 cycles) used for all metering calculations is done on top of the trace memory sampling. The harmonic analysis sampling (256 samples/cycles, 1 cycle) causes the trace memory sampling to stop for one cycle whenever a harmonic analysis is requested. Refer to Chapter 6 for details on trace memory implementation in PQMPC.

- **TRACE MEMORY USAGE:** The trace memory feature allows the user to capture maximum of 36 cycles. The **TRACE MEMORY USAGE** setpoint allows the buffer to be divided into maximum of 3 separate buffers as shown in table below.

SETPOINT VALUE	RESULT
1 x 36 cycles	Upon a trigger, the entire buffer is filled with 36 cycles of data.
2 x 18 cycles	The buffer is split into 2 separate buffers and upon a trigger, the first buffer is filled with 18 cycles of data and upon a second trigger, the second buffer is filled with 18 cycles of data.
3 x 12 cycles	The buffer is split into 3 separate buffers and upon a trigger, the first buffer is filled with 12 cycles of data, upon a second trigger, the second buffer is filled with 12 cycles of data and upon a third trigger, the third buffer is filled with 12 cycles of data.

- **TRACE MEMORY TRIGGER MODE:** The trace memory can be configured to trigger in two different modes as described in the table below.

SETPOINT VALUE	RESULT
ONE SHOT	The trace memory will be triggered once per buffer as defined in the **TRACE MEMORY USAGE** setpoint above. In order for it to re-trigger, it must be re-armed through the serial port using PQMPC or other software. Once re-armed the trace memory will default back to the first buffer.
RETRIGGER	The trace memory will automatically re-trigger upon each condition and overwrite the previous buffer data.

- **Ia OVERCURRENT TRIG LEVEL:** Once the phase A current equals or increases above this setpoint value, the trace memory is triggered and data on all inputs are captured in the buffer. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint.
- **Ib OVERCURRENT TRIG LEVEL:** Once the phase B current equals or increases above this setpoint value, the trace memory is triggered and data on all inputs are captured in the buffer. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint.
- **Ic OVERCURRENT TRIG LEVEL:** Once the phase C current equals or increases above this setpoint value, the trace memory is triggered and data on all inputs are captured in the buffer. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint.
- **In OVERCURRENT TRIG LEVEL:** Once the neutral current equals or increases above this setpoint value, the trace memory is triggered and data on all inputs are captured in the buffer. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint.
- **Va OVERVOLTAGE TRIG LEVEL:** Once the phase A voltage equals or increases above this setpoint value, the trace memory is triggered and data on all inputs are captured in the buffer. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint. Phase to neutral levels are used regardless of the VT wiring.

- **Vb OVERVOLTAGE TRIG LEVEL:** Once the phase B voltage equals or increases above this setpoint value, the trace memory is triggered and data on all inputs are captured in the buffer. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint. Phase to neutral levels are used regardless of the VT wiring.
- **Vc OVERVOLTAGE TRIG LEVEL:** Once the phase C voltage equals or increases above this setpoint value, the trace memory is triggered and data on all inputs are captured in the buffer. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint. Phase to neutral levels are used regardless of the VT wiring.
- **Va UNDERVOLTAGE TRIG LEVEL:** Once the phase A voltage is equal to or less than this setpoint value, the trace memory is triggered and data on all inputs are captured in the buffer. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint.
- **Vb UNDERVOLTAGE TRIG LEVEL:** Once the phase B voltage is equal to or less than this setpoint value, the trace memory is triggered and data on all inputs are captured in the buffer. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint.
- **Vc UNDERVOLTAGE TRIG LEVEL:** Once the phase C voltage is equal to or less than this setpoint value, the trace memory is triggered and data on all inputs are captured in the buffer. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint.
- **SWITCH INPUT A TRIG:** If the setpoint is set to OPEN-TO-CLOSED, the trace memory is triggered and data on all inputs are captured in the buffer on a switch A close transition. If the setpoint is set to CLOSED-TO-OPEN, the trace memory is triggered and data on all inputs are captured in the buffer on a switch A open transition. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint.
- **SWITCH INPUT B TRIG:** If the setpoint is set to OPEN-TO-CLOSED, the trace memory will be triggered and data on all inputs are captured in the buffer on a switch B close transition. If the setpoint is set to CLOSED-TO-OPEN, the trace memory is triggered and data on all inputs are captured in the buffer on a switch B open transition. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint.
- **SWITCH INPUT C TRIG:** If the setpoint is set to OPEN-TO-CLOSED, the trace memory is triggered and data on all inputs are captured in the buffer on a switch C close transition. If the setpoint is set to CLOSED-TO-OPEN, the trace memory is triggered and data on all inputs are captured in the buffer on a switch C open transition. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint.
- **SWITCH INPUT D TRIG:** If the setpoint is set to OPEN-TO-CLOSED, the trace memory is triggered and data on all inputs will be captured in the buffer on a switch D close transition. If the setpoint is set to CLOSED-TO-OPEN, the trace memory is triggered and data on all inputs are captured in the buffer on a switch D open transition. The number of cycles captured depends on the value specified in the **TRACE MEMORY USAGE** setpoint.
- **TRACE MEMORY TRIGGER DELAY:** In some applications it may be necessary to delay the trigger point to observe the data before the fault occurred. The PQM allows the trigger to be delayed by the amount of cycles set in this setpoint. Therefore, buffer will always contain the number cycles specified in this setpoint before the trigger point and the remaining space in the buffer is filled with the cycles after the trigger point.
- **TRACE MEMORY TRIGGER RELAY**: The relay selected here will be activated upon the occurrence of a Trace Memory Trigger. This relay will be cleared once the Trace Memory is re-armed.

See the application note in Section A.1.4: TRIGGERED TRACE MEMORY RESOLUTION for additional details.

4.2.11 PROGRAMMABLE MESSAGE

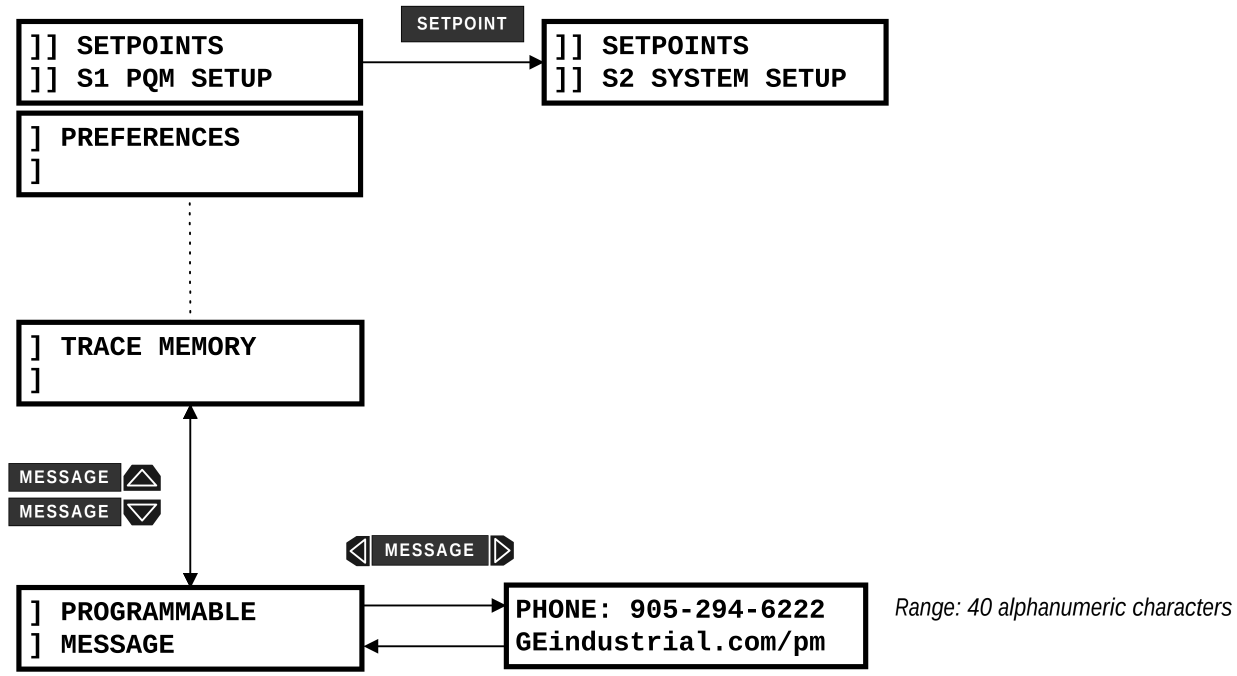
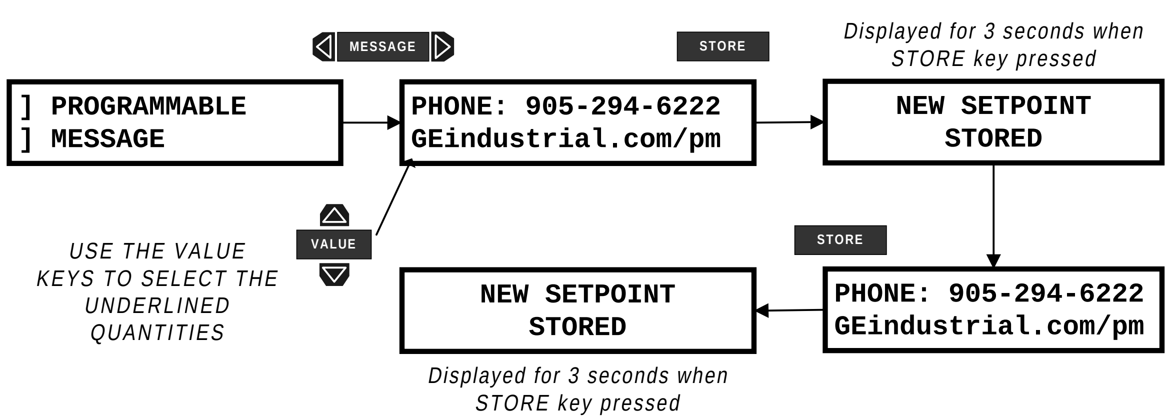


Figure 4–11: SETPOINTS PAGE 1 – PQM SETUP / PROGRAMMABLE MESSAGE

PROGRAMMABLE MESSAGE: A 40-character message can be programmed using the keypad, or via a serial port using PQMPC. An example of writing a new message over the existing one is shown below:



TIPS:

- The setpoint access must be enabled in order to alter the characters.
- To skip over a character press the STORE key.
- If a character is entered incorrectly, press the STORE key repeatedly until the cursor returns to the position of the error, and re-enter the character.
- To select this message as a default message, see Section 3.4: DEFAULT MESSAGES on page 3–8.

A copy of this message is displayed in actual values page A1 under **PROGRAMMABLE MESSAGE**.

4.2.12 PRODUCT OPTIONS

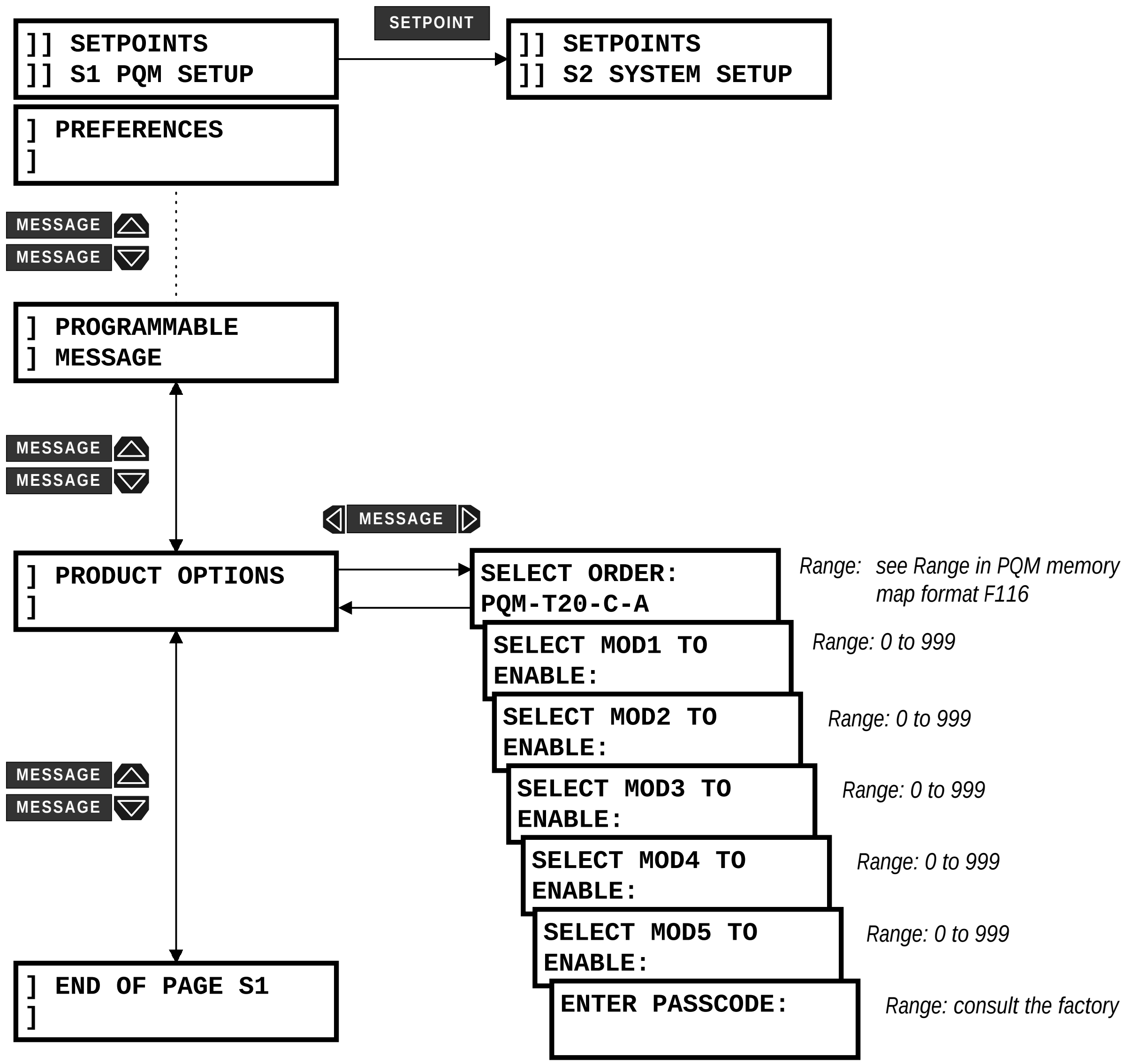


Figure 4–12: SETPOINTS PAGE 1 – PQM SETUP / PRODUCT OPTIONS

PRODUCT OPTIONS: The PQM can have options and certain modifications upgraded on-site via use of a passcode provided by GE Power Management. Consult the factory for details on the use of this feature.

4.3.1 CURRENT/VOLTAGE CONFIGURATION

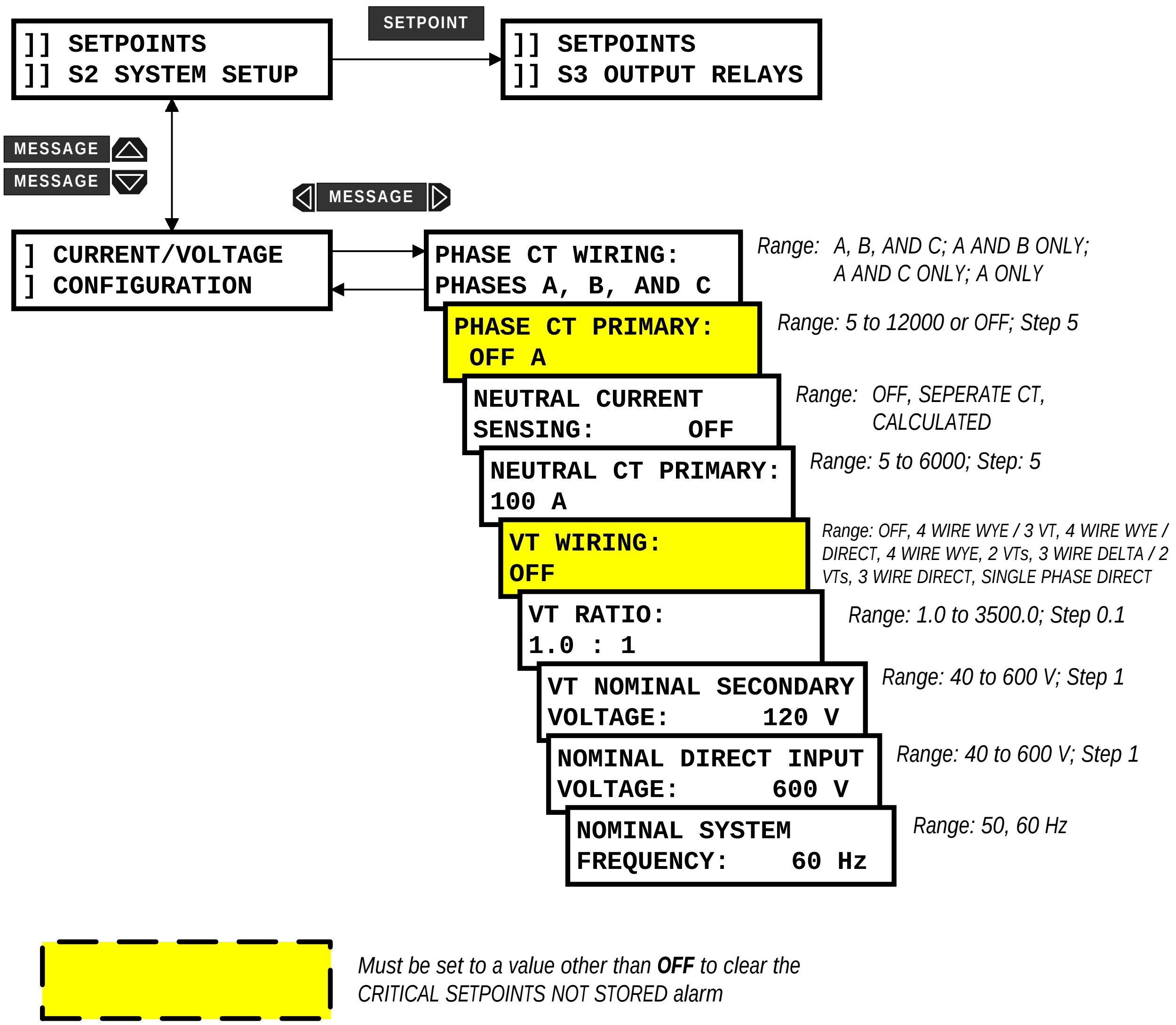


Figure 4–13: SETPOINTS PAGE 2 – SYSTEM SETUP / CURRENT/VOLTAGE CONFIGURATION

- **PHASE CT WIRING:** The table below indicates the required connection per setpoint setting.

SETPOINT VALUE	REQUIRED CT CONNECTION
A,B, AND C	CTs are connected to phase A, B and C inputs.
A AND B ONLY	CTs are connected to phase A and B only. Phase C input is left open. The value for phase C is calculated by the PQM.
A AND C ONLY	CTs are connected to phase A and C only. Phase B input is left open. The value for phase B is calculated by the PQM.
A ONLY	CT is connected to phase A only. Phase B and C inputs are left open. The values for phase B and C are calculated by the PQM.

NOTE

If A AND B ONLY, A AND C ONLY, or A ONLY connection is selected, the neutral sensing must be accomplished with a separate CT.

- **PHASE CT PRIMARY:** Enter the primary current rating of the phase current transformers. All three phase CTs must have the same rating. For example, if 500:5 CTs are used, the **PHASE CT PRIMARY** value is entered as 500. The **PHASE CT PRIMARY** factory default is OFF. While set to OFF, the PQM is forced to an alarm state as a safety precaution until a valid CT value is entered. Ensure that the CT is connected to the correct 1 A or 5 A terminals to match the CT secondary.

- **NEUTRAL CURRENT SENSING:** Neutral current sensing can be accomplished by using a separate external CT connection or by calculations. Select SEPARATE CT when using an external CT. If CALCULATED is selected, the PQM calculates the neutral current using the vector sum of $I_a + I_b + I_c = I_n$. If a residual connection is required using the PQM internal CT, the neutral CT primary must be the same as the phase CT primary to ensure correct readings.

- **NEUTRAL CT PRIMARY:** This message is visible only if the **NEUTRAL CURRENT SENSING** setpoint is set to SEPARATE CT. Enter the CT primary current. For example, if a 50:5 CT is installed for neutral sensing enter 50. One amp CTs can also be used for neutral sensing.

- **VT WIRING:** Enter the VT connection of the system in this setpoint. The three possible selections are Wye, Delta and Single Phase.

If the system to be measured is a Wye connection, the selections are 4 WIRE WYE DIRECT, 4 WIRE WYE (3 VTs), and 4 WIRE WYE (2 VTs). The 4 WIRE WYE DIRECT value is used for systems that are 600 V or less and directly connected to the PQM. The **VT NOMINAL SECONDARY VOLTAGE** setpoint is replaced by **NOMINAL DIRECT INPUT VOLTAGE**. With external VTs (depending upon how many external VTs are used) 4 WIRE WYE (3 VTs) or 4 WIRE WYE (2 VTs) must be selected. Note that when using the 4 WIRE WYE (2 VTs) value, only two voltages are measured; the third voltage is calculated on the assumption that $V_{an} + V_{bn} + V_{cn} = 0$. This assumption is valid only for balanced system voltages.

If the system to be measured is a Delta connection, the values are 3 WIRE DIRECT and 3 WIRE DELTA (2 VTs). The 3 WIRE DIRECT value should be used for systems that are 600 V or less and directly connected to the PQM. With external VTs, 3 WIRE DELTA (2 VTs) must be selected.

The PQM accepts input voltages from 0 to 600 V AC between any two of the voltage terminals (V_1, V_2, V_3, and V_n). These inputs can be directly connected or supplied via external VTs. External VTs are required for input voltages greater than 600 V AC (line-to-line). When measuring line-to-line quantities using inputs V_1, V_2 and V_3, ensure that the voltage common input V_n is grounded. This input is used as a reference for measuring the voltage inputs.

NOTE

All connections to the PQM voltage inputs should be connected using HRC fuses rated at 2 amps to ensure adequate interrupting capacity.

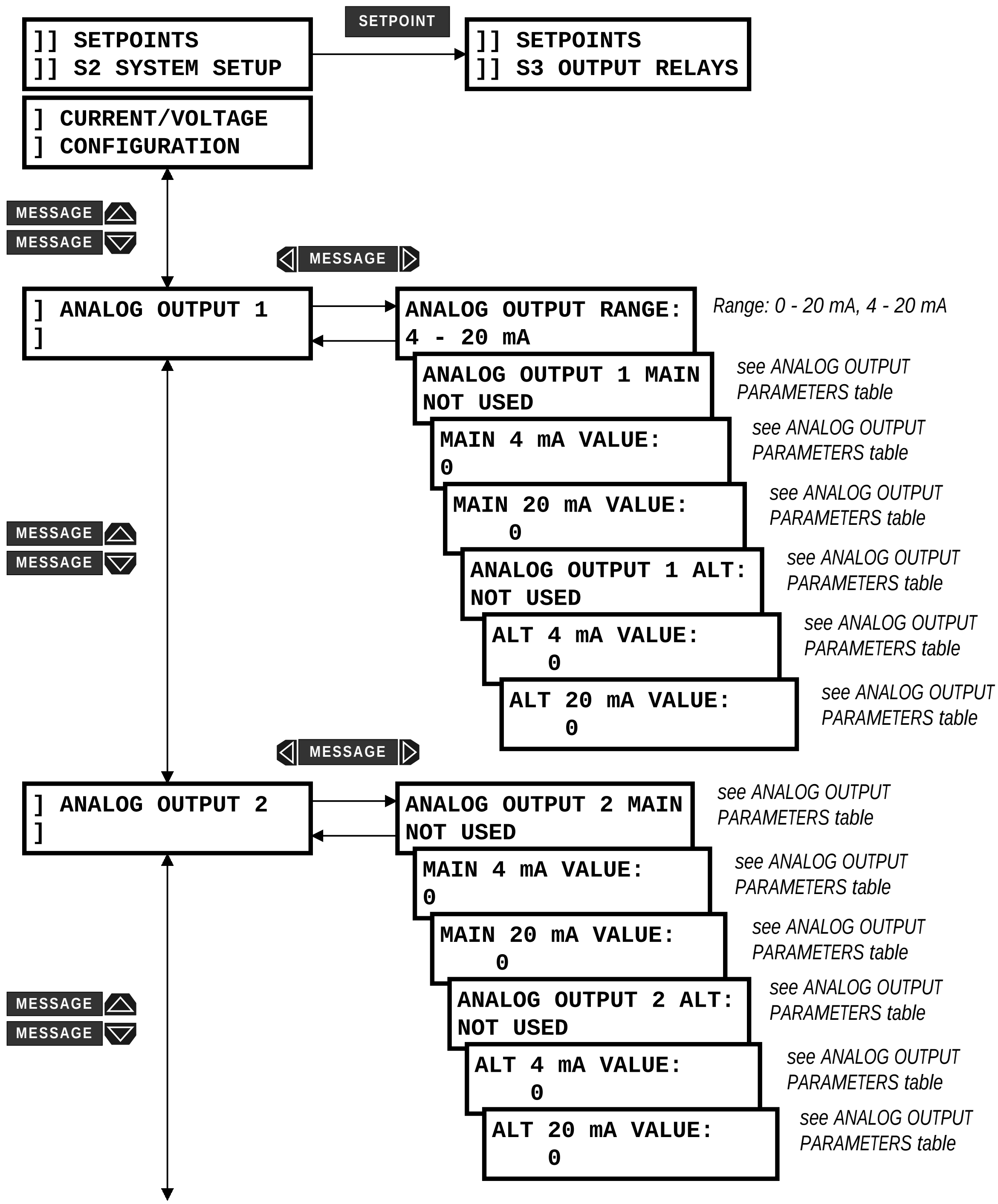
- **VT RATIO:** Enter the voltage transformer ratio. All three voltage inputs must be of the same rating. For example, if 4200:120 VTs are used, the **VT RATIO** should be 4200 / 120 = 35.0:1. This setpoint is not visible if **VT WIRING** is set to 3 WIRE DIRECT, 4 WIRE DIRECT, or SINGLE PHASE DIRECT.

- **VT NOMINAL SECONDARY:** Enter the nominal secondary of the VTs. If the voltage inputs are directly connected, enter the nominal system voltage that will be applied to the PQM. This setpoint is not visible if the **VT WIRING** is set to 3 WIRE DIRECT, 4 WIRE DIRECT, or SINGLE PHASE DIRECT. This value is used to scale an analog output that is assigned to display voltage as a percentage of nominal.

- **NOMINAL DIRECT INPUT VOLTAGE:** This setpoint is displayed only if **VT WIRING** is selected as a direct connection. The nominal direct input voltage must be entered in this message. This value will be used to scale an analog output that is assigned to display voltage as a percentage of nominal.

- **NOMINAL SYSTEM FREQUENCY:** Enter the nominal system frequency. The PQM measures frequency from the V_{an} voltage and adjusts its internal sampling to best fit the measured frequency. If the V_{an} input is unavailable, the PQM will assume the frequency entered here.

4.3.2 ANALOG OUTPUTS



CONTINUED ON NEXT PAGE

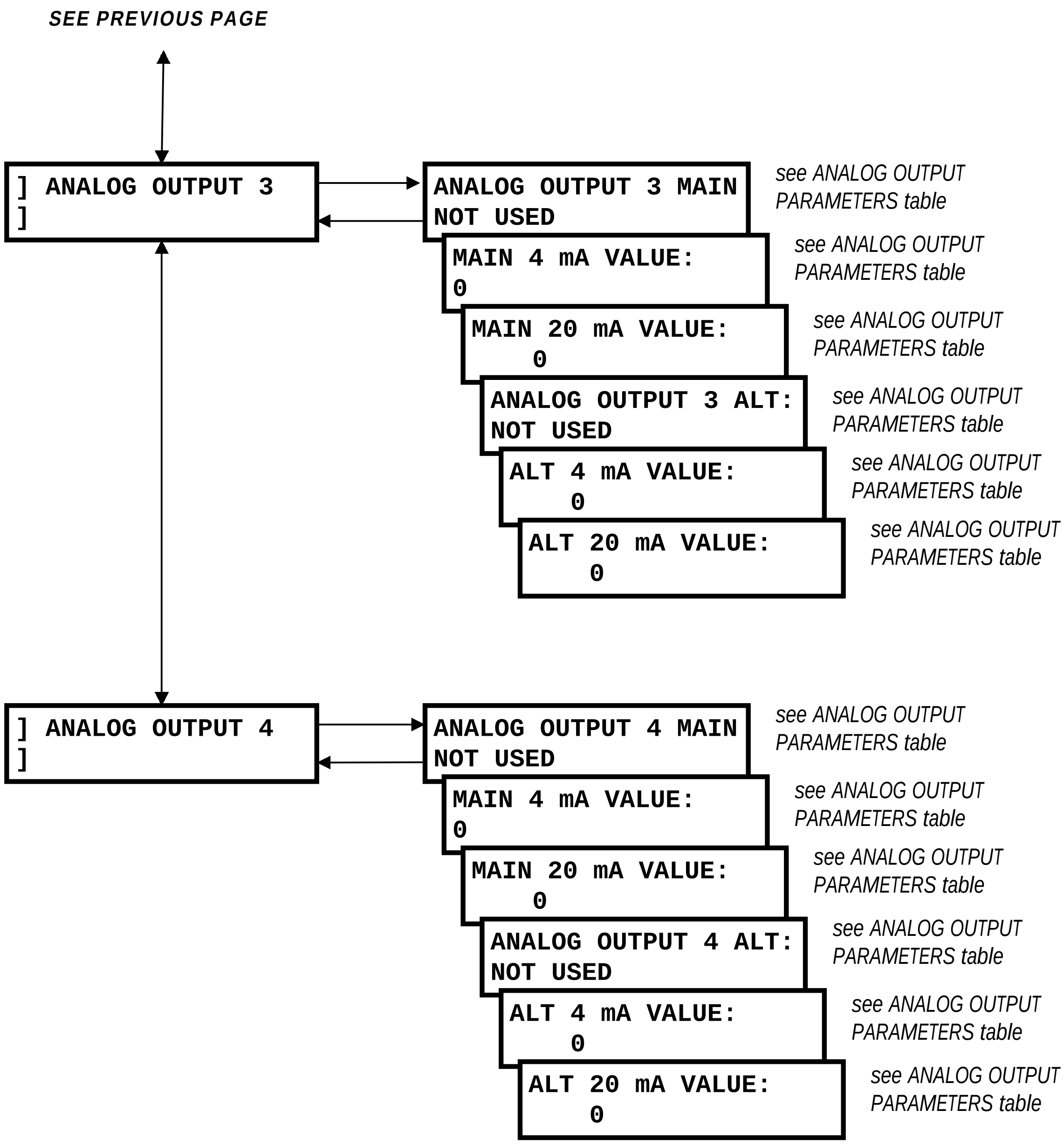


Figure 4–14: SETPOINTS PAGE 2 – SYSTEM SETUP / ANALOG OUTPUTS

- **ANALOG OUTPUT RANGE:** If the T20 option is installed, the Analog Outputs can be configured to operate as 4 to 20 mA current sources or 0 to 20 mA current sources. All four Analog Outputs will operate with the same range as selected in this setpoint.
- **ANALOG OUTPUT MAIN / ANALOG OUTPUT ALT:** If the PQM is used in conjunction with programmable controllers, automated equipment, or a chart recorder, the analog outputs can be used for continuous monitoring. Although parameters can be selected for continuous analog output, all values are available digitally through the communications interface. Applications include using a computer to automatically shed loads as the frequency decreases by monitoring frequency or a chart recorder to plot the loading of a system in a particular process.

Each of the analog outputs can be assigned to two of the parameters listed in Table 4–3: ANALOG OUTPUT PARAMETERS. The analog output main selection is the default selection and a programmable switch input can be programmed to multiplex the **ANALOG OUTPUT ALT** selection to the same output depending upon the open or closed state of the switch input. See Section 4.3.4: SWITCH INPUTS on page 4–27 for details about configuring a switch input. If no switch input is assigned as an analog output multiplexer, the analog output main selection will be the only parameter which appears at the analog output terminals. The ability to multiplex two different analog output quantities on one analog output effectively gives the PQM eight analog outputs. The table below shows the criteria used by the PQM to decide whether the output is based on MAIN or ALT settings.

Table 4–2: ANALOG OUTPUT SELECTION CRITERIA

CONDITION PRESENT	'MAIN' PARAMETER	'ALT' PARAMETER	OUTPUT BASED ON
Any condition	**NOT USED**	**NOT USED**	MAIN
Control option 'C' not installed	any	not available	MAIN
Switch assigned to **SELECT ANALOG OUTPUT** and is disabled	any	NOT USED	MAIN
Switch assigned to **SELECT ANALOG OUTPUT** and is enabled	any	NOT USED	MAIN
Any condition	**NOT USED**	anything other than **NOT USED**	ALT
Switch assigned to **SELECT ANALOG OUTPUT** and is disabled	**NOT USED**	anything other than **NOT USED**	ALT
Switch assigned to **SELECT ANALOG OUTPUT** and is enabled	any	anything other than **NOT USED**	ALT

- **MAIN/ALT 4 mA VALUE:** This message appears for each analog output and allows the user to assign a numeric value which corresponds to the 4 mA end of the 4 to 20 mA signal range (T20 option) or the 0 mA end of the 0 to 1 mA signal range (T1 option). The numeric value range will depend upon which parameter is selected. See Table 4–3: ANALOG OUTPUT PARAMETERS below for details. Note that if the T20 option is installed and the **ANALOG OUTPUT RANGE** setpoint is set to 0-20 mA, this message represents the 0 mA end of the signal range.
- **MAIN/ALT 20 mA Value:** This message appears for each analog output and allows the user to assign a numeric value which corresponds to the 20 mA end of the 4 to 20 mA signal range (T20 option) or the 1 mA end of the 0 to 1 mA signal range (T1 option). The numeric value range will depend upon which parameter is selected. See Table 4–3: ANALOG OUTPUT PARAMETERS below for details.

  If the 4 mA (or 0 mA) value is programmed to be higher than the 20 mA (or 1 mA) value, the analog output will decrease towards 4 mA (or 0 mA) as the value increases and the analog output will increase towards 20 mA (or 1 mA) as the value decreases. If the 4 mA (or 0 mA) and 20 mA (or 1 mA) values are programmed to an identical value, the output will always be 4 mA (or 0 mA).

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Table 4–3: ANALOG OUTPUT PARAMETERS

PARAMETER	RANGE	STEP
Phase A Current	0 to 150%	1%
Phase B Current	0 to 150%	1%
Phase C Current	0 to 150%	1%
Neutral Current	0 to 150%	1%
Average Phase Current	0 to 150%	1%
Current Unbalance	0 to 100.0%	0.1%
Voltage Van	0 to 200%	1%
Voltage Vbn	0 to 200%	1%
Voltage Vcn	0 to 200%	1%
Voltage Vab	0 to 200%	1%
Voltage Vbc	0 to 200%	1%
Voltage Vca	0 to 200%	1%
Average Phase Voltage	0 to 200%	1%
Average Line Voltage	0 to 200%	1%
Voltage Unbalance	0 to 100.0%	0.1%
Frequency	00.00 to 75.00 Hz	0.01 Hz
3 Phase PF	0.01 lead to 0.01 lag	0.01
3 Phase kW	–32500 to +32500	1 kW
3 Phase kvar	–32500 to +32500	1 kW
3 Phase kVA	0 to 65400	1 kVA
3 Phase MW	–3250.0 to +3250.0	0.1 MW
3 Phase Mvar	–3250.0 to +3250.0	0.1 Mvar
3 Phase MVA	0 to 6540.0	0.1 MVA
Phase A PF	0.01 lead to 0.01 lag	0.01
Phase A kW	–32500 to +32500	1 kW
Phase A kvar	–32500 to +32500	1 kvar
Phase A kVA	0 to 65400	1 kVA
Phase B PF	0.01 lead to 0.01 lag	0.01
Phase B kW	–32500 to +32500	1 kW
Phase B kvar	–32500 to +32500	1 kvar

PARAMETER	RANGE	STEP
Phase B kVA	0 to 65400	1 kVA
Phase C PF	0.01 lead to 0.01 lag	0.01
Phase C kW	–32500 to +32500	1 kW
Phase C kvar	–32500 to +32500	1 kvar
Phase C kVA	0 to 65400	1 kVA
3 Phase +kWh Used	0 to 65400	1 kWh
3 Phase +kvarh Used	0 to 65400	1 kvarh
3 Phase –kWh Used	0 to 65400	1 kWh
3 Phase –kvarh Used	0 to 65400	1 kvarh
3 Phase kVAh Used	0 to 65400	1 kVAh
Ph. A Current Demand	0 to 7500	1 A
Ph. B Current Demand	0 to 7500	1 A
Ph. C Current Demand	0 to 7500	1 A
Neutral Current Demand	0 to 7500	1 A
3 Phase kW Demand	–32500 to +32500	1 kW
3 Phase kvar Demand	–32500 to +32500	1 kvar
3 Phase kVA Demand	0 to 65400	1 kVA
3 Phase Current THD	0.0 to 100%	0.1%
3 Phase Voltage THD	0.0 to 100%	0.1%
Phase A Current THD	0.0 to 100%	0.1%
Phase B Current THD	0.0 to 100%	0.1%
Phase C Current THD	0.0 to 100%	0.1%
Voltage Van THD	0.0 to 100%	0.1%
Voltage Vbn THD	0.0 to 100%	0.1%
Voltage Vcn THD	0.0 to 100%	0.1%
Voltage Vab THD	0.0 to 100%	0.1%
Voltage Vbc THD	0.0 to 100%	0.1%
Neutral Current THD	0.0 to 100%	0.1%
Serial Control	–32500 to +32500	1 Unit

- **ANALOG OUTPUT PARAMETER – Serial Control**: When the Analog Output parameter is set to Serial Control, the analog output(s) reflect a value in proportion to the serial value written to a specific register within the PQM memory map. The locations are as described in the table below.

ANALOG OUTPUT	MODBUS REGISTER	REGISTER
Analog Output 1	Analog Output1 Serial Value	1067
Analog Output 2	Analog Output2 Serial Value	106F
Analog Output 3	Analog Output3 Serial Value	1077
Analog Output 4	Analog Output4 Serial Value	106F

4.3.3 ANALOG INPUT

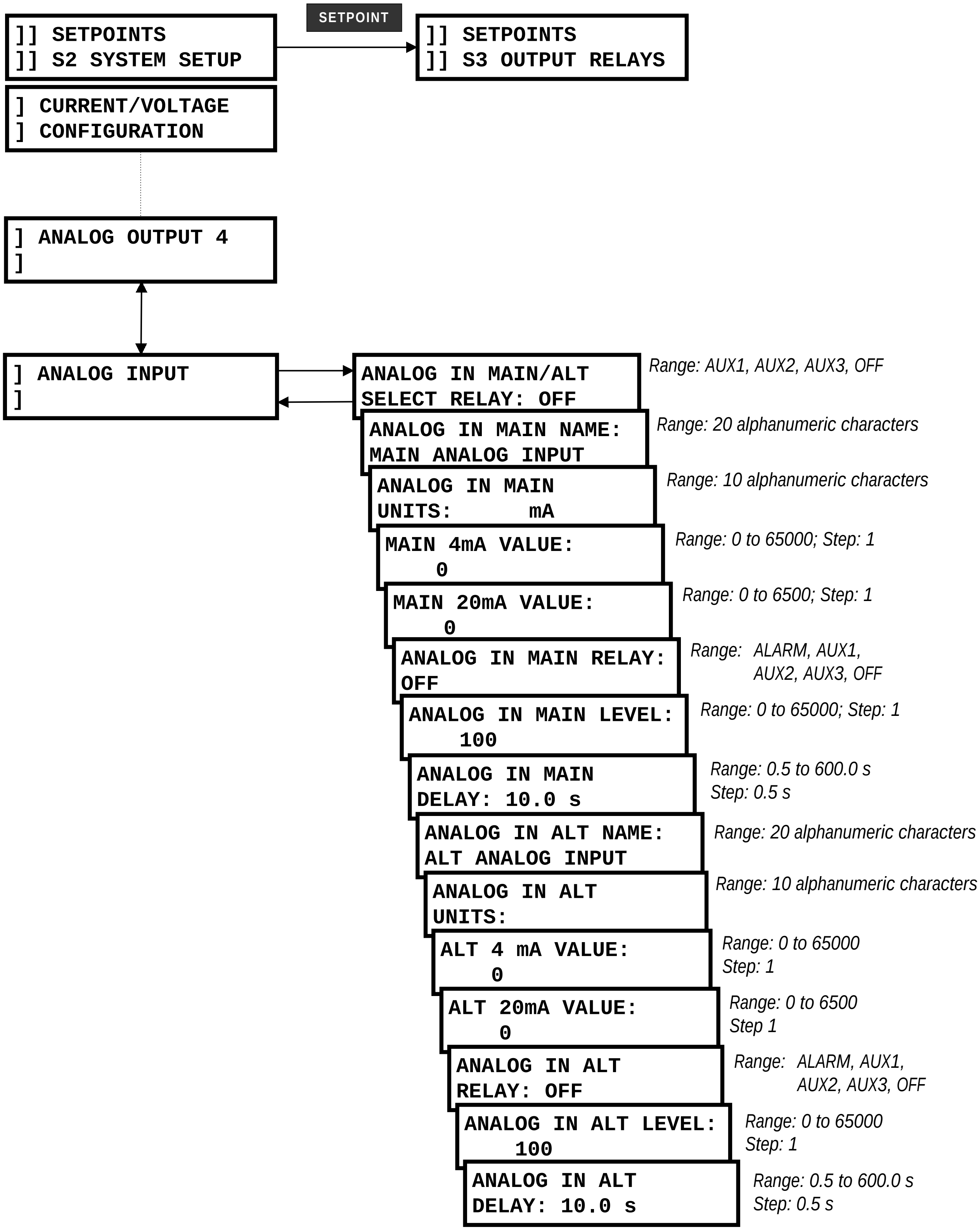

Figure 4–15: SETPOINTS PAGE 2 – SYSTEM SETUP / ANALOG INPUT

- **ANALOG IN MAIN/ALT SELECT RELAY:** Select the output relay that is to be used to multiplex two analog input signals to the PQM. If this setpoint is OFF, the MAIN analog input setpoints will be used unless a switch input assigned to SELECT ANALOG INPUT is activated. For more information on multiplexing two analog inputs using one of the PQM output relays, refer to Section 2.2.6: SWITCH INPUTS (OPTIONAL) on page 2–15.
- **ANALOG IN MAIN/ALT NAME:** This message allows the user to input a user defined 20 character alpha-numeric name for the MAIN and ALT analog inputs. To enter the names, perform the following steps:
  1. Allow access to setpoints by enabling setpoint access.
  2. Select the Analog Input name message display under the **S2 SYSTEM SETUP \ ANALOG INPUT** setpoints group.
  3. Use the VALUE ▲ and VALUE ▼ keys to change the blinking character over the cursor. A space is selected like a character.
  4. Press the STORE key to store the character and advance the cursor to the next position. To skip over a character press the STORE key.
  5. Continue entering characters and spaces until the desired message is displayed. If a character is entered incorrectly, press the STORE key repeatedly until the cursor returns to the position of the error, and re-enter the character.

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- **ANALOG IN MAIN/ALT UNITS:** This message allows the user to input a user defined 10 character alpha-numeric name for the MAIN and ALT units. To enter the units, perform the same steps as shown for analog input name.
- **MAIN/ALT 4 mA VALUE:** This message appears for each analog input and allows the user to assign a numeric value which corresponds to the 4 mA end of the 4 to 20 mA signal range.
- **MAIN/ALT 20 mA VALUE:** This message appears for each analog input and allows the user to assign a numeric value which corresponds to the 20 mA end of the 4 to 20 mA signal range.
- **ANALOG IN MAIN/ALT RELAY:** Analog input MAIN and ALT detection can either be disabled, used as an alarm or as a process control. Set this setpoint to OFF if the feature is not required. Selecting ALARM causes the alarm relay to activate and displays an alarm message whenever a MAIN or ALT analog input condition exists. Selecting an AUXILIARY relay causes the selected auxiliary relay to activate with no message displayed. This is intended for process control.
- **ANALOG IN MAIN/ALT LEVEL:** When the measured MAIN or ALT analog input exceeds the level set by this setpoint, a MAIN or ALT analog input condition will occur.
- **ANALOG IN MAIN/ALT DELAY:** If the MAIN or ALT analog input exceeds the **ANALOG IN MAIN/ALT LEVEL** setpoint value and remains this way for the time delay programmed in this setpoint, an analog input condition will occur. If the **ANALOG IN MAIN/ALT RELAY:** setpoint is set to ALARM, the alarm relay will activate and the ANALOG IN MAIN/ALT ALARM message will be displayed. If the setpoint **ANALOG IN MAIN/ALT RELAY:** is set to AUX1, AUX2 or AUX3 the respective auxiliary relay will activate and no message will be displayed after the delay expires.

4.3.4 SWITCH INPUTS

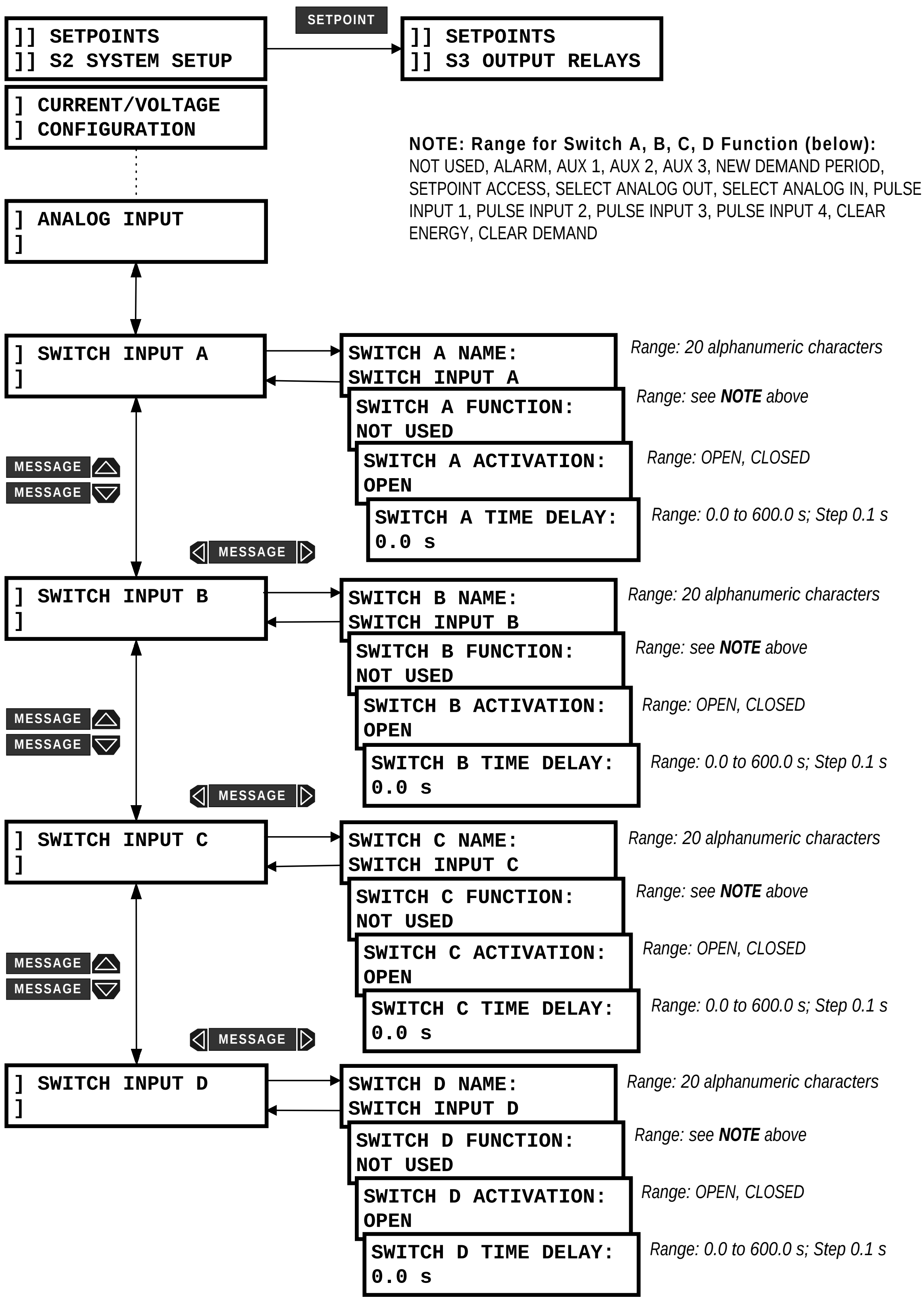


Figure 4–16: SETPOINTS PAGE 2 – SYSTEM SETUP / SWITCH INPUTS

- **SWITCH A/B/C/D NAME:** This message allows the user to input a user defined 20-character alphanumeric name for each switch input. To enter a switch name, perform the following steps:

  1. Allow access to setpoints by enabling setpoint access.
  2. Select the switch input message display under the subgroup **S2: SYSTEM SETUP \ SWITCH INPUT A**.
  3. Use the VALUE △ and VALUE ▽ keys to change the blinking character over the cursor. A space is selected like a character.
  4. Press the STORE key to store the character and advance the cursor to the next position. To skip over a character press the STORE key.
  5. Continue entering characters and spaces until the desired message is displayed. If a character is entered incorrectly, press the STORE key repeatedly until the cursor returns to the position of the error, and re-enter the character.

- **SWITCH A/B/C/D FUNCTION:** Select the required function for each switch input. See chapter 2 "Switch Inputs" for a description of each function. The NEW DEMAND PERIOD, SETPOINT ACCESS, SELECT ANALOG OUTPUT and SELECT ANALOG INPUT, PULSE INPUT 1, PULSE INPUT 2, PULSE INPUT 3, PULSE INPUT 4, CLEAR ENERGY and CLEAR DEMAND functions can be assigned to only one switch input at a time. If an attempt is made to assign one of these functions to more than one input, the flash message THIS SWITCH FUNCTION ALREADY ASSIGNED will be displayed. If an attempt is made via the serial port, no flash message will appear but an error code will be returned.

- **SWITCH A/B/C/D ACTIVATION:** This setpoint determines the operating sequence of the switch. Select OPEN if a switch activation is required for a switch input transition of closed to open. Select CLOSED if a switch activation is required for a switch input transition of open to closed.

- **SWITCH A/B/C/D TIME DELAY:** If the switch input function is assigned to ALARM, AUX1, AUX2, or AUX3, this message will be displayed. Enter the required time delay in this message.

4.3.5 PULSE OUTPUT

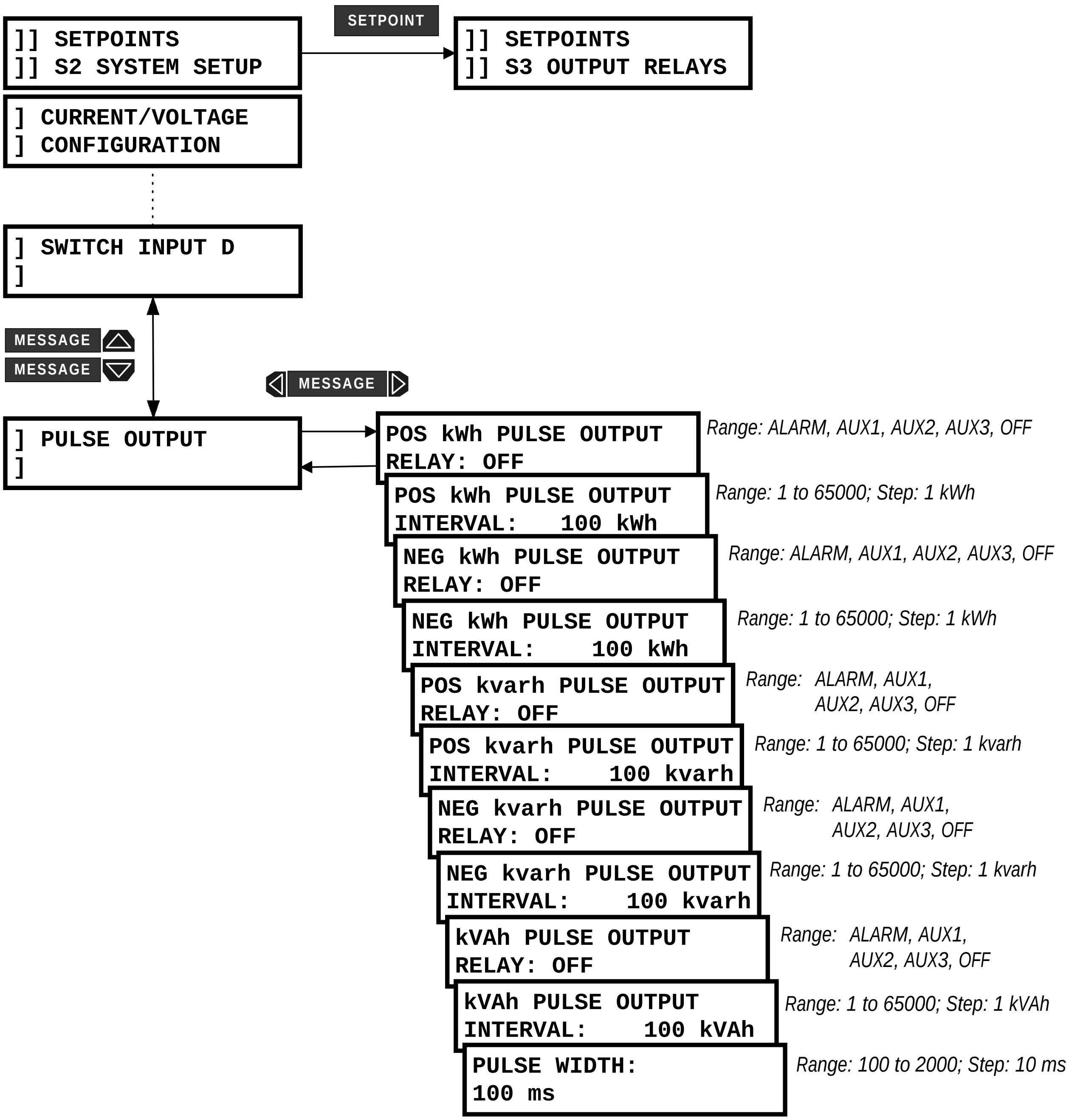


Figure 4–17: SETPOINTS PAGE 2 – SYSTEM SETUP / PULSE OUTPUT

- **kWh / kvarh / kVAh PULSE OUTPUT RELAY:** Five pulse output parameters can be assigned to the alarm or auxiliary relays. They are Positive kWh, Negative kWh, Positive kvarh, Negative kvarh, and kVAh. Enter the desired relay to which each parameter is assigned. Select OFF if a particular output parameter is not required.
- **KWh / kvarh / kVAh PULSE OUTPUT INTERVAL:** Enter the interval for the appropriate quantity at which the relay pulse will occur. The pulse width is set by the PULSE WIDTH setpoint described below. If the pulse interval is set to 100 kWh, one pulse will indicate that 100kWh has been accumulated.
- **PULSE WIDTH:** This setpoint determines the duration of each pulse as shown in the figure below.

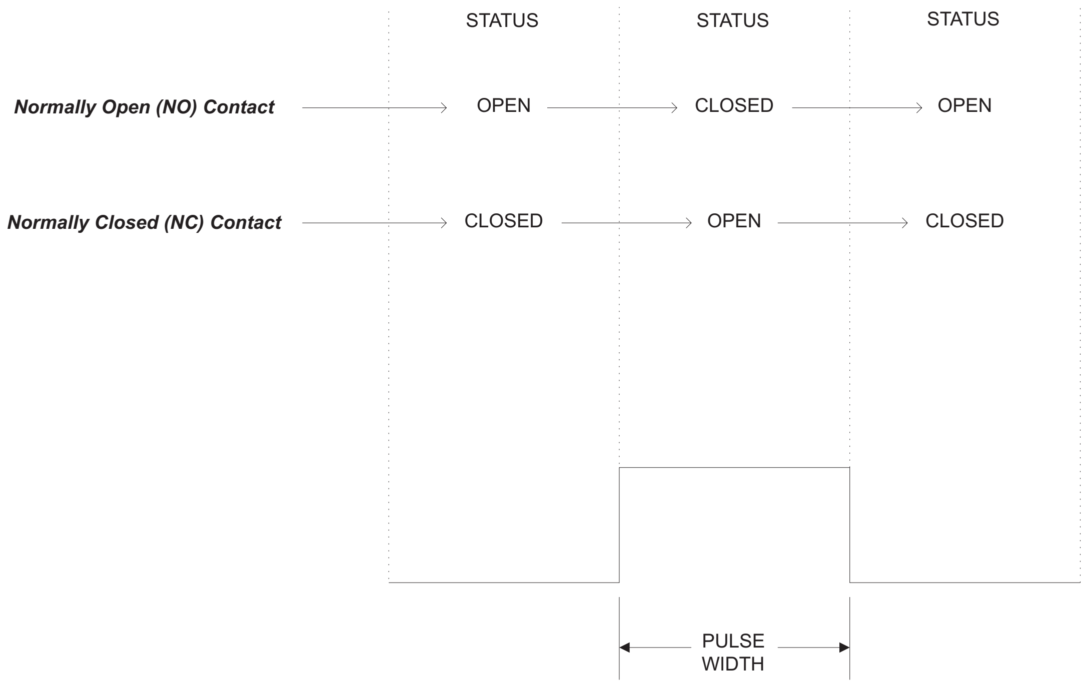


Figure 4–18: PULSE OUTPUT TIMING

4.3.6 PULSE INPUT

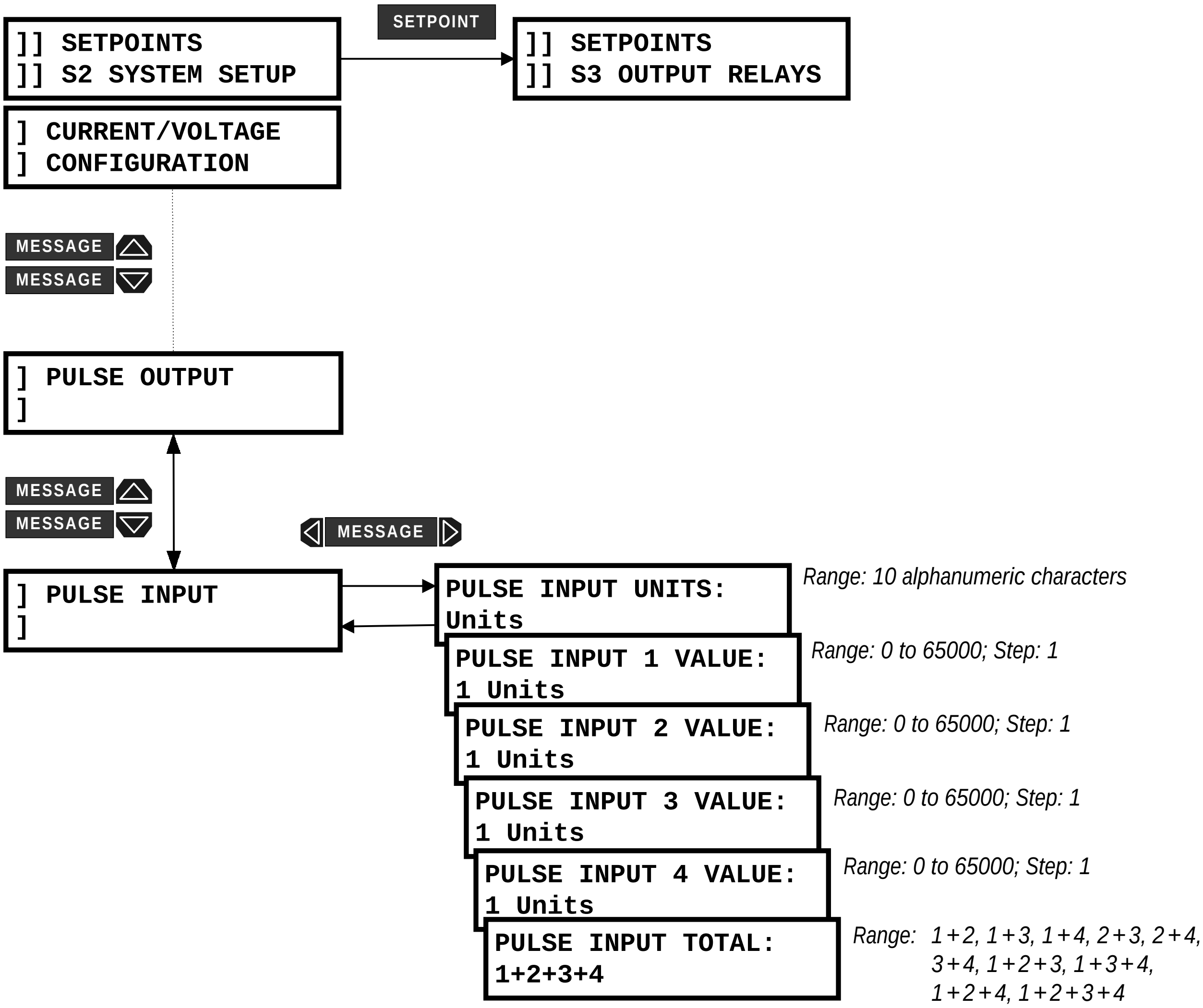


Figure 4–19: SETPOINTS PAGE 2 – SYSTEM SETUP / PULSE INPUT

- **PULSE INPUT UNITS:** This message allows the user to input a user defined 10 character alphanumeric unit for the pulse inputs (i.e. kWh). The unit will be used by all pulse inputs including the totalized value.

  To enter the unit, perform the following steps:

  1. Allow access to setpoints by enabling setpoint access.
  2. Select the **PULSE INPUT UNITS** message under the subgroup **S2 SYSTEM SETUP \ PULSE INPUT**.
  3. Use the VALUE ▲ and VALUE ▼ keys to change the blinking character over the cursor. A space is selected like a character.
  4. Press the STORE key to store the character and advance the cursor to the next position. To skip over a character press the STORE key.
  5. Continue entering characters and spaces until the desired message is displayed. If a character is entered incorrectly, press the STORE key repeatedly until the cursor returns to the position of the error, and re-enter the character.

- **PULSE INPUT 1 VALUE:** Enter a value in this setpoint that will be equivalent to 1 pulse input on the switch input assigned to PULSE INPUT 1 (i.e. 1 pulse = 100 kWh). The accumulated value is displayed in actual values under **A1 METERING\PULSE INPUT COUNTERS\PULSE INPUT 1**.
- **PULSE INPUT 2 VALUE:** Enter a value in this setpoint that will be equivalent to 1 pulse input on the switch input assigned to PULSE INPUT 2 (i.e. 1 pulse = 100 kWh). The accumulated value is displayed in actual values under **A1 METERING\PULSE INPUT COUNTERS\PULSE INPUT 2**.
- **PULSE INPUT 3 VALUE:** Enter a value in this setpoint that will be equivalent to 1 pulse input on the switch input assigned to PULSE INPUT 3 (i.e. 1 pulse = 100 kWh). The accumulated value is displayed in actual values under **A1 METERING\PULSE INPUT COUNTERS\PULSE INPUT 3**.
- **PULSE INPUT 4 VALUE:** Enter a value in this setpoint that will be equivalent to 1 pulse input on the switch input assigned to PULSE INPUT 4 (i.e. 1 pulse = 100 kWh). The accumulated value is displayed in actual values under **A1 METERING\PULSE INPUT COUNTERS\PULSE INPUT 4**.
- **PULSE INPUT TOTAL:** This setpoint allows the user to define which pulse inputs are to added together. For example, if the selection is this setpoint is 1+2+3, the PULSE INPUT 1, PULSE INPUT 2 and PULSE INPUT 3 values shown in **A1 METERING \ PULSE COUNTERS \ PULSE INPUT 1/2/3/4** will be added together and displayed in **A1:METERING \ PULSE INPUT COUNTERS \ PULSE IN 1+2+3**.

4.3.7 DATA LOGGER

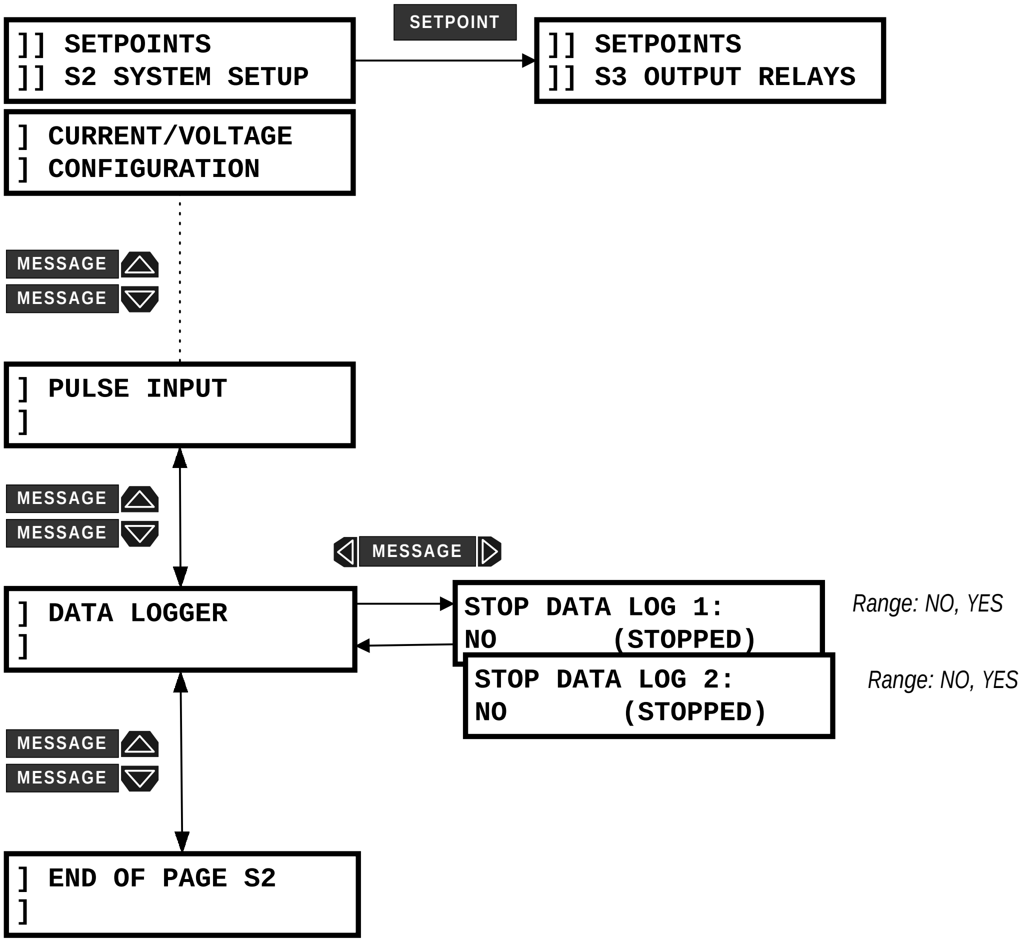
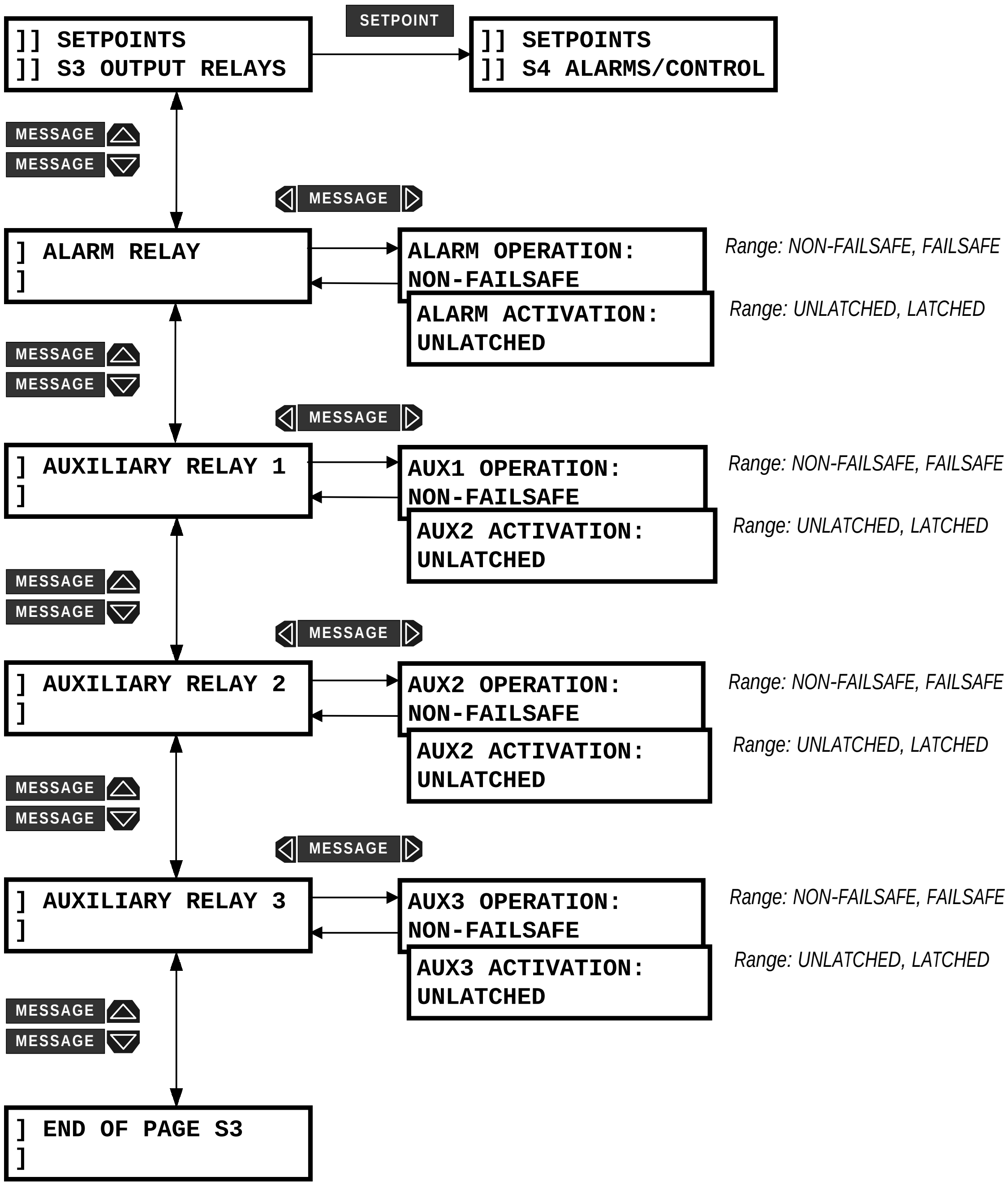


Figure 4–20: SETPOINTS PAGE 2 – SYSTEM SETUP / DATA LOGGER

- **STOP DATA LOG 1 / 2:** The data logger operation is only configurable over the serial port using PQMPC or other third party software. On occasions it may be necessary to stop the data loggers using the PQM keypad and then a computer to extract the logged information. The STOP DATA LOG 1 and 2 setpoints allow the user to stop the respective data log. These setpoints also display the current status of the respective data logger. Refer to the Appendix for a detailed description of the data logger implementation.

4

4.4.1 DESCRIPTION



NON-FAILSAFE: The relay coil is not energized in its non-active state. Loss of control power will cause the relay to remain in the non-active state. That is, a non-failsafe alarm relay will not cause an alarm on loss of control power. Contact configuration in the Wiring Diagrams is shown with relays programmed non-failsafe and control power not applied.

FAILSAFE: The relay coil is energized in its non-active state. Loss of control power will cause the relay to go into its active state. That is, a failsafe alarm relay will cause an alarm on loss of control power. Contact configuration is opposite to that shown in the Wiring Diagrams for relays programmed as failsafe when control power is applied.

Figure 4–21: SETPOINTS PAGE 3 – OUTPUT RELAYS

4.4.2 ALARM RELAY

- **ALARM OPERATION:** The terms 'failsafe' and 'non-failsafe' are defined above as implemented in the PQM. If an alarm is required when the PQM is not operational due to a loss of control power, select failsafe operation. Otherwise, choose non-failsafe.
- **ALARM ACTIVATION:** If an alarm indication is required only while an alarm is present, select unlatched. Once the alarm condition disappears, the alarm and associated message automatically clear. To ensure all alarms are acknowledged, select latched. Even if an alarm condition is no longer present, the alarm relay and message can only be cleared by pressing the RESET key or by sending the reset command via the computer.

4.4.3 AUXILIARY RELAYS

- **AUXILIARY 1, 2, 3 OPERATION:** The terms 'failsafe' and 'non-failsafe' are defined above as implemented in the PQM. If an output is required when the PQM is not operational due to a loss of control power, select failsafe auxiliary operation, otherwise, choose non-failsafe.
- **AUXILIARY 1, 2, 3 ACTIVATION:** If an auxiliary relay output is required only while the selected conditions are present, select unlatched. Once the selected condition disappears, the auxiliary relay returns to the non-active state. To ensure all conditions are acknowledged, select latched. If the condition is no longer present, the auxiliary relay can be reset by pressing the RESET key or by sending the reset command via the computer.

NOTE

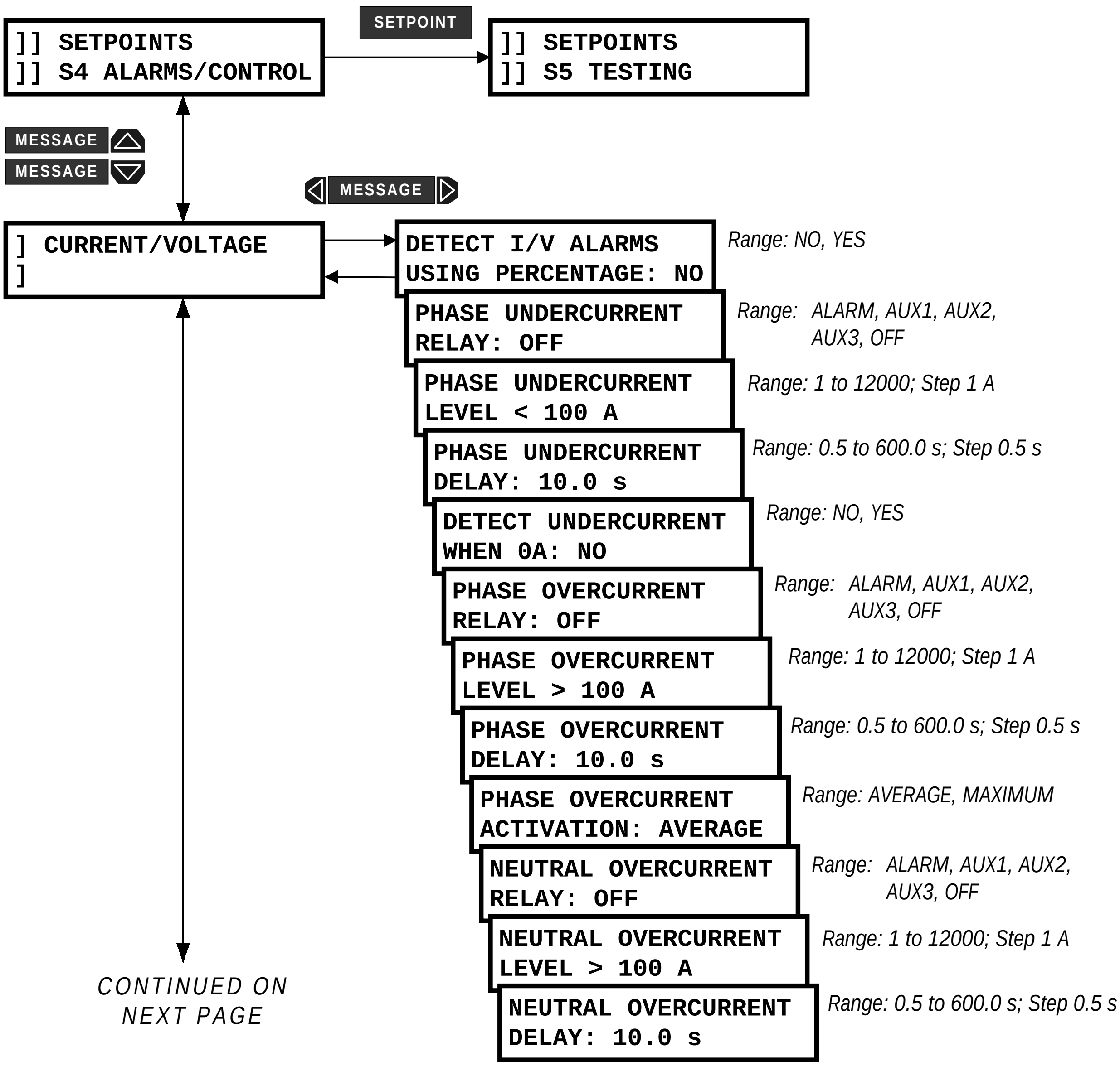
Since the relays can be assigned to perform many different functions, the PQM uses a priority system to determine which function will control the relays if they happen to be assigned to more than one function. The Table below shows the priority of the functions.

Table 4–4: AUXILIARY RELAYS ACTIVATION PRIORITY

PRIORITY	FUNCTION
HIGHEST	PULSE OUTPUT
↓	ANALOG INPUT MAIN/ALT SELECT
LOWEST	ALL ALARM FUNCTIONS

For example, if one of the relays is assigned to an alarm function and it is also assigned to one of the pulse output parameters, the relay will respond only to the pulse output function.

4.5.1 CURRENT/VOLTAGE ALARMS



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CONTINUED FROM PREVIOUS PAGE

Setpoint	Range
UNDERVOLTAGE RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
UNDERVOLTAGE LEVEL < 100 V	Range: 20 to 65000; Step 1 V
UNDERVOLTAGE DELAY: 10.0 s	Range: 0.5 to 600.0 s; Step 0.5 s
PHASES REQ'D FOR U/V OPERATION: ANY ONE	Range: ANY ONE, ANY TWO, ALL THREE
DETECT UNDERVOLTAGE BELOW 20V: NO	Range: NO, YES
OVERVOLTAGE RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
OVERVOLTAGE LEVEL > 100 V	Range: 20 to 65000; Step 1 V
OVERVOLTAGE DELAY: 10.0 s	Range: 0.5 to 600.0 s; Step 0.5 s
PHASES REQ'D FOR O/V OPERATION: ANY ONE	Range: ANY ONE, ANY TWO, ALL THREE
CURRENT UNBALANCE RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
CURRENT UNBALANCE LEVEL > 100%	Range: 1 to 100%; Step 1%
CURRENT UNBALANCE DELAY: 10.0 s	Range: 0.5 to 600.0 s; Step 0.5 s
VOLTAGE UNBALANCE RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
VOLTAGE UNBALANCE LEVEL ³ 100%	Range: 1 to 100%; Step 1%
VOLTAGE UNBALANCE DELAY: 10.0 s	Range: 0.5 to 600.0 s; Step 0.5 s
VOLTS PHASE REVERSAL RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
VOLTS PHASE REVERSAL DELAY: 1.0 s	Range: 0.5 to 600.0 s; Step 0.5 s

These setpoints are not visible if **VT WIRING** is set to SINGLE PHASE DIRECT

Figure 4–22: SETPOINTS PAGE 4 – ALARMS/CONTROL / CURRENT/VOLTAGE

4

- **DETECT I/V ALARMS USING PERCENTAGE:** When YES is selected, all current and voltage alarms can be set in percentages of CT and VT. When NO is selected, all current and voltage alarms are actual voltage and current levels.
- **PHASE UNDERCURRENT RELAY:** Undercurrent can either be disabled, used as an alarm or as a process control feature. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever an undercurrent condition exists. Selecting an auxiliary relay will cause the selected auxiliary relay to activate for an undercurrent condition but no message will be displayed. This is intended for process control.
- **PHASE UNDERCURRENT LEVEL:** When the average three phase current drops to or below the level set by this setpoint, a phase undercurrent condition will occur. Refer to the **DETECT UNDERCURRENT WHEN 0A** setpoint description below to enable/disable undercurrent detection below 5% of CT.
- **PHASE UNDERCURRENT DELAY:** If the average phase current drops to or below the **PHASE UNDERCURRENT LEVEL** setpoint value and remains this way for the time delay programmed in this setpoint, a phase undercurrent condition will occur.
- **DETECT UNDERCURRENT WHEN 0A:** If this setpoint is set to YES, undercurrent will be detected if the average phase current drops below 5% of CT. If the setting is NO, the undercurrent detection is only enabled if the average phase current is equal to or above 5% of CT.
- **PHASE OVERCURRENT RELAY:** Overcurrent can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever an overcurrent condition exists. Selecting auxiliary relay will cause the auxiliary relay to activate for an overcurrent condition but no message will be displayed. This is intended for process control.
- **PHASE OVERCURRENT LEVEL:** When the average (or maximum, see below) three phase current equals or exceeds the level set by this setpoint, a phase overcurrent condition will occur.
- **PHASE OVERCURRENT DELAY:** If the average (or maximum, see below) phase current equals or exceeds the **PHASE OVERCURRENT LEVEL** setpoint value and remains this way for the time delay programmed in this setpoint, a phase overcurrent condition will occur.
- **PHASE OVERCURRENT ACTIVATION:** The Phase Overcurrent function can use either the average phase current or the maximum of the three phase currents. This setpoint determines which is used.
- **NEUTRAL OVERCURRENT RELAY:** Neutral overcurrent can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever a neutral overcurrent condition exists. Selecting auxiliary relay will cause the auxiliary relay to activate for a neutral overcurrent condition but no message will be displayed. This is intended for process control.
- **NEUTRAL OVERCURRENT LEVEL:** When the neutral current equals or exceeds the level set by this setpoint, a neutral overcurrent condition will occur.
- **NEUTRAL OVERCURRENT DELAY:** If the neutral current equals or exceeds the **NEUTRAL OVERCURRENT LEVEL** setpoint value and remains this way for the time delay programmed in this setpoint, a neutral overcurrent condition will occur.
- **UNDERVOLTAGE RELAY:** Undervoltage can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever an undervoltage condition exists. Selecting auxiliary relay will cause the auxiliary relay to activate for an undervoltage condition but no message will be displayed. This is intended for process control.
- **UNDERVOLTAGE LEVEL:** When the voltage on one, two, or three phases drops to or below this level, an undervoltage condition occurs. The number of phases required is determined by the **PHASES REQUIRED FOR U/V OPERATION** setpoint. To clear the undervoltage condition, the level must increase to 103% of the **UNDER-**

VOLTAGE LEVEL setting. For example, if the **UNDERVOLTAGE LEVEL** is set to 4000 V, the condition clears when the voltage in the appropriate phase(s) increases above 4120 V (4000 × 1.03). This hysteresis is implemented to avoid nuisance alarms due to voltage fluctuations.

- **UNDERVOLTAGE DELAY:** If the voltage drops to or below the **UNDERVOLTAGE LEVEL** setpoint value and remains this way for the time delay programmed in this setpoint, an undervoltage condition will occur.
- **PHASES REQ'D FOR U/V OPERATION:** Select the minimum number of phases on which the undervoltage condition must be detected before the selected output relay will operate. This setpoint is not visible if **VT WIRING** is set to SINGLE PHASE DIRECT.
- **DETECT UNDERVOLTAGE BELOW 20V:** If an indication is required for loss of voltage, select YES for this setpoint. If NO is selected and any one of the voltage inputs has less than 20 V applied, the undervoltage feature will be disabled.
- **OVERVOLTAGE RELAY:** Overvoltage can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever an overvoltage condition exists. Selecting auxiliary relay will cause the auxiliary relay to activate for an overvoltage condition but no message will be displayed. This is intended for process control.
- **OVERVOLTAGE LEVEL:** When the voltage on one, two, or three phases equals or exceeds the level determined with this setpoint, an overvoltage condition occurs. The number of phases required is determined by the **PHASES REQUIRED FOR O/V OPERATION** setpoint. To clear the overvoltage condition, the level must decrease to 97% of the **OVERVOLTAGE LEVEL** setting. For example, if the **OVERVOLTAGE LEVEL** is set to 4200 V, the condition clears when the voltage in the appropriate phase(s) goes below 4074 V (4200 × 0.97). This hysteresis is implemented to avoid nuisance alarms due to voltage fluctuations.
- **OVERVOLTAGE DELAY:** If the voltage equals or exceeds the **OVERVOLTAGE LEVEL** setpoint value and remains this way for the time delay programmed in this setpoint, an overvoltage condition will occur.
- **PHASES REQ'D FOR O/V OPERATION:** Select the minimum number of phases on which the overvoltage condition must be detected before the selected output relay will operate. This setpoint is not visible if **VT WIRING** is set to SINGLE PHASE DIRECT.
- **CURRENT UNBALANCE RELAY:** Current unbalance is calculated as the maximum deviation from the average divided by the average three phase current. Current unbalance can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever a current unbalance condition exists. Selecting auxiliary relay will cause the auxiliary relay to activate for a current unbalance condition but no message will be displayed. This is intended for process control.
- **CURRENT UNBALANCE LEVEL:** When the current unbalance equals or exceeds this level, a current unbalance condition will occur. See chapter 5 for details on the method of calculation.
- **CURRENT UNBALANCE DELAY:** If the current unbalance equals or exceeds the **CURRENT UNBALANCE LEVEL** value for the time delay programmed in this setpoint, a current unbalance condition occurs.
- **VOLTAGE UNBALANCE RELAY:** Voltage unbalance is calculated as the maximum deviation from the average divided by the average three phase voltage. Voltage unbalance can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever a voltage unbalance condition exists. Selecting auxiliary relay will cause the auxiliary relay to activate for a voltage unbalance condition but no message will be displayed. This is intended for process control.
- **VOLTAGE UNBALANCE LEVEL:** When the voltage unbalance equals or exceeds this level, a voltage unbalance condition occurs. See chapter 5 for details on the method of calculation.

- **VOLTAGE UNBALANCE DELAY:** If the voltage unbalance equals or exceeds the **VOLTAGE UNBALANCE LEVEL** setpoint value and remains this way for the time delay programmed in this setpoint, a voltage unbalance condition will occur.
- **VOLTAGE PHASE REVERSAL:** Under normal operating conditions, the PQM expects to see the voltages connected with a 1-2-3 or A-B-C sequence. If the voltages are connected with the wrong sequence, 2-1-3 or B-A-C, a voltage phase reversal condition will occur. A minimum of 20 V must be applied to the PQM on all voltage inputs before the phase reversal feature will operate.

  A phase reversal condition is determined by looking at the phase angle at the occurrence of the peak sample of phase B voltage and subtracting it from the phase angle at the peak sample of phase A voltage (phase A angle - phase B angle). This angle is averaged over several cycles before deciding on the condition to avoid any false triggering of the feature. Only two phases are required to detect phase reversal because all phase reversal conditions can be covered without the use of the third phase. The angle to detect phase reversal will vary depending on the connection being used as described below.

  For 4-wire wye (3 VTs), 4-wire wye (2 VTs), 4-wire direct, and 3-wire direct connections, the phase reversal function operates when the angle between phase A and B becomes ≤ –150° or ≥ –90° as shown below.

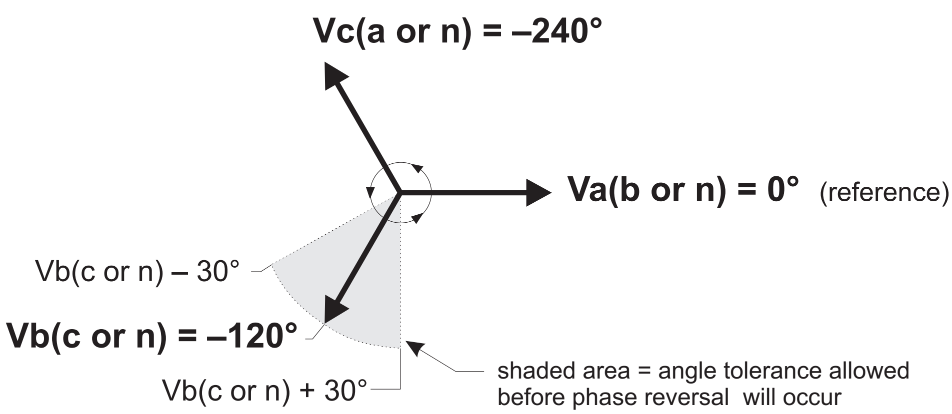

Figure 4–23: PHASE REVERSAL FOR 4-WIRE & 3-WIRE DIRECT CONNECTIONS

For the 3 WIRE DELTA (2 VTs) connection the phase reversal function operates when the angle between phase A and B becomes ≤ 30° or ≥ 90° as shown below.

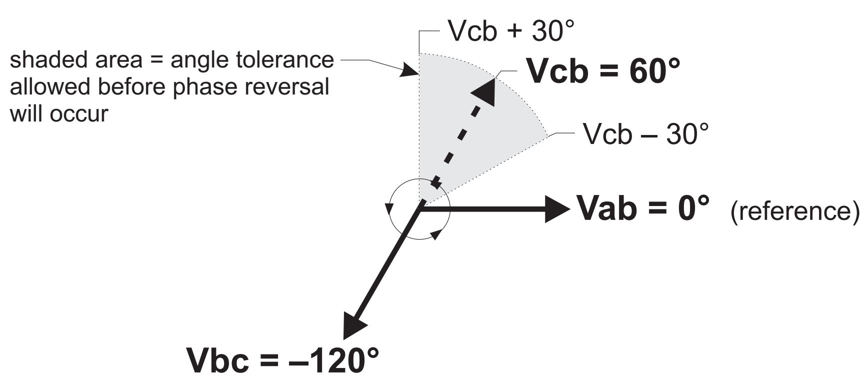

Figure 4–24: PHASE REVERSAL FOR 3-WIRE DELTA (2 VTs OPEN-DELTA) CONNECTION

When the SINGLE PHASE DIRECT connection is used the phase reversal feature will never operate.

- **VOLTAGE PHASE REVERSAL DELAY:** If a voltage phase reversal exists for the time programmed in this setpoint a voltage phase reversal condition will occur.

4.5.2 TOTAL HARMONIC DISTORTION

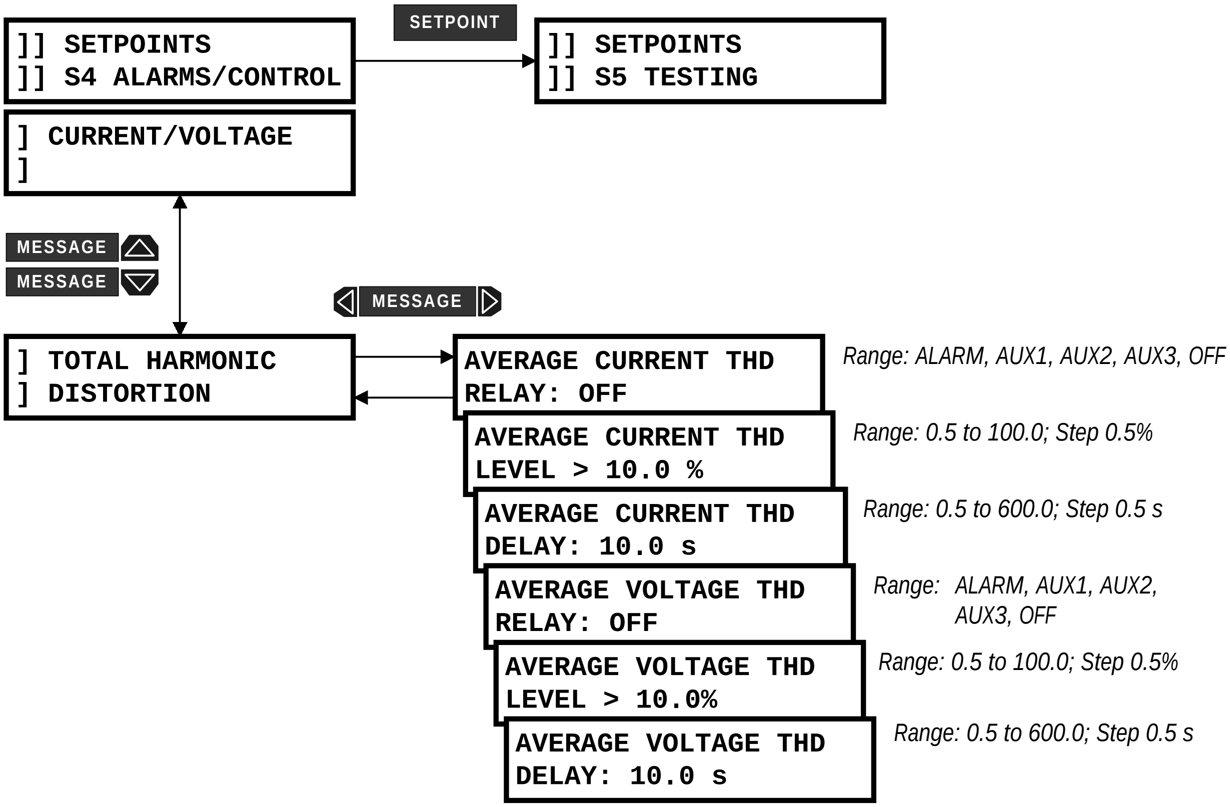

Figure 4–25: SETPOINTS PAGE 4: ALARMS/CONTROL / TOTAL HARMONIC DISTORTION

- **AVERAGE CURRENT THD RELAY:** Excessive phase current THD detection can either be disabled, used as an alarm, or as a process control. Set this setpoint to OFF if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever an excessive average current THD condition exists. Selecting auxiliary relay will cause the auxiliary relay to activate, but no message will be displayed. This is intended for process control.
- **AVERAGE CURRENT THD LEVEL:** When the measured average current THD exceeds this setpoint value, an average current THD condition occurs.
- **AVERAGE CURRENT THD DELAY:** If the average current THD exceeds the **AVERAGE CURRENT THD LEVEL** for the time delay programmed in this setpoint, an average current THD condition occurs.
- **AVERAGE VOLTAGE THD RELAY**: Average voltage THD detection can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever an average voltage THD condition exists. Selecting auxiliary relay will cause the auxiliary relay to activate, but no message will be displayed. This is intended for process control.
- **AVERAGE VOLTAGE THD LEVEL:** When the measured average voltage THD equals or exceeds this setpoint value, an AVERAGE VOLTAGE THD condition occurs.
- **AVERAGE VOLTAGE THD DELAY:** If the average voltage THD equals or exceeds the **AVERAGE VOLTAGE THD LEVEL** setpoint value and remains this way for the time delay programmed in this setpoint, an AVERAGE VOLTAGE THD condition will occur.

4.5.3 FREQUENCY

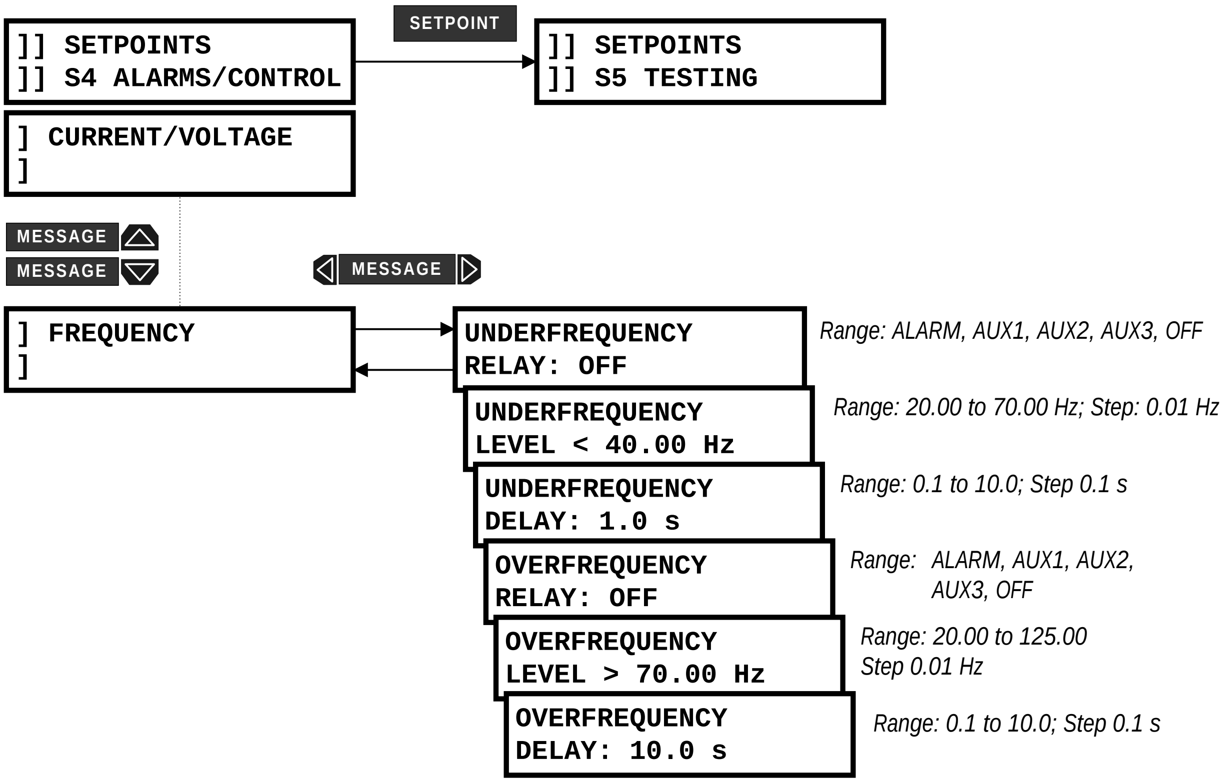

Figure 4–26: SETPOINTS PAGE 4 – ALARMS/CONTROL / FREQUENCY

- **UNDERFREQUENCY RELAY:** Underfrequency detection can either be disabled or used as an alarm, or process control. Set this setpoint to OFF if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever an underfrequency condition exists. Selecting auxiliary relay will cause the auxiliary relay to activate for an underfrequency condition, but no message will be displayed. This is intended for process control.
- **UNDERFREQUENCY LEVEL:** When the measured frequency drops to or below the level set by this setpoint, an underfrequency condition will occur.
- **UNDERFREQUENCY DELAY:** If the underfrequency drops to or below the **UNDERFREQUENCY LEVEL** value for the time delay programmed in this setpoint, an underfrequency condition will occur.
- **UNDERFREQUENCY WHEN FREQ = 0 Hz:** A voltage greater than 20 V is required on phase AN (AB) voltage input before frequency can be measured. If no voltage is applied or if the voltage applied is less than 20 V, the displayed frequency will be 0 Hz. If NO is selected in this setpoint, an underfrequency condition will not occur when the displayed frequency is 0 Hz.
- **OVERFREQUENCY RELAY:** Overfrequency detection can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever an overfrequency condition exists. Selecting auxiliary relay will cause the auxiliary relay to activate for an overfrequency condition, but no message will be displayed. This is intended for process control.
- **OVERFREQUENCY LEVEL**: When the measured frequency equals or exceeds the level set by this setpoint, an overfrequency condition will occur.
- **OVERFREQUENCY DELAY**: If the overfrequency equals or exceeds the **OVERFREQUENCY LEVEL** setpoint value for the time delay programmed in this setpoint, an overfrequency condition will occur.

4.5.4 POWER ALARMS

```
]] SETPOINTS                SETPOINT   ]] SETPOINTS
]] S4 ALARMS/CONTROL        -------->  ]] S5 TESTING

] CURRENT/VOLTAGE
]

MESSAGE ▲
MESSAGE ▼                 ◄ MESSAGE ►

] POWER
]
```

POWER ALARMS LEVEL BASE UNITS: kW/kVAR	Range: kW/kVAR, MW/MVAR
POSITIVE REAL POWER RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
POSITIVE REAL POWER LEVEL > 1000 kW	Range: 1 to 65000, Step 1 kW 0.01 to 650.00, Step 0.01 MW **
POSITIVE REAL POWER DELAY: 10.0 s	Range: 0.5 to 600.0; Step 0.5 s
NEGATIVE REAL POWER RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
NEGATIVE REAL POWER LEVEL > 1000 kW	Range: 1 to 65000, Step 1 kW 0.01 to 650.00, Step 0.01 MW **
NEGATIVE REAL POWER DELAY: 10.0 s	Range: 0.5 to 600.0; Step 0.5 s
POSITIVE REACT POWER RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
POSITIVE REACT POWER LEVEL ≥ 1000 kvar	Range: 1 to 65000, Step 1 kvar 0.01 to 650.00, Step 0.01 Mvar **
POSITIVE REACT POWER DELAY: 10.0 s	Range: 0.5 to 600.0 Step 0.5 s
NEGATIVE REACT POWER RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
NEGATIVE REACT POWER LEVEL ≥ 1000 kvar	Range: 1 to 65000, Step 1 kvar 0.01 to 650.00, Step 0.01 Mvar **
NEGATIVE REACT POWER DELAY: 10.0 s	Range: 0.5 to 600.0 Step 0.5 s

** These setpoint ranges are dependent upon the **POWER ALARMS LEVEL BASE UNITS** setpoint.
If **POWER ALARMS LEVEL BASE UNITS** = kW/kVAR, then the ranges are in kW/kvar.
If **POWER ALARM LEVEL BASE UNITS** = MW/Mvar, then the ranges are in MW/Mvar

Figure 4–27: SETPOINTS PAGE 4 – ALARMS/CONTROL / POWER

- **POWER ALARMS LEVEL BASE UNITS:** This setpoint is used to select the base unit multiplier for all power alarms. When set to kW/kVAR, all power alarm levels can be set in terms of kW and kVAR with a step value of 1 kW/kVAR. When set to MW/MVAR, all power alarm levels can be set in terms of MW and MVAR with a step value of 0.01 MW/MVAR.

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- **POSITIVE REAL POWER RELAY:** Positive real power level detection can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever a positive real power level exceeds the selected level. Selecting auxiliary relay will cause the auxiliary relay to activate for a set level of positive real power but no message will be displayed. This is intended for process control.
- **POSITIVE REAL POWER LEVEL:** When the three phase real power equals or exceeds the level set by this setpoint, an excess positive real power condition will occur.
- **POSITIVE REAL POWER DELAY:** If the positive real power equals or exceeds the **POSITIVE REAL POWER LEVEL** setpoint value for the time delay programmed in this setpoint, an excessive positive real power condition will occur.
- **NEGATIVE REAL POWER RELAY:** Negative real power level detection can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever a negative real power level exceeds the selected level. Selecting auxiliary relay will cause the auxiliary relay to activate for a set level of negative real power but no message will be displayed. This is intended for process control.
- **NEGATIVE REAL POWER LEVEL:** When the three phase real power equals or exceeds the level set by this setpoint, an excess negative real power condition will occur.
- **NEGATIVE REAL POWER DELAY:** If the negative real power equals or exceeds the **NEGATIVE REAL POWER LEVEL** setpoint value for the time delay programmed in this setpoint, an excessive negative real power condition will occur.
- **POSITIVE REACTIVE POWER RELAY:** Positive reactive power level detection can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever a positive reactive power level exceeds the selected level. Selecting auxiliary relay will cause the auxiliary relay to activate for a set level of positive reactive power but no message will be displayed. This is intended for process control.
- **POSITIVE REACTIVE POWER LEVEL:** When the three phase reactive power equals or exceeds the level set by this setpoint, an excess positive reactive power condition will occur.
- **POSITIVE REACTIVE POWER DELAY:** If the positive reactive power equals or exceeds the **POSITIVE REACTIVE POWER LEVEL** setpoint value for the time delay programmed in this setpoint, an excessive positive reactive power condition will occur.
- **NEGATIVE REACTIVE POWER RELAY:** Negative reactive power level detection can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message whenever a negative reactive power level exceeds the selected level. Selecting auxiliary relay will cause the auxiliary relay to activate for a set level of negative reactive power but no message will be displayed. This is intended for process control.
- **NEGATIVE REACTIVE POWER LEVEL:** When the three phase reactive power equals or exceeds the level set by this setpoint, an excess negative reactive power condition will occur.
- **NEGATIVE REACTIVE POWER DELAY:** If the negative reactive power equals or exceeds the **NEGATIVE REACTIVE POWER LEVEL** setpoint value for the time delay programmed in this setpoint, an excessive negative reactive power condition will occur.

4.5.5 POWER FACTOR

]] SETPOINTS
]] S4 ALARMS/CONTROL

SETPOINT

]] SETPOINTS
]] S5 TESTING

MESSAGE
MESSAGE

MESSAGE

] POWER FACTOR
]

POWER FACTOR LEAD 1 RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
POWER FACTOR LEAD 1 PICKUP ≤ 0.99	Range: 0.50 to 1.00, Step 0.01
POWER FACTOR LEAD 1 DROPOUT ≥ 1.00	Range: 0.50 to 1.00, Step 0.01
POWER FACTOR LEAD 1 DELAY: 10.0 s	Range: 0.5 to 600.0; Step 0.5 s
POWER FACTOR LAG 1 RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
POWER FACTOR LAG 1 PICKUP ≤ 0.99	Range: 0.50 to 1.00, Step 0.01
POWER FACTOR LAG 1 DROPOUT ≥ 1.00	Range: 0.50 to 1.00, Step 0.01
POWER FACTOR LAG 1 DELAY: 10.0 s	Range: 0.5 to 600.0; Step 0.5 s
POWER FACTOR LEAD 2 RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
POWER FACTOR LEAD 2 PICKUP ≤ 0.99	Range: 0.50 to 1.00, Step 0.01
POWER FACTOR LEAD 2 DROPOUT ≥ 1.00	Range: 0.50 to 1.00, Step 0.01
POWER FACTOR LEAD 2 DELAY: 10.0 s	Range: 0.5 to 600.0; Step 0.5 s
POWER FACTOR LAG 2 RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
POWER FACTOR LAG 2 PICKUP ≤ 0.99	Range: 0.50 to 1.00, Step 0.01
POWER FACTOR LAG 2 DROPOUT ≥ 1.00	Range: 0.50 to 1.00, Step 0.01
POWER FACTOR LAG 2 DELAY: 10.0 s	Range: 0.5 to 600.0; Step 0.5 s

Figure 4–28: SETPOINTS PAGE 4 – ALARMS/CONTROL / POWER FACTOR

It is generally desirable for a system operator to maintain the power factor as close to unity as possible (that is, to make the real power of the system as close as possible to the apparent power) to minimize both costs and voltage excursions. On dedicated circuits such as some large motors, with a near-fixed load, a capacitor bank may be switched on or off with the motor to supply leading vars to compensate for the lagging vars required by the motor. Since the power factor is variable on common non-dedicated circuits, it is advantageous to compensate for low (lagging) power factor values by connecting a capacitor bank to the circuit when required. The PQM provides power factor monitoring and allows two stages of capacitance switching for power factor compensation.

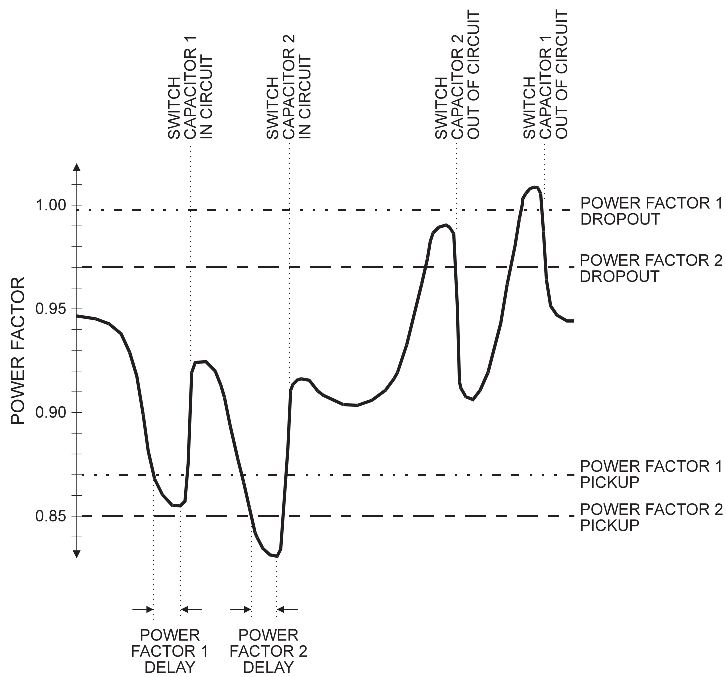


Figure 4–29: CAPACITOR BANK SWITCHING

The PQM calculates the average power factor in the three phases, according to the following equation:

$$\text{Average Power Factor} = \frac{\text{Total 3-phase Real Power}}{\text{Total 3-phase Apparent Power}}$$

Two independent "elements" are available for monitoring power factor, POWER FACTOR 1 and POWER FACTOR 2, each having a pickup and a dropout level. For each element, when the measured power factor is equal to or becomes more lagging than the pickup level (i.e. numerically less than), the PQM will operate a user-selected output relay. This output can be used to control a switching device which connects capacitance to the circuit, or to signal an alarm to the system operator. After entering this state, when the power factor becomes less lagging than the power factor dropout level for a time larger than the set delay, the PQM will reset the output relay to the non-operated state.

Both power factor 1 and 2 features are inhibited from operating unless all three voltages are above 20% of nominal and one or more currents is above 0. Power factor 1 and 2 delay timers will be allowed to time only when the 20% threshold is exceeded on all phases (and, of course, only while the power factor remains outside of the programmed pickup and dropout levels). In the same way, when a power factor condition starts the power factor 1 or 2 delay timer, if all three phase voltages fall below the 20% threshold before the timer has timed-out, the element will reset without operating. A loss of voltage during any state will return both power factor 1 and 2 to the reset state.

- **POWER FACTOR LEAD 1 / 2 RELAY**: Power factor detection can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message when the power factor is more leading than the level set. Selecting AUX1, AUX2 or AUX3 relay will cause the respective auxiliary relay to activate when the power factor is equal to or more leading than the level set, but no message will be displayed. This is intended for process control. A minimum of 20V applied must exist on all voltage inputs before this feature will operate.
- **POWER FACTOR LEAD 1 / 2 PICKUP**: When a leading power factor equals or exceeds the level set by this setpoint, a power factor lead 1/2 condition will occur.
- **POWER FACTOR LEAD 1 / 2 DROPOUT**: When a leading power factor drops below the level set by this setpoint, the power factor lead 1/2 condition will drop out.
- **POWER FACTOR LEAD 1 / 2 DELAY**: If the power factor equals or exceeds the **POWER FACTOR LEAD 1/2 PICKUP** setpoint value and remains this way for the time delay programmed in this setpoint, a power factor lead 1/2 condition will occur.

  This setpoint also applies to the **POWER FACTOR DROPOUT 1/2** setpoint. If the power factor drops below the **POWER FACTOR LEAD 1/2 DROPOUT** setpoint value and remains this way for the time delay programmed in this setpoint, the power factor lead 1/2 condition will drop out. If the **POWER FACTOR LEAD 1/2 RELAY** setpoint is set to ALARM, the alarm relay will deactivate and the POWER FACTOR LEAD 1/2 ALARM message will be cleared. If the **POWER FACTOR LEAD 1/2 RELAY** setpoint is set to AUX1, AUX2, or AUX3, the respective auxiliary relay will deactivate.
- **POWER FACTOR LAG 1 / 2 RELAY**: Power factor detection can either be disabled, used as an alarm or as a process control. Set this setpoint to off if the feature is not required. Selecting alarm relay will cause the alarm relay to activate and display an alarm message when the power factor is more lagging than the level set. Selecting AUX1, AUX2, or AUX3 relay activates the respective auxiliary relay when the power factor is equal to or more lagging than the level set, but no message will be displayed. This is intended for process control. A minimum of 20 V applied must exist on all voltage inputs before this feature will operate.
- **POWER FACTOR LAG 1 / 2 PICKUP**: When a lagging power factor equals or exceeds the level set by this setpoint, a power factor lag 1/2 condition will occur.
- **POWER FACTOR LAG 1 / 2 DROPOUT**: When a lagging power factor drops below the level set by this setpoint, the power factor lag 1/2 condition will drop out.
- **POWER FACTOR LAG 1 / 2 DELAY**: If the power factor equals or exceeds the **POWER FACTOR LAG 1/2 PICKUP** setpoint value and remains this way for the time delay programmed in this setpoint, a power factor lag 1/2 condition will occur.

  This setpoint also applies to the **POWER FACTOR LAG 1/2 DROPOUT** setpoint. If the power factor drops below the **POWER FACTOR LAG 1/2 DROPOUT** setpoint value and remains this way for the time delay programmed in this setpoint, the power factor 1/2 lag condition will drop out. If the **POWER FACTOR LAG 1/2 RELAY** setpoint is set to ALARM, the alarm relay will deactivate and the POWER FACTOR LAG 1/2 ALARM message will be cleared. If the **POWER FACTOR LAG 1/2 RELAY** setpoint is set to AUX1, AUX2. or AUX3, the respective auxiliary relay will deactivate.

4.5.6 DEMAND ALARMS

```
]] SETPOINTS                 SETPOINT      ]] SETPOINTS
]] S4 ALARMS/CONTROL      ------------->   ]] S5 TESTING
```

MESSAGE ▲

MESSAGE ▼

◁ MESSAGE ▷

```
] DEMAND
]
```

PHASE A CURRENT DMD RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
PHASE A CURRENT DMD LEVEL ≥ 100 A	Range: 10 to 7500, Step: 1 A
PHASE B CURRENT DMD RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
PHASE A CURRENT DMD LEVEL ≥ 100 A	Range: 10 to 7500, Step: 1 A
PHASE C CURRENT DMD RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
PHASE C CURRENT DMD LEVEL ≥ 100 A	Range: 10 to 7500, Step: 1 A
NEUTRAL CURRENT DMD RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
NEUTRAL CURRENT DMD LEVEL ≥ 100 A	Range: 10 to 7500, Step: 1 A
3Φ POS REAL PWR DMD RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
3Φ POS REAL PWR DMD LEVEL ≥ 1000 kW	Range: 1 to 65000; Step: 1 kW
3Φ POS REACT PWR DMD RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
3Φ POS REACT PWR DMD LEVEL ≥ 1000 kvar	Range: 1 to 65000; Step: 1 kvar
3Φ NEG REAL PWR DMD RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
3Φ NEG REAL PWR DMD LEVEL ≥ 1000 kW	Range: 1 to 65000; Step: 1 kW
3Φ NEG REACT PWR DMD RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
3Φ NEG REACT PWR DMD LEVEL ≥ 1000 kvar	Range: 1 to 65000; Step: 1 kvar
3Φ APPARENT PWR DMD RELAY: OFF	Range: ALARM, AUX1, AUX2, AUX3, OFF
3Φ APPARENT PWR DMD LEVEL ≥ 1000 kVA	Range: 1 to 65000; Step: 1 kVA

Figure 4–30: SETPOINTS PAGE 4 – ALARMS/CONTROL / DEMAND

- **PHASE A/B/C/N CURRENT DEMAND RELAY**: Phase current demand detection can either be disabled or used as an alarm or process control. Set this setpoint to OFF if the feature is not required. Selecting alarm relay activates the alarm relay and displays an alarm message whenever a phase current demand level is equalled or exceeded. Selecting AUX1, AUX2 or AUX3 relay activates the respective auxiliary relay with no message displayed. This is intended for process control.
- **PHASE A/B/C/N CURRENT DEMAND LEVEL**: When the phase A/B/C/N current demand equals or exceeds this setpoint, a phase A/B/C/N demand alarm or process control indication occurs.
- **3Φ POSITIVE REAL POWER DEMAND RELAY**: Three-phase positive real power demand detection can either be disabled or used as an alarm or process control. Set this setpoint to OFF if the feature is not required. Selecting ALARM activates the alarm relay and displays an alarm message whenever the three-phase real power demand level is equalled or exceeded. Selecting AUX1, AUX2 or AUX3 activates the respective auxiliary relay with no message displayed. This is intended for process control.
- **3Φ POSITIVE REAL POWER DEMAND LEVEL**: When the three-phase real power demand exceeds this setpoint, a three-phase positive real power demand alarm or process control indication will occur.
- **3Φ POSITIVE REACTIVE POWER DEMAND RELAY**: Three-phase positive reactive power demand detection can either be disabled or used as an alarm or process control. Set to OFF if this feature is not required. Selecting ALARM activates the alarm relay and displays an alarm message whenever the three-phase reactive power demand level is equalled or exceeded. Selecting AUX1, AUX2, or AUX3 activates the respective auxiliary relay with no message displayed. This is intended for process control.
- **3Φ POSITIVE REACTIVE POWER DEMAND LEVEL**: When the three-phase reactive power demand equals or exceeds this setpoint, a three-phase positive reactive power demand alarm or process control indication will occur.
- **3Φ NEGATIVE REAL POWER DEMAND RELAY**: Three-phase negative real power demand detection can be disabled or used as an alarm or process control. Set to OFF if this feature is not required. Selecting ALARM activates the alarm relay and displays an alarm message whenever the level of the negative three-phase real power demand is equalled or exceeded. Selecting AUX1, AUX2 or AUX3 activates the respective auxiliary relay with no message displayed. This is intended for process control.
- **3Φ NEGATIVE REAL POWER DEMAND LEVEL**: When the three-phase real power demand is negative and exceeds this setpoint, a three-phase negative real power demand alarm or process control indication will occur.
- **3Φ NEGATIVE REACTIVE POWER DEMAND RELAY**: Three-phase negative reactive power demand detection can be disabled or used as an alarm or process control. Set to OFF if this feature is not required. Selecting ALARM activates the alarm relay and displays an alarm message if the level of the negative three-phase reactive power demand is equalled or exceeded. Selecting AUX1, AUX2 or AUX3 activates the respective auxiliary relay with no message displayed (intended for process control).
- **3Φ NEGATIVE REACTIVE POWER DEMAND LEVEL**: If the three-phase reactive power demand is negative and equals or exceeds this setpoint, a three-phase negative reactive power demand alarm or process control indication will occur.
- **3Φ APPARENT POWER DEMAND RELAY**: Three-phase apparent power demand detection can be disabled or used as an alarm or process control. Set to OFF if this feature is not required. Selecting ALARM activates the alarm relay and displays an alarm message if the three-phase apparent power demand level is equalled or exceeded. Selecting AUX1, AUX2 or AUX3 activates the respective auxiliary relay with no message displayed. This is intended for process control.
- **3Φ APPARENT POWER DEMAND LEVEL**: When the three-phase apparent power demand equals or exceeds this setpoint, a three-phase apparent power alarm or process control indication will occur.

4.5.7 PULSE INPUT

```
]] SETPOINTS
]] S4 ALARMS/CONTROL
```

SETPOINT →

```
]] SETPOINTS
]] S5 TESTING
```

MESSAGE ▲ MESSAGE ▼

◁ MESSAGE ▷

```
] PULSE INPUT
]
```

```
PULSE INPUT 1
RELAY: OFF
```

Range: ALARM, AUX1, AUX2, AUX3, OFF

```
PULSE INPUT 1
LEVEL ≥ 100 Units
```

Range: 1 to 65000, Step 1

```
PULSE INPUT 1
DELAY: 10.0 s
```

Range: 0.5 to 600.0, Step 0.5 s

```
PULSE INPUT 2
RELAY: OFF
```

Range: ALARM, AUX1, AUX2, AUX3, OFF

```
PULSE INPUT 2
LEVEL ≥ 100 Units
```

Range: 1 to 65000, Step 1

```
PULSE INPUT 2
DELAY: 10.0 s
```

Range: 0.5 to 600.0, Step 0.5 s

```
PULSE INPUT 3
RELAY: OFF
```

Range: ALARM, AUX1, AUX2, AUX3, OFF

```
PULSE INPUT 3
LEVEL ≥ 100 Units
```

Range: 1 to 65000, Step 1

```
PULSE INPUT 3
DELAY: 10.0 s
```

Range: 0.5 to 600.0, Step 0.5 s

```
PULSE INPUT 4
RELAY: OFF
```

Range: ALARM, AUX1, AUX2, AUX3, OFF

```
PULSE INPUT 4
LEVEL ≥ 100 Units
```

Range: 1 to 65000, Step 1

```
PULSE INPUT 4
DELAY: 10.0 s
```

Range: 0.5 to 600.0, Step 0.5 s

```
TOTALIZED PULSES
RELAY: OFF
```

Range: ALARM, AUX1, AUX2, AUX3, OFF

```
TOTALIZED PULES
LEVEL ≥ 100 Units
```

Range: 1 to 65000, Step 1

```
TOTALIZED PULSES
DELAY: 10.0 s
```

Range: 0.5 to 600.0, Step 0.5 s

Figure 4–31: SETPOINTS PAGE 4 – ALARMS/CONTROL / PULSE INPUT

- **PULSE INPUT 1 RELAY**: Any of the PQM switch inputs can be assigned to count pulse inputs as shown in Section 4.3.4: SWITCH INPUTS on page 4–27. This setpoint can be used to give an indication (alarm or control) if the programmedlevel is exceeded. Set this setpoint to OFF if the feature is not required. Selecting ALARM will cause the alarm relay to activate and display an alarm message whenever a pulse count level equals or exceeds the selected level. Selecting AUX1, AUX2 or AUX3 activates the appropriate auxiliary relay but no message is displayed. The AUX1, AUX2 or AUX3 selections are intended for process control.
- **PULSE INPUT 1 LEVEL**: When the pulse input value accumulated in the **A1 METERING \ PULSE INPUT COUNTERS \ PULSE INPUT 1** actual value exceeds this setpoint value, the relay assigned in the **PULSE INPUT 1 RELAY** will energize. If the ALARM relay is assigned, a PULSE INPUT 1 ALARM message will also be displayed. The units in this setpoint are determined by the **S2 SYSTEM SETUP \ PULSE INPUT \ PULSE INPUT UNITS** setpoint.
- **PULSE INPUT 1 DELAY**: This setpoint can be used to allow a time delay before the assigned relay will energize after the **PULSE INPUT 1 LEVEL** has been equaled or exceeded.
- **PULSE INPUT 2 RELAY**: See **PULSE INPUT 1 RELAY** description above and replace all references to PULSE INPUT 1 with PULSE INPUT 2.
- **PULSE INPUT 2 LEVEL**: See **PULSE INPUT 1 RELAY** description above and replace all references to PULSE INPUT 1 with PULSE INPUT 2.
- **PULSE INPUT 2 DELAY**: See **PULSE INPUT 1 RELAY** description above and replace all references to PULSE INPUT 1 with PULSE INPUT 2.
- **PULSE INPUT 3 RELAY**: See **PULSE INPUT 1 RELAY** description above and replace all references to PULSE INPUT 1 with PULSE INPUT 3.
- **PULSE INPUT 3 LEVEL**: See **PULSE INPUT 1 RELAY** description above and replace all references to PULSE INPUT 1 with PULSE INPUT 3.
- **PULSE INPUT 3 DELAY**: See **PULSE INPUT 1 RELAY** description above and replace all references to PULSE INPUT 1 with PULSE INPUT 3.
- **PULSE INPUT 4 RELAY**: See **PULSE INPUT 1 RELAY** description above and replace all references to PULSE INPUT 1 with PULSE INPUT 4.
- **PULSE INPUT 4 LEVEL**: See **PULSE INPUT 1 RELAY** description above and replace all references to PULSE INPUT 1 with PULSE INPUT 4.
- **PULSE INPUT 4 DELAY**: See **PULSE INPUT 1 RELAY** description above and replace all references to PULSE INPUT 1 with PULSE INPUT 4.
- **TOTALIZED PULSES RELAY**: A relay can be selected to operate based upon a Total Pulse Input Count as configured in the PQM. Selecting ALARM will cause the alarm relay to activate and display an alarm message whenever a pulse count level equals or exceeds the selected level. Selecting AUX1, AUX2, or AUX3 will cause the appropriate auxiliary relay to activate but no message will be displayed. The AUX1, AUX2, and AUX3 selections are intended for process control.
- **TOTALIZED PULSES LEVEL**: See **PULSE INPUT 1 LEVEL** description above and replace all references to PULSE INPUT 1 with TOTALIZED PULSES.
- **TOTALIZED PULSES DELAY**: See **PULSE INPUT 1 DELAY** description above and replace all references to PULSE INPUT 1 with TOTALIZED PULSES.

4.5.8 TIME

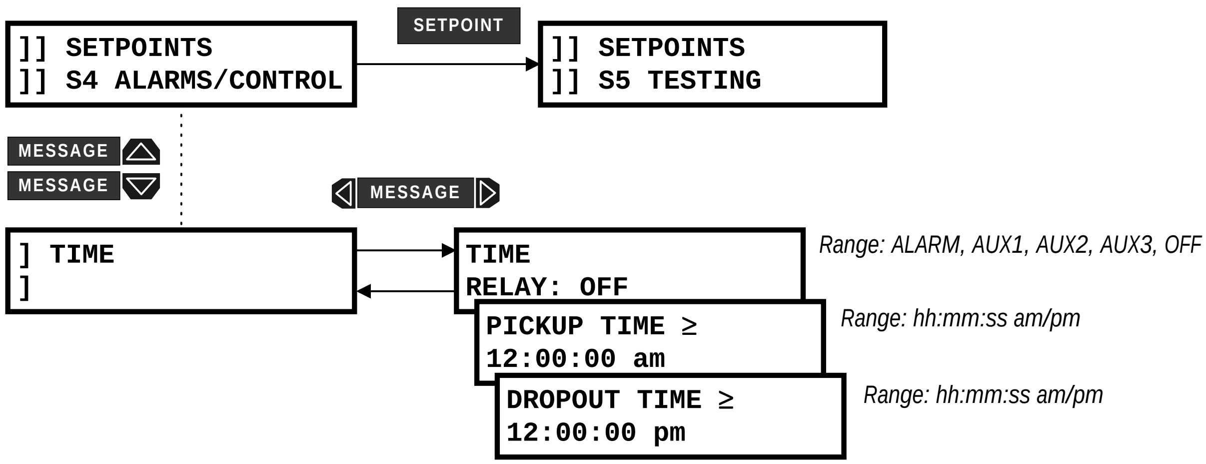
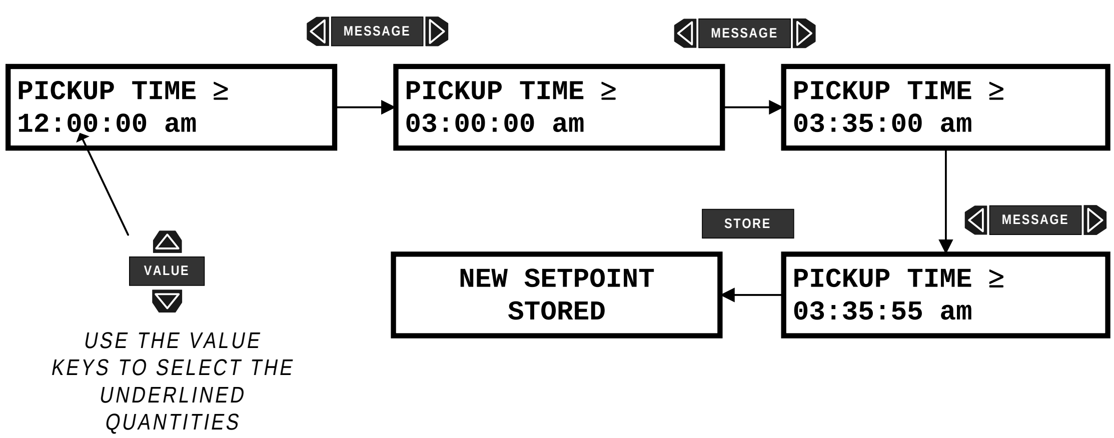


Figure 4–32: SETPOINTS PAGE 4 – ALARMS/CONTROL / TIME

The time function is useful where a general purpose time alarm is required or a process is required to start and stop each day at the specified time.

- **TIME RELAY**: This setpoint can be used to give an indication (alarm or control) if the programmed **PICKUP TIME** is equaled or exceeded. Set to OFF if the feature is not required. Selecting ALARM activates the alarm relay and displays an alarm message whenever the PQM clock time equals or exceeds the set **PICKUP TIME**. Selecting AUX1, AUX2 or AUX3 activates the appropriate auxiliary relay but no message is displayed. The AUX1, AUX2 and AUX3 selections are intended for process control. The selected relay will de-energize when the PQM clock time equals or exceeds the **DROPOUT TIME** setting.
- **PICKUP TIME**: The relay assigned in the **TIME RELAY** setpoint energizes when the PQM clock time equals or exceeds the time specified in this setpoint. Follow the example below to set the **PICKUP TIME**.



- **DROPOUT TIME**: The relay assigned in the **TIME RELAY** setpoint de-energizes when the PQM clock time equals or exceeds the time specified in this setpoint. Follow the example above to set the **DROPOUT TIME**.

4.5.9 MISCELLANEOUS ALARMS

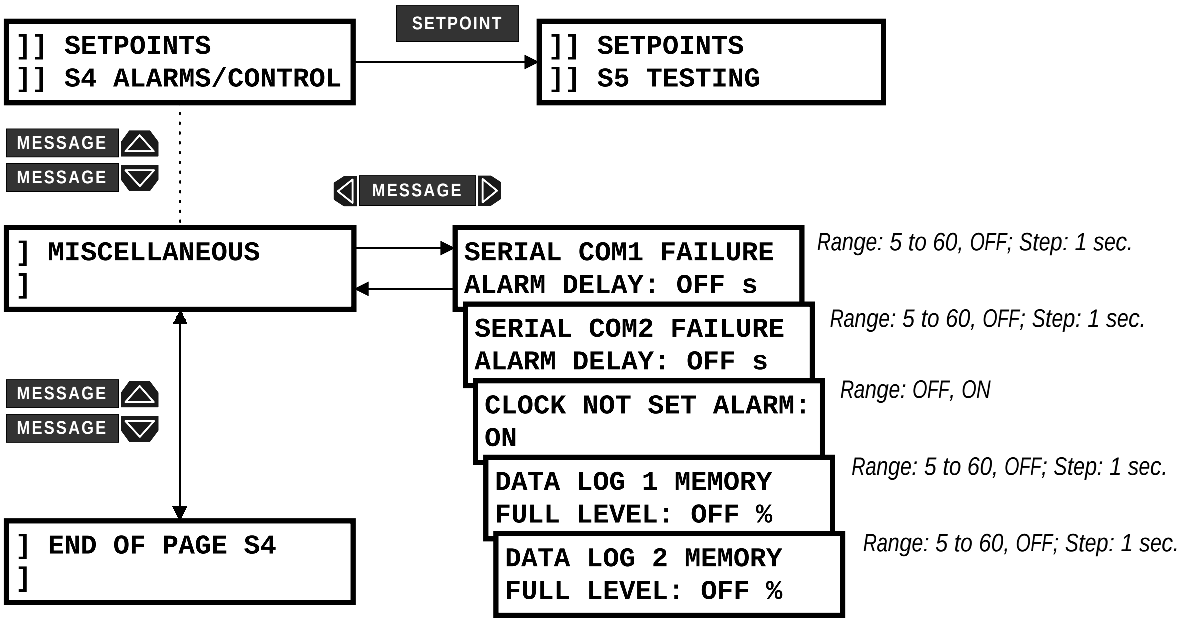


Figure 4–33: SETPOINTS PAGE 4 – ALARMS/CONTROL / MISCELLANEOUS

- **SERIAL COM1/2 FAILURE ALARM DELAY**: If loss of communications to the external master is required to activate an output relay, select a time delay in the range of 5 to 60 seconds. In this case, an absence of communication polling on the RS485 communication port for the selected time delay will generate the alarm condition. Disable this alarm if communications is not used or is not considered critical. This alarm is not available on the front RS232 port.
- **CLOCK NOT SET ALARM**: The software clock in the PQM will remain running for a period of approximately one hour after power has been removed from the PQM power supply inputs. Selecting ON in this message causes a "CLOCK NOT SET ALARM" to occur at power-up for power losses greater than one hour. Once the alarm occurs, the clock setting on **S1 PQM SETUP \ CLOCK \ SET TIME & DATE** must be stored to reset the alarm.
- **DATA LOG 1 / 2 MEMORY FULL LEVEL**: These messages can be used to configure alarms to indicate that the Data Logger memory is almost full. Separate alarms are provided for each log. When the log memory reaches the level programmed in this message a DATA LOG 1 / 2 Alarm will occur.

4.6.1 TEST OUTPUT RELAYS & LEDS

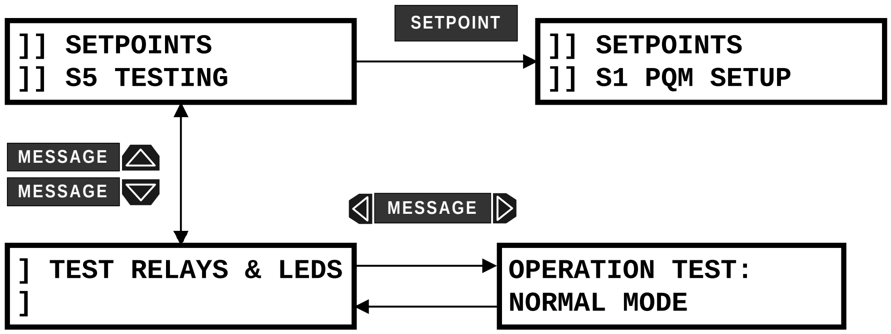


Figure 4–34: SETPOINTS PAGE 5 – TESTING

4

- **OPERATION TEST**: To verify correct operation of output relay wiring, each output relay and status indicator can be manually forced on or off via the keypad or serial port.

  While the **OPERATION TEST** setpoint is displayed, use the VALUE ▲ or VALUE ▼ keys to scroll to the desired output relay and/or status indicator to be tested. As long as the test message remains displayed the respective output relay and/or status indicator will be forced to remain energized. As soon as a new message is selected, the respective output relay and/or status indicator return to normal operation.

4.6.2 CURRENT/VOLTAGE SIMULATION

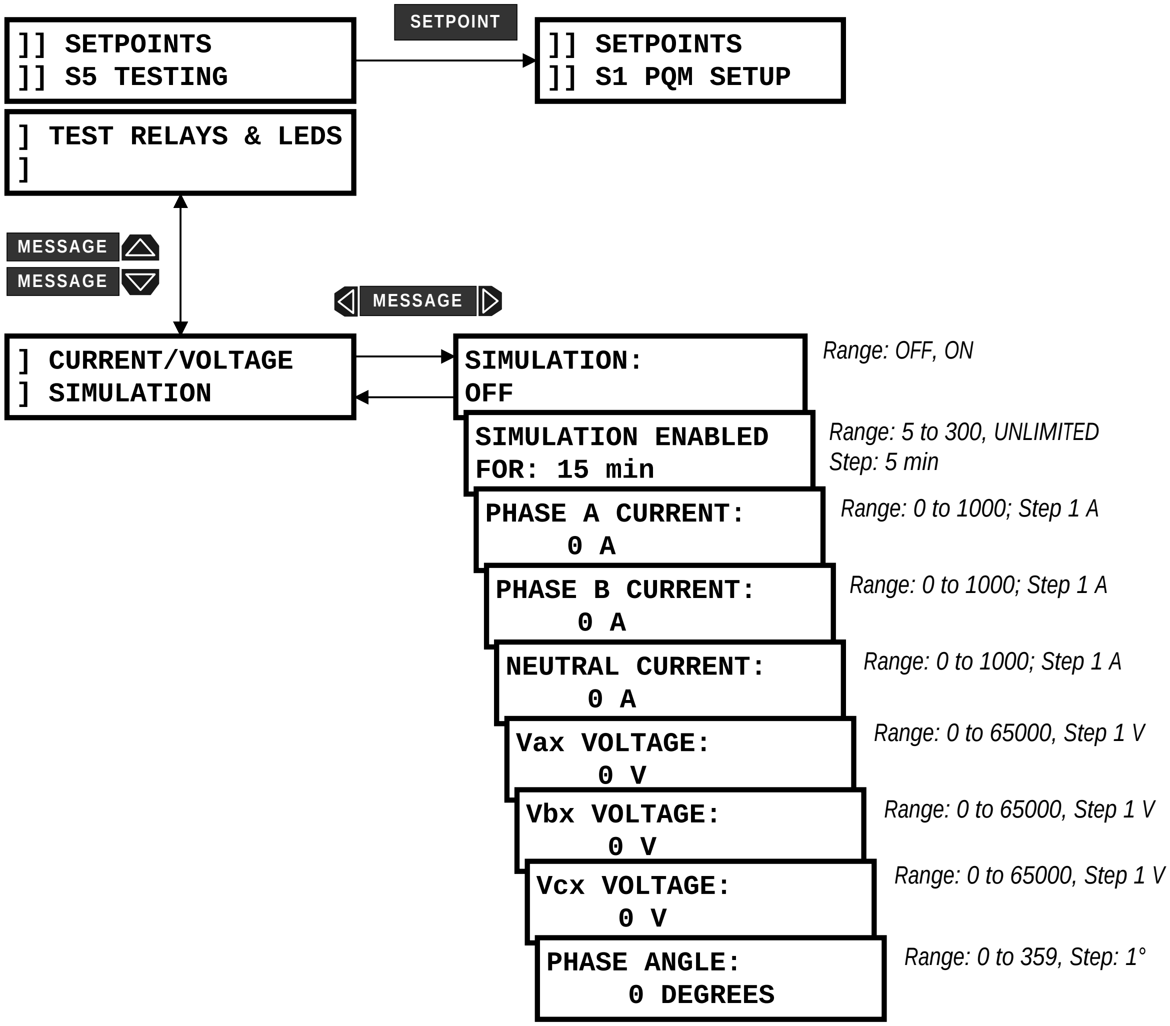


Figure 4–35: SETPOINTS PAGE 5 – TESTING / CURRENT/VOLTAGE SIMULATION

Simulated currents and voltages can be forced instead of the actual currents or voltages sensed by the external CTs and VTs. This allows for verification of all current and voltage related relay functions.

- **SIMULATION**: Enter ON to switch from actual currents and voltages to the programmed simulated values. Set this setpoint OFF after simulation is complete.
- **SIMULATION ENABLED FOR**: Select the desired length of time that simulation will be enabled. When the programmed time has elapsed, current and voltage simulation will turn off. If unlimited is selected, simulated currents and voltages will be used until simulation is turned off via the simulation on/off message or via the serial port or until control power is removed from the PQM.
- **PHASE A/B/C/NEUTRAL CURRENT**: Enter the desired phase and neutral currents for simulation.
- **Vax/Vbx/Vcx VOLTAGE**: Enter the desired voltages for simulation. The voltages entered will be line or phase quantities depending upon the VT wiring type selected with the **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING** setpoint.
- **PHASE ANGLE**: The phase angle in this setpoint represents the phase shift from a unity power factor. Enter the desired phase angle between the current and voltage. The angle between the individual currents and voltages is fixed at 120°.

4.6.3 ANALOG OUTPUTS SIMULATION

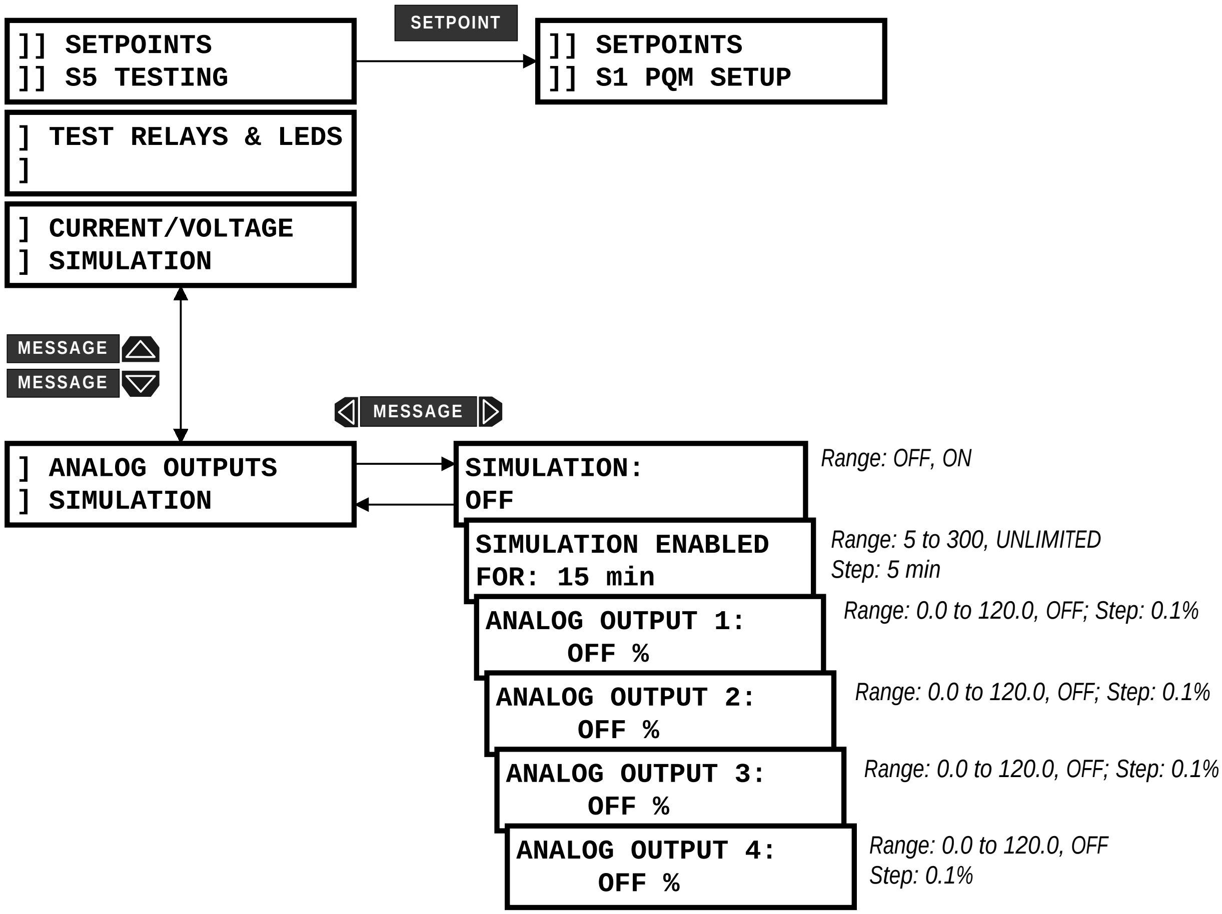


Figure 4–36: SETPOINTS PAGE 5 – ANALOG OUTPUT SIMULATION

- **SIMULATION**: Enter ON to switch from actual analog outputs to the programmed simulated values. Set this setpoint OFF after simulation is complete.
- **SIMULATION ENABLED FOR**: Select the desired length of time that simulation will be enabled. When the programmed time has elapsed, analog output simulation will turn off. If unlimited is selected, simulated analog outputs will be used until simulation is turned off via the simulation on/off message or via the serial port or until control power is removed from the PQM.
- **ANALOG OUTPUT 1/2/3/4**: Enter the percent analog output value to be simulated. Whether the output is 0 to 1 mA, or 4 to 20 mA is dependent upon the option installed.

For example, alter the setpoints below:

S5 TESTING \ ANALOG OUTPUTS SIMULATION \ ANALOG OUTPUT 1: 50.0%
S5 TESTING \ ANALOG OUTPUTS SIMULATION \ SIMULATION: ON

The output current level on analog output 1 will be 12 mA (4 to 20mA) or 0.5 mA (0 to 1mA).

4.6.4 ANALOG INPUT SIMULATION

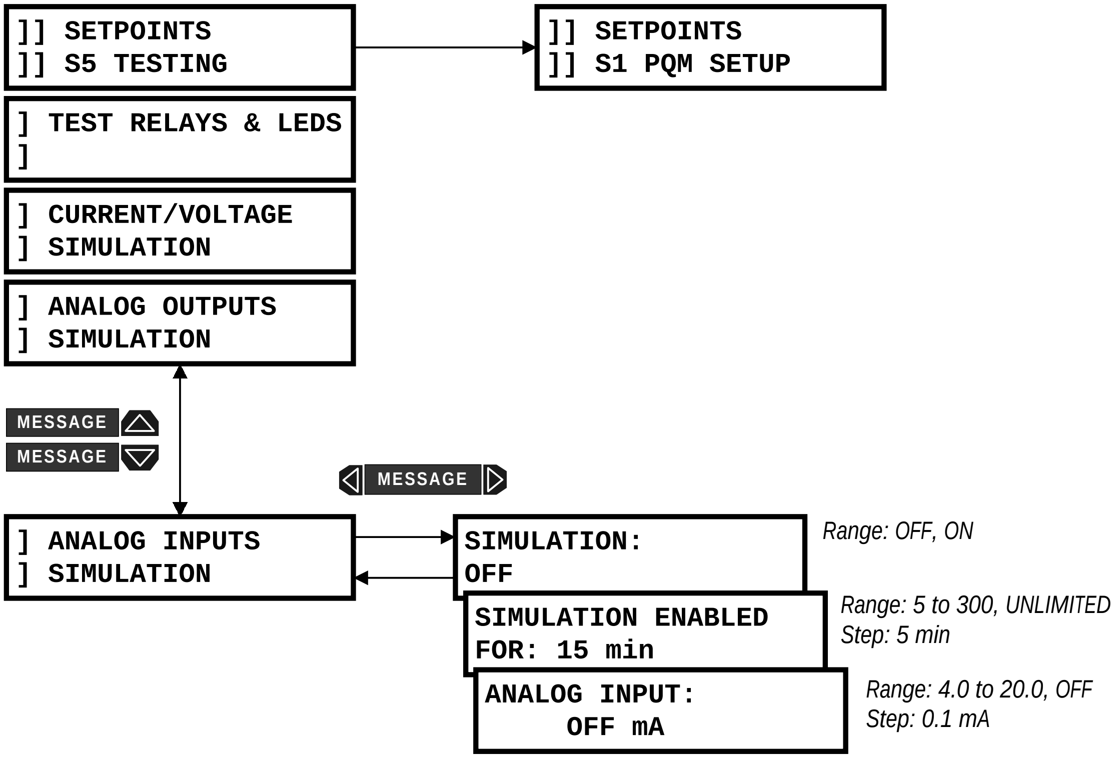


Figure 4–37: SETPOINTS PAGE 5 – ANALOG INPUT SIMULATION

- **SIMULATION**: Enter ON to switch from an actual analog input to the programmed simulated value. Set this setpoint OFF after simulation is complete.
- **SIMULATION ENABLED FOR**: Select the desired length of time that simulation will be enabled. When the programmed time has elapsed, analog input simulation will turn off. If unlimited is selected, the simulated analog input will be used until simulation is turned off via the **SIMULATION** setpoint or via the serial port or until control power is removed from the PQM.
- **ANALOG INPUT**: Enter an analog input current in the range of 4 to 20 mA to be simulated.

4.6.5 SWITCH INPUTS SIMULATION

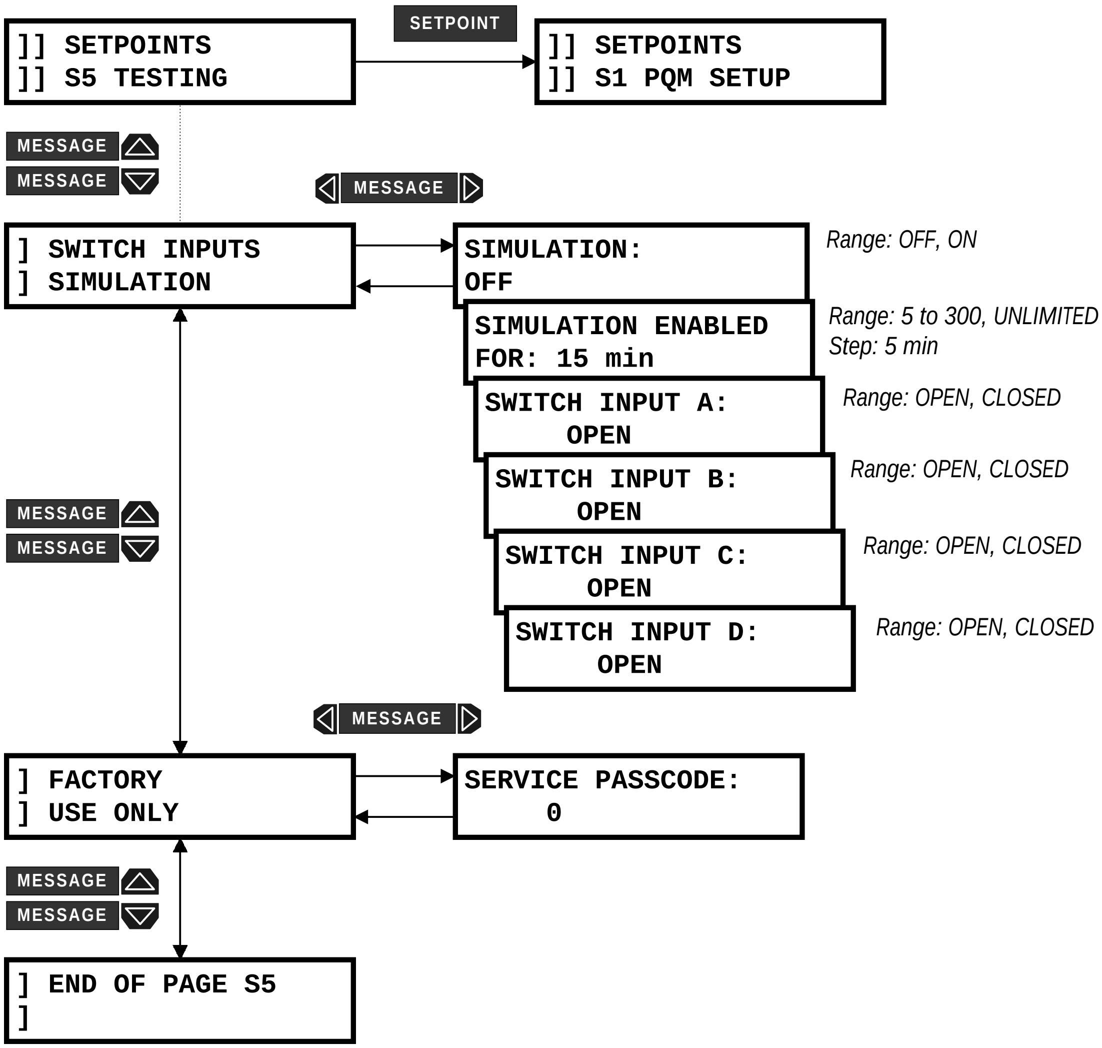


Figure 4–38: SETPOINTS PAGE 5 – TESTING / SWITCH INPUTS SIMULATION

- **SIMULATION**: Enter ON to switch from actual switch inputs to the programmed simulated switches. Set this setpoint OFF after simulation is complete.
- **SIMULATION ENABLED FOR**: Select the desired length of time that simulation will be enabled. When the programmed time has elapsed, switch input simulation will turn off. If UNLIMITED is selected, the simulated switch inputs will be used until simulation is turned off via the simulation on/off message or via the serial port or until control power is removed from the PQM.
- **SWITCH INPUT A / B / C / D**: Enter the switch input status (open or closed) to be simulated.

4.6.6 FACTORY USE ONLY

- **SERVICE PASSCODE**: These messages are for access by GE Power Management personnel only for testing and service.

5.1.1 DESCRIPTION

Any measured value can be displayed on demand using the ACTUAL key. Each time the ACTUAL key is pressed, the beginning of a new page of monitored values is displayed. These are grouped as: A1 METERING, A2 STATUS, A3 POWER ANALYSIS, A4 PRODUCT INFO. Use the MESSAGE ▲ and MESSAGE ▼ keys to move between actual value messages. A detailed description of each displayed message in these groups is given in the sections that follow.

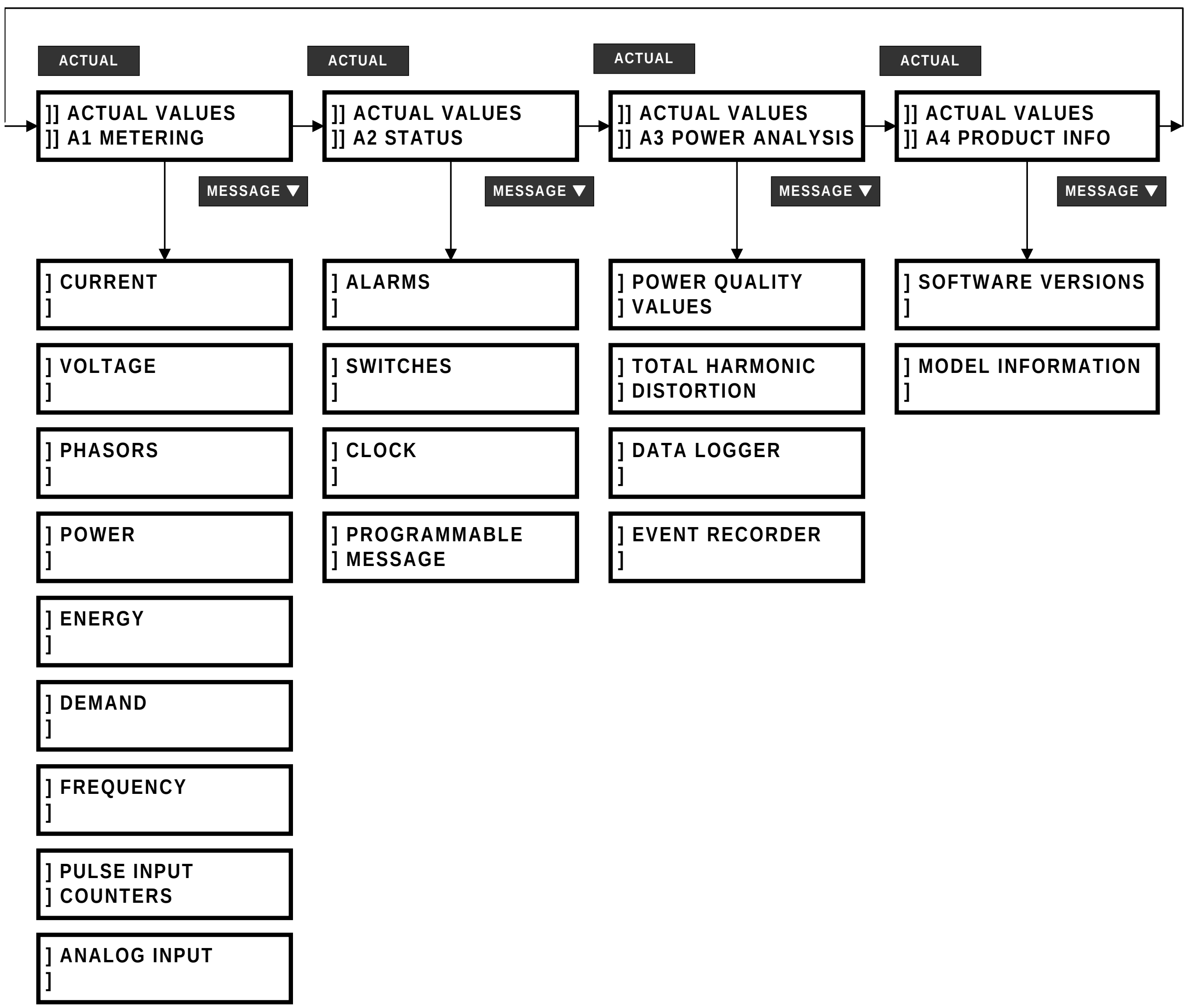


Figure 5–1: ACTUAL VALUES MESSAGE ORGANIZATION

5

5.2.1 CURRENT

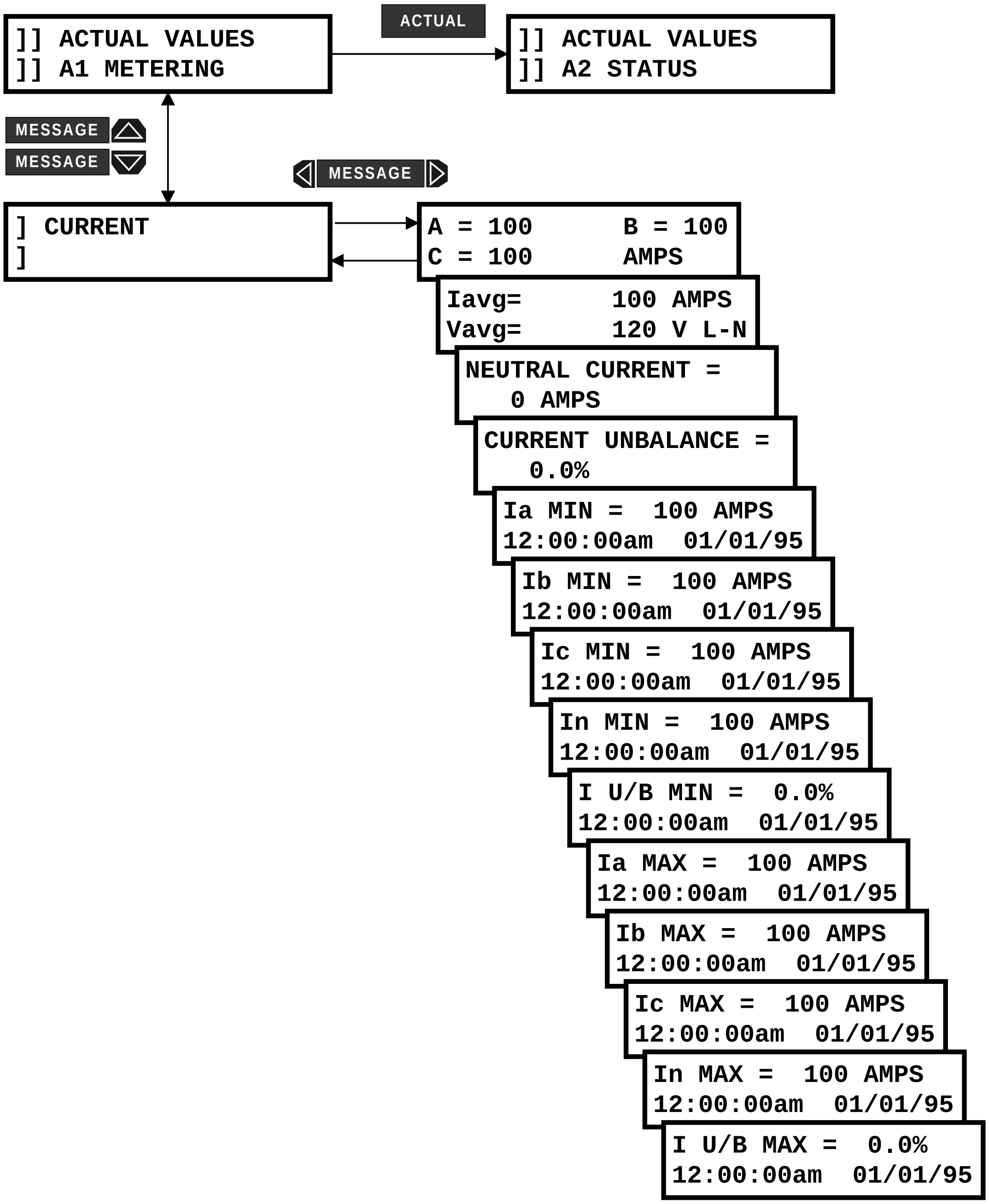


Figure 5–2: ACTUAL VALUES – METERING / CURRENT

A: B: C: CURRENT: Displays the current in each phase corresponding to the A, B, and C phase inputs. Current will be measured correctly only if the **CT PRIMARY** is entered to match the installed CT primary and the CT secondary is wired to match the 1 or 5 A input. If the displayed current does not match the actual current, check this setpoint and wiring.

Iavg/Vavg: Displays the average of the three phase currents and three voltages is displayed in this message. This line is not visible if the **VT WIRING** setpoint is set to SINGLE PHASE DIRECT. L-N is displayed when **VT WIRING** is set to 4 WIRE WYE (3 VTs), 4 WIRE WYE DIRECT, 4 WIRE WYE (2 VTs), or 3 WIRE DIRECT. L-L is displayed when **VT WIRING** is set to 3 WIRE DELTA (2 VTs).

NEUTRAL CURRENT: Neutral current can be determined by two methods. One method measures the current via the neutral CT input. The second calculates the neutral current based on the three phase currents; using the instantaneous samples, $I_a + I_b + I_c = I_n$. If the sum of the phase currents does not equal 0, the result is the neutral current. When using the CT input, the neutral current reading will be correct only if the CT is wired correctly and the correct neutral CT primary value is entered. Verify neutral current by connecting a clamp-on ammeter around all 3 phases. If the neutral current appears incorrect, check the settings in **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION** and verify the CT wiring.

CURRENT UNBALANCE: Displays the percentage of current unbalance. Current unbalance is calculated as:

$$\frac{|I_m - I_{av}|}{I_{av}} \times 100\%$$

where: I_{av} = *average phase current* = $(I_a + I_b + I_c) / 3$
I_m = current in phase with maximum deviation from I_{av},

NOTE

Even though it is possible to achieve unbalance greater than 100% with the above formula, the PQM limits unbalance readings to 100%.

If the average current is below 10% of the **CT PRIMARY** setpoint, the unbalance reading is forced to 0%. This avoids nuisance alarms when the system is lightly loaded. If the simulation currents are being used, the unbalance is never forced to 0%.

Ia, Ib, Ic, In MINIMUM: Displays the minimum current magnitudes and the time and date of their occurrence. This information is stored in non-volatile memory and is retained during loss of control power. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX CURRENT VALUES** setpoint clears these values.

I U/B MINIMUM: Displays the minimum current unbalance and the time and date of its measurement. This information is stored in non-volatile memory and is retained during loss of control power. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX CURRENT VALUES** setpoint clears this value.

Ia, Ib, Ic, In MAXIMUM: Displays the maximum current magnitudes and the time and date of their occurrence. This information is stored in non-volatile memory and is retained during loss of control power. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX CURRENT VALUES** setpoint clears these values.

I U/B MAXIMUM: Displays the maximum current unbalance and the time and date of its measurement. This information is stored in non-volatile memory and is retained during loss of control power. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX CURRENT VALUES** setpoint command clears this value.

5.2.2 VOLTAGE

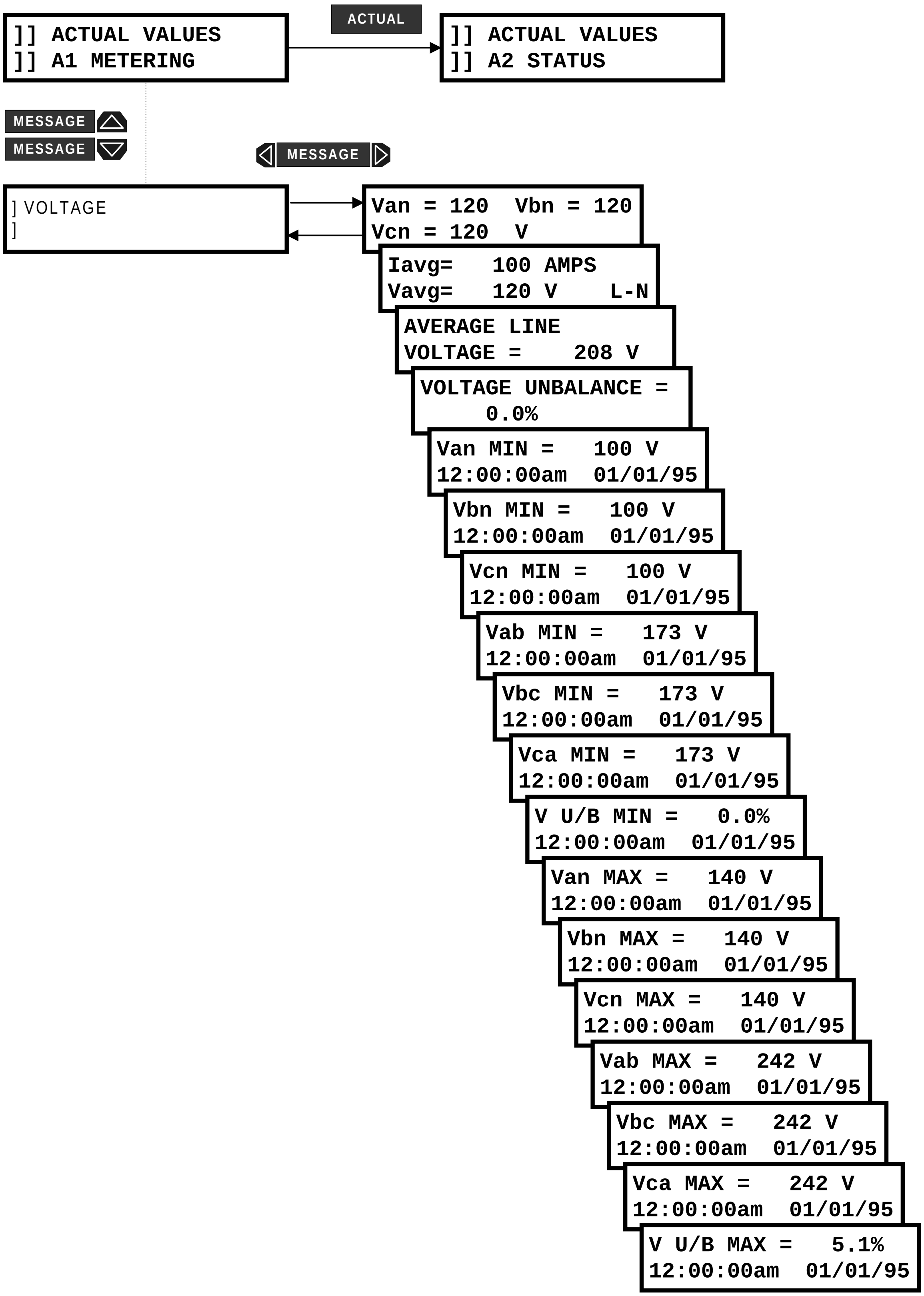


Figure 5–3: ACTUAL VALUES PAGE 1 – METERING / VOLTAGE

Van, Vbn, Vcn, VOLTAGE: Displays each phase voltage corresponding to the A, B, and C voltage inputs. This voltage will be measured correctly only if the **VT RATIO**, **VT NOMINAL SECONDARY**, and **VOLTAGE WIRING** setpoint values match the installed VTs. If the displayed voltage does not match the actual voltage, check the setpoints and wiring. This message appears only if the **VT WIRING** is configured for a wye input.

Iavg/Vavg: Displays the average of the three phase currents/voltages. This value is not visible if the **VT WIRING** setpoint is set to SINGLE PHASE DIRECT. L-N is displayed when **VT WIRING** is set to 4 WIRE WYE (3 VTs), 4 WIRE WYE DIRECT, 4 WIRE WYE (2 VTs), or 3 WIRE DIRECT and L-L is displayed when **VT WIRING** is set to 3 WIRE DELTA (2 VTs).

Vab, Vbc, Vca, VOLTAGE: Displays each line voltage corresponding to the A, B, and C voltage inputs. The measured voltage is correct only if the **VT RATIO**, **VT NOMINAL SECONDARY**, and **VOLTAGE WIRING** setpoints match the installed VTs. If the displayed voltage does not match the actual voltage, check the setpoints and wiring.

AVERAGE LINE VOLTAGE: Displays the average of the three line voltages. This value is not visible if the **VT WIRING** setpoint is set to SINGLE PHASE DIRECT.

VOLTAGE UNBALANCE: Displays the percentage voltage unbalance. Voltage unbalance is calculated as shown below. If the **VOLTAGE WIRING** is configured for a WYE input, voltage unbalance is calculated using phase quantities. If the **VT WIRING** is configured as a DELTA input, voltage unbalance is calculated using line voltages.

$$\frac{|V_m - V_{av}|}{V_{av}} \times 100\%$$

where: V_{av} = average phase voltage = $(V_{an} + V_{bn} + V_{cn})$ / 3 for WYE and 3 WIRE DIRECT connections
= average line voltage $(V_{ab} + V_{bc} + V_{ca})$ / 3 for 3 WIRE DELTA/2 VTs connection
V_m = voltage in a phase (or line) with maximum deviation from V_{av}.

NOTE

Even though it is possible to achieve unbalance greater than 100% with the above formula, the PQM will limit unbalance readings to 100%.

If the average voltage is below 10% of **VT RATIO** × **VT NOMINAL SECONDARY VOLTAGE** for 3 WIRE DELTA/2 VTs, 4 WIRE WYE/3 VTs, and 4 WIRE WYE/2 VTs connections, or below 10% of **VT RATIO** × **NOMINAL DIRECT INPUT VOLTAGE** for 4 WIRE WYE/DIRECT and 3 WIRE DIRECT connections, the unbalance reading is forced to 0%. This is implemented to avoid nuisance alarms when the system is lightly loaded. If the simulation voltages are being used, the unbalance is never forced to 0%.

Van, Vbn, Vcn MINIMUM: Displays the minimum phase voltage magnitudes and the time and date of their occurrence. This information is stored in non-volatile memory and is retained during loss of control power. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX VOLTAGE VALUES** setpoint clears these values.

Vab, Vbc, Vca MINIMUM: Displays the minimum line voltage magnitudes and the time and date of their occurrence. This information is stored in non-volatile memory and is retained during loss of control power. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX VOLTAGE VALUES** setpoint clears these values.

V U/B MINIMUM: Displays minimum voltage unbalance and the time and date of its measurement. This information is stored in non-volatile memory and is retained during loss of control power. This value is cleared with the **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX VOLTAGE VALUES** setpoint.

Van, Vbn, Vcn MAXIMUM: Displays the maximum phase voltage magnitudes and the time and date of their occurrence. This information is stored in non-volatile memory and is retained during loss of control power. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX VOLTAGE VALUES** setpoint clears these values.

Vab, Vbc, Vca MAXIMUM: Displays the maximum line voltage magnitudes and the time and date of their occurrence. This information is stored in non-volatile memory and is retained during loss of control power. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX VOLTAGE VALUES** setpoint clears these values.

V U/B MAXIMUM: Displays the maximum voltage unbalance and the time and date of its measurement. This information is stored in non-volatile memory and is retained during loss of control power. The value is cleared with the **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX VOLTAGE VALUES** setpoint.

5.2.3 PHASORS

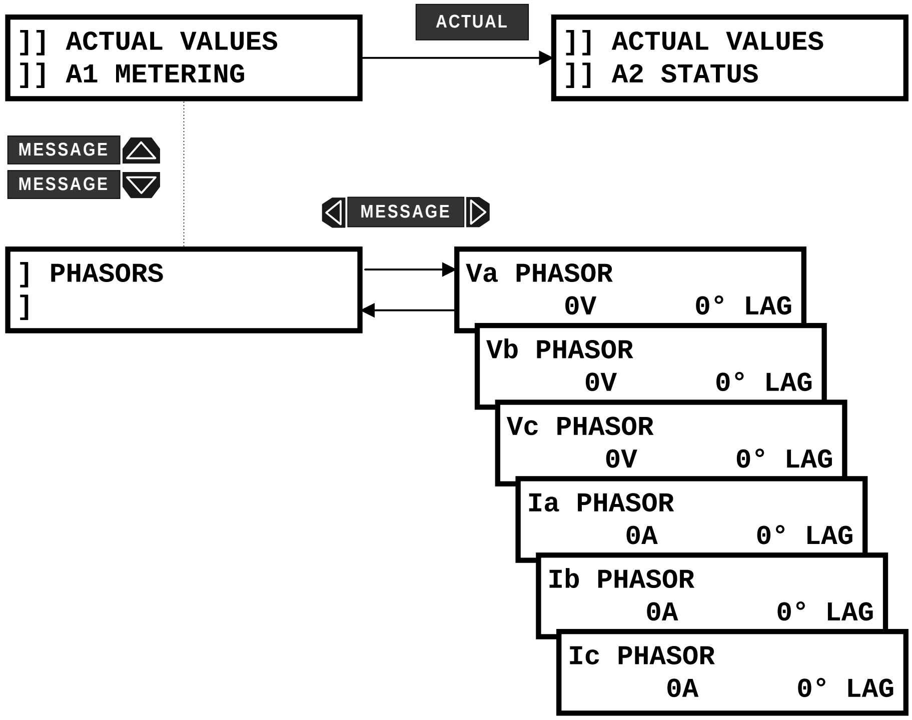


Figure 5–4: ACTUAL VALUES PAGE 1 – METERING/PHASORS

Va PHASOR: Displays a phasor representation for the magnitude and angle of Va. Va is used as a reference for all other phasor angles. If there is no voltage present at the PQM voltage inputs, then Ia will be used as the reference for all other angles. Va is also used as the reference when in Simulation Mode.

Vb PHASOR: Displays a phasor representation for the magnitude and angle of Vb. Vb uses the angle of Va as a reference point. If there is no voltage at the PQM voltage inputs, Ia is used as the reference. Vb is not displayed when the PQM is configured for the 3 WIRE DELTA/2 VTs, 4 WIRE WYE/2 VTs, or SINGLE PHASE DIRECT connections.

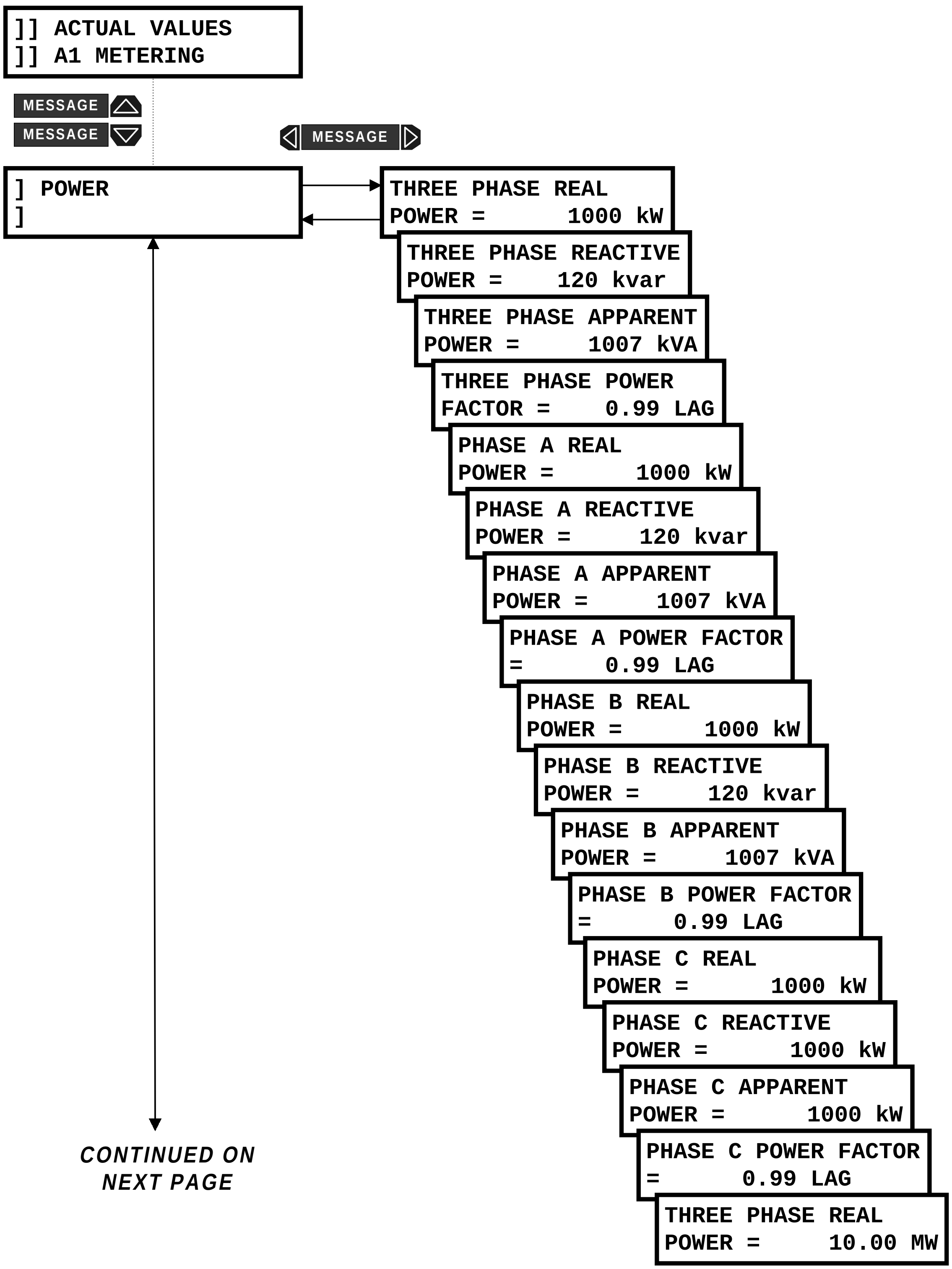
Vc PHASOR: A phasor representation for the magnitude and angle of Vc is displayed here. Vc uses the angle of Va as a reference point. If there is no voltage at the PQM voltage inputs, Ia is used as the reference. Vc is not displayed when the PQM is configured for SINGLE PHASE DIRECT connection.

Ia PHASOR: A phasor representation for the magnitude and angle of Ia is displayed here. Ia is used as a reference for all other Phasor angles only when there is no voltage present at the PQM voltage inputs, otherwise, Va is used as the reference.

Ib PHASOR: A phasor representation for the magnitude and angle of Ib is displayed here. Ib uses the angle of Va as a reference point. If there is no voltage at the PQM voltage inputs, Ia is used as the reference. Ib is not displayed when the PQM is configured for SINGLE PHASE DIRECT connection.

Ic PHASOR: A phasor representation for the magnitude and angle of Ic is displayed here. Ic is uses the angle of Va as a reference point. If there is no voltage at the PQM voltage inputs, Ia is used as the reference. Ic is not displayed when the PQM is configured for SINGLE PHASE DIRECT connection.

5.2.4 POWER



]] ACTUAL VALUES
]] A1 METERING
MESSAGE
MESSAGE
MESSAGE
] POWER
]
THREE PHASE REAL POWER = 1000 kW
THREE PHASE REACTIVE POWER = 120 kvar
THREE PHASE APPARENT POWER = 1007 kVA
THREE PHASE POWER FACTOR = 0.99 LAG
PHASE A REAL POWER = 1000 kW
PHASE A REACTIVE POWER = 120 kvar
PHASE A APPARENT POWER = 1007 kVA
PHASE A POWER FACTOR = 0.99 LAG
PHASE B REAL POWER = 1000 kW
PHASE B REACTIVE POWER = 120 kvar
PHASE B APPARENT POWER = 1007 kVA
PHASE B POWER FACTOR = 0.99 LAG
PHASE C REAL POWER = 1000 kW
PHASE C REACTIVE POWER = 1000 kW
PHASE C APPARENT POWER = 1000 kW
PHASE C POWER FACTOR = 0.99 LAG
THREE PHASE REAL POWER = 10.00 MW
CONTINUED ON NEXT PAGE

5

CONTINUED FROM PREVIOUS PAGE

MESSAGE ▲
MESSAGE ▼

```
THREE PHASE REACTIVE
POWER = 1.20 Mvar
```

```
THREE PHASE APPARENT
POWER = 10.07 MVA
```

```
3Φ kW MIN =        1000
12:00:00am    01/01/95
```

```
3Φ kvar MIN =       120
12:00:00am    01/01/95
```

```
3Φ kVA MIN =       1007
12:00:00am    01/01/95
```

```
3Φ PF MIN =   0.99 LAG
12:00:00am    01/01/95
```

```
3Φ kW MAX =        1000
12:00:00am    01/01/95
```

```
3Φ kvar MAX =       120
12:00:00am    01/01/95
```

```
3Φ PF MAX =   0.99 LAG
12:00:00am    01/01/95
```

```
AΦ kW MIN =        1000
12:00:00am    01/01/95
```

```
AΦ kvar MIN =       120
12:00:00am    01/01/95
```

```
AΦ kVA MIN =       1007
12:00:00am    01/01/95
```

```
AΦ PF MIN =   0.99 LAG
12:00:00am    01/01/95
```

```
AΦ kW MAX =        1000
12:00:00am    01/01/95
```

```
AΦ kvar MAX =       120
12:00:00am    01/01/95
```

```
AΦ kVA MAX =       1007
12:00:00am    01/01/95
```

```
AΦ PF MAX =   0.99 LAG
12:00:00am    01/01/95
```

CONTINUED ON NEXT PAGE

5

CONTINUED FROM PREVIOUS PAGE

MESSAGE ▲
MESSAGE ▼

```
BΦ kW MIN =      1000
12:00:00am  01/01/95

BΦ kvar MIN =     120
12:00:00am  01/01/95

BΦ kVA MIN =     1007
12:00:00am  01/01/95

BΦ PF MIN = 0.99 LAG
12:00:00am  01/01/95

BΦ kW MAX =      1000
12:00:00am  01/01/95

BΦ kvar MAX =     120
12:00:00am  01/01/95

BΦ kVA MAX =     1007
12:00:00am  01/01/95

BΦ PF MAX = 0.99 LAG
12:00:00am  01/01/95

CΦ kW MIN =      1000
12:00:00am  01/01/95

CΦ kvar MIN =     120
12:00:00am  01/01/95

CΦ kVA MIN =     1007
12:00:00am  01/01/95

CΦ PF MIN = 0.99 LAG
12:00:00am  01/01/95

CΦ kW MAX =      1000
12:00:00am  01/01/95

CΦ kvar MAX =     120
12:00:00am  01/01/95

CΦ kVA MAX =     1007
12:00:00am  01/01/95

CΦ PF MAX = 0.99 LAG
12:00:00am  01/01/95
```

Figure 5–5: ACTUAL VALUES PAGE 1 – METERING/POWER

5

THREE PHASE/A/B/C REAL POWER: The total RMS three phase real power as well as the individual phase A/B/C real power is displayed in these messages. The phase A/B/C real power messages will be displayed only for a WYE or 3 WIRE DIRECT connected system. The PQM shows direction of flow by displaying the signed value of kW. Refer to Figure 5.6 for the convention used to describe power direction.

THREE PHASE/A/B/C REACTIVE POWER: The total RMS three phase reactive power as well as the individual phase A/B/C reactive power is displayed in these messages. The phase A/B/C reactive power messages will be displayed only for a WYE or 3 WIRE DIRECT connected system. The PQM shows direction of flow by displaying the signed value of kvar. Refer to Figure 5.6 for the convention used to describe power direction.

THREE PHASE/A/B/C APPARENT POWER: The total RMS three phase apparent power as well as the individual phase A/B/C apparent power is displayed in these messages. The phase A/B/C apparent power messages will be displayed only for a WYE or 3 WIRE DIRECT connected system.

THREE PHASE/A/B/C POWER FACTOR: The three phase true power factor as well as the individual phase A/B/C true power factors is displayed in these messages. The phase A/B/C true power factor messages will be displayed only for a WYE or 3 WIRE DIRECT connected system.

THREE PHASE/A/B/C kW MINIMUM: The minimum three phase real power as well as the minimum individual phase A/B/C real power is displayed in these messages. The time and date at which these minimum values were measured is also displayed in these messages. This information is stored in non-volatile memory and will be retained during a loss of control power. The phase A/B/C minimum real power messages will be displayed only for a WYE connected system. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX POWER VALUES** is used to clear these values.

5

THREE PHASE/A/B/C kvar MINIMUM: The minimum three phase reactive power as well as the minimum individual phase A/B/C reactive power is displayed in these messages. The time and date at which these minimum values were measured is also displayed in these messages. This information is stored in non-volatile memory and will be retained during a loss of control power. The phase A/B/C minimum reactive power messages will be displayed only for a WYE connected system. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX POWER VALUES** is used to clear these values.

THREE PHASE/A/B/C kVA MINIMUM: The minimum three phase apparent power as well as the minimum individual phase A/B/C apparent power is displayed in these messages. The time and date at which these minimum values were measured is also displayed in these messages. This information is stored in non-volatile memory and will be retained during a loss of control power. The phase A/B/C minimum apparent power messages will be displayed only for a WYE connected system. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX POWER VALUES** is used to clear these values.

THREE PHASE/A/B/C PF MINIMUM: The minimum three phase lead or lag power factor as well as the minimum lead or lag individual phase A/B/C power factor is displayed in these messages. The time and date at which these minimum values were measured is also displayed in these messages. This information is stored in non-volatile memory and will be retained during a loss of control power. The phase A/B/C minimum lead or lag power factor messages will be displayed only for a WYE connected system. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX POWER VALUES** is used to clear these values.

THREE PHASE/A/B/C kW MAXIMUM: The maximum three phase real power as well as the maximum individual phase A/B/C real power is displayed in these messages. The time and date at which these maximum values were measured is also displayed in these messages. This information is stored in non-volatile memory and will be retained during a loss of control power. The phase A/B/C maximum real power messages will be displayed only for a WYE connected system. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX POWER VALUES** is used to clear these values.

THREE PHASE/A/B/C kvar MAXIMUM: The maximum three phase reactive power as well as the maximum individual phase A/B/C reactive power is displayed in these messages. The time and date at which these maximum values were measured is also displayed in these messages. This information is stored in non-volatile memory and will be retained during a loss of control power. The phase A/B/C maximum reactive power messages will be displayed only for a WYE connected system. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX POWER VALUES** is used to clear these values.

THREE PHASE/A/B/C kVA MAXIMUM: The maximum three phase apparent power as well as the maximum individual phase A/B/C apparent power is displayed in these messages. The time and date at which these maximum values were measured is also displayed in these messages. This information is stored in non-volatile memory and will be retained during a loss of control power. The phase A/B/C maximum apparent power messages will be displayed only for a WYE connected system. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX POWER VALUES** is used to clear these values.

THREE PHASE/A/B/C PF MAXIMUM: The maximum three phase lead or lag power factor as well as the maximum lead or lag individual phase A/B/C power factor is displayed in these messages. The time and date at which these maximum values were measured is also displayed in these messages. This information is stored in non-volatile memory and will be retained during a loss of control power. The phase A/B/C maximum lead or lag power factor messages will be displayed only for a WYE connected system. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX POWER VALUES** is used to clear these values.

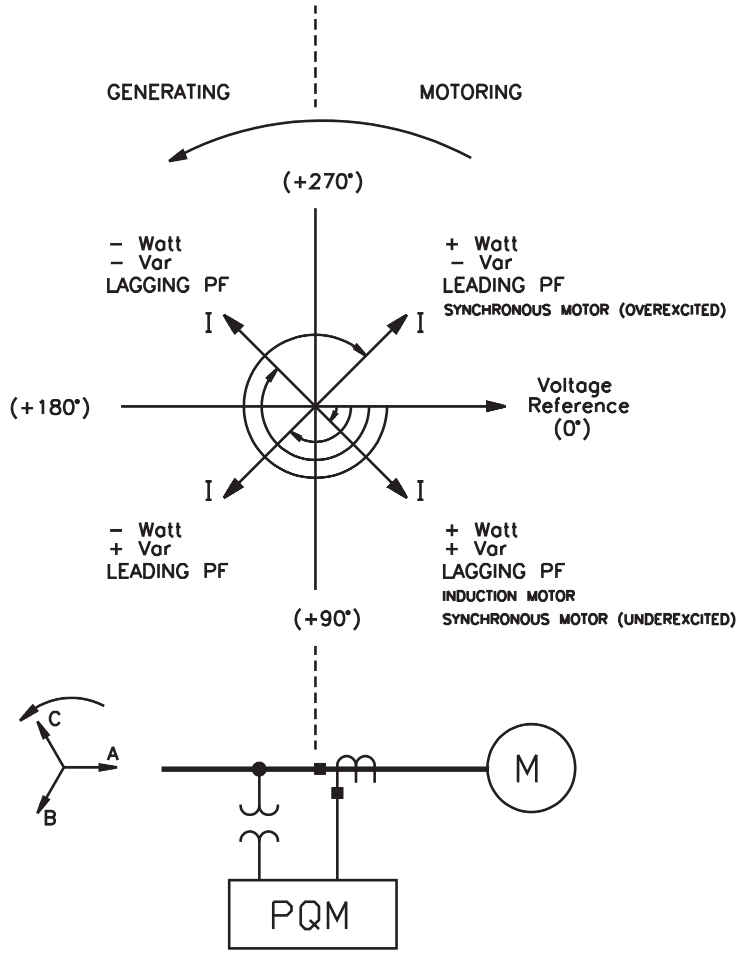


Figure 5–6: POWER MEASUREMENT CONVENTIONS

5.2.5 ENERGY

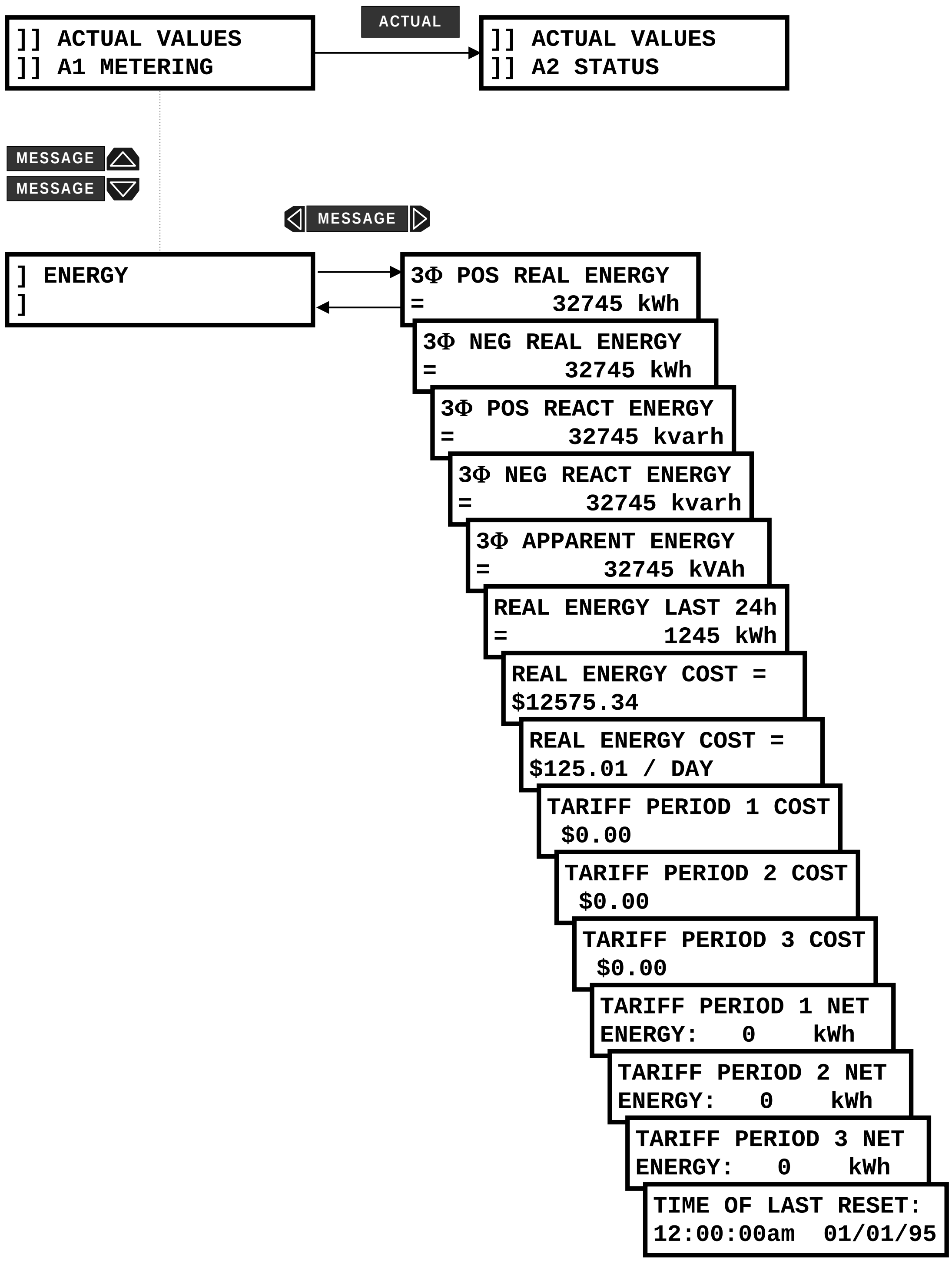


Figure 5–7: ACTUAL VALUES PAGE 1 – METERING / ENERGY

3Φ POS REAL ENERGY: This message displays the positive watthours (in kWh) since the **TIME OF LAST RESET** date. Real power in the positive direction will add to this accumulated value, and real power in the negative direction will add to the negative watthour value. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR ENERGY VALUES** is used to clear this value. The displayed value rolls over to 0 once the value 4294967295 (FFFFFFFFh) has been reached.

3Φ NEG REAL ENERGY: This message displays the negative watthours (in kWh) since the **TIME OF LAST RESET** date. Real power in the negative direction will add to this accumulated value, and real power in the positive direction will add to the positive watthour value. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR ENERGY VALUES** is used to clear this value. The displayed value will roll over to 0 once the value 4294967295 (FFFFFFFFh) has been reached.

3Φ POS REACT ENERGY: This message displays the positive varhours (in kvarh) since the **TIME OF LAST RESET** date. Reactive power in the positive direction will add to this accumulated value, and reactive power in the negative direction will add to the negative varhour value. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR ENERGY VALUES** is used to clear this value. The displayed value will roll over to 0 once the value 4294967295 (FFFFFFFFh) has been reached.

3Φ NEG REACT ENERGY: This message displays the negative varhours (in kvarh) since the **TIME OF LAST RESET** date. Reactive power in the negative direction will add to this accumulated value, and reactive power in the positive direction will add to the positive varhour value. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR ENERGY VALUES** setpoint clears this value. The displayed value will roll over to 0 once the value 4294967295 (FFFFFFFFh) has been reached.

3Φ APPARENT ENERGY: This message displays the accumulated VAhours (in kVAh) since the TIME OF LAST RESET date. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR ENERGY VALUES** clears this value. The displayed value will roll over to 0 once the value 4294967295 (FFFFFFFFh) has been reached.

5

REAL ENERGY LAST 24h: This message displays the accumulated real energy (in kWh) over the last 24-hour period. The 24-hour period used by the PQM is started when control power is applied. The PQM updates this value every hour based on the previous 24-hour period. This information will be lost if control power to the PQM is removed.

REAL ENERGY COST: This message displays the total cost for the real energy accumulated since the **TIME OF LAST RESET** date. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR ENERGY VALUES** clears this value.

REAL ENERGY COST PER DAY: This message displays the average cost of real energy per day from time of last reset to the present day. The cost per kWh is entered in the **S1 PQM SETUP \ CALCULATION PARAMETERS \ ENERGY COST PER KWH** setpoint.

TARIFF PERIOD 1/2/3 COST: These messages display the cost accrued for the three user-definable tariff periods. The start time and cost per MWh for these tariff periods are entered with the **S1 PQM SETUP \ CALCULATION PARAMETERS \ TARIFF PERIOD 1/2/3 START TIME** and the **S1 PQM SETUP \ CALCULATION PARAMETERS \ TARIFF PERIOD 1/2/3 COST PER MWH** setpoints, respectively.

TARIFF PERIOD 1/2/3 NET ENERGY: These messages display the net energy for the three user-definable tariff periods. The start time and cost per MWh for these tariff periods are entered with the **S1 PQM SETUP \ CALCULATION PARAMETERS \ TARIFF PERIOD 1/2/3 START TIME** and the **S1 PQM SETUP \ CALCULATION PARAMETERS \ TARIFF PERIOD 1/2/3 COST PER MWH** setpoints, respectively.

TIME OF LAST RESET: This message displays the time and date when the energy parameters were last cleared. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR ENERGY VALUES** clears the energy values.

5.2.6 DEMAND

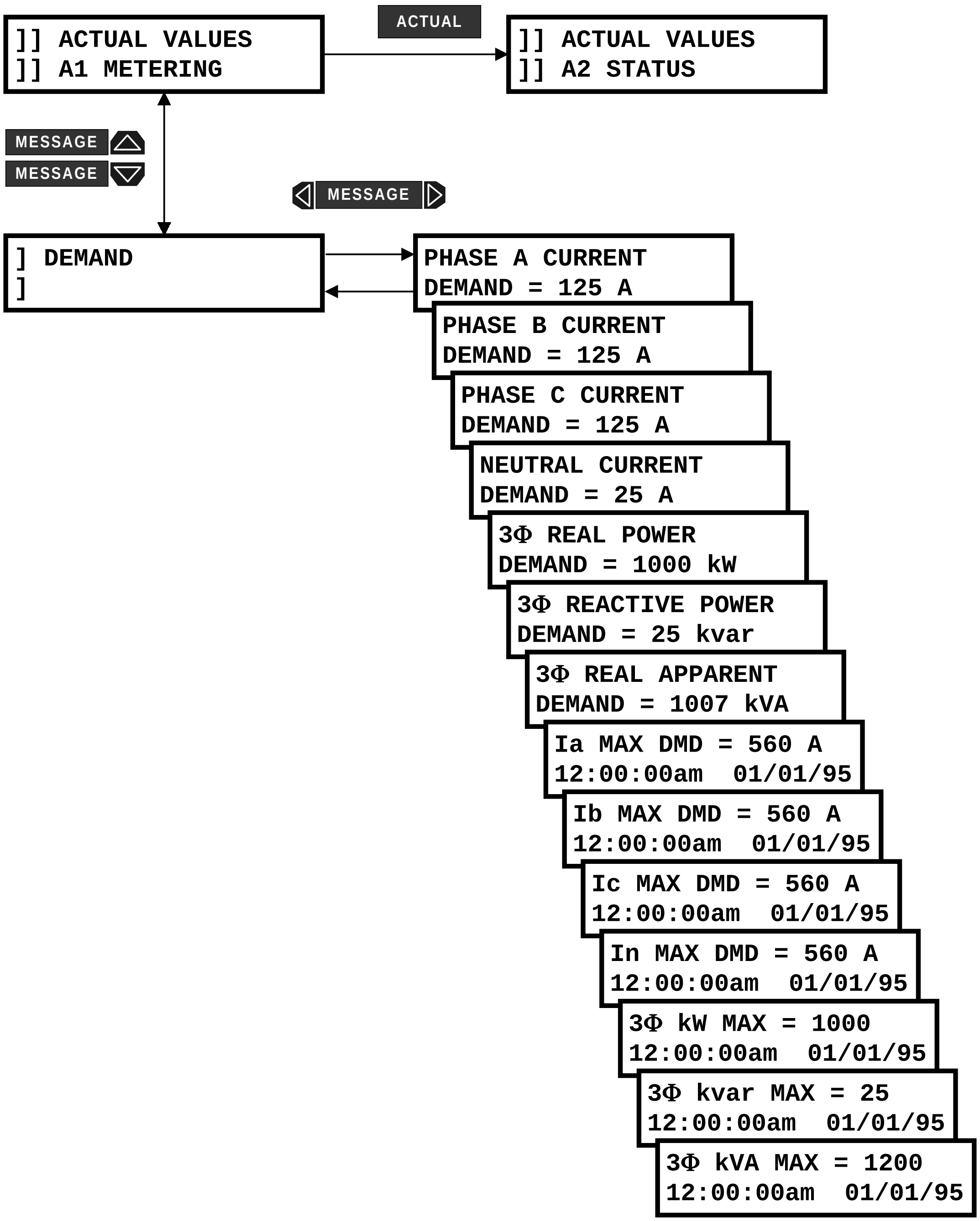


Figure 5–8: ACTUAL VALUES PAGE 1 – METERING / DEMAND

PHASE A/B/C/NEUTRAL DEMAND: This message displays the phase A/B/C/N current demand (in Amps) over the most recent time interval.

3Φ REAL POWER DEMAND: This message displays the 3 phase real power demand (in kW) over the most recent time interval.

3Φ REACTIVE POWER DEMAND: This message displays the 3 phase reactive power demand (in kvar) over the most recent time interval.

3Φ APPARENT POWER DEMAND: This message displays the 3 phase apparent power demand (in kVA) over the most recent time interval.

A/B/C/N CURRENT MAX DEMAND: This message displays the maximum phase A/B/C/N current demand (in Amps) and the time and date when this occurred. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MAX DEMAND VALUES** is used to clear this value.

3Φ kW MAX: This message displays the maximum three-phase real power demand (in kW) and the time and date when this occurred. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MAX DEMAND VALUES** clears this value.

3Φ kvar MAX: This message displays the maximum 3 phase reactive power demand (in kvar) and the time and date when this occurred. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MAX DEMAND VALUES** is used to clear this value.

3Φ kVA MAX: This message displays the maximum 3 phase apparent power demand (in kVA) and the time and date when this occurred. The setpoint **S1 PQM SETUP\CLEAR DATA\CLEAR MAX DEMAND VALUES** is used to clear this value.

5.2.7 FREQUENCY

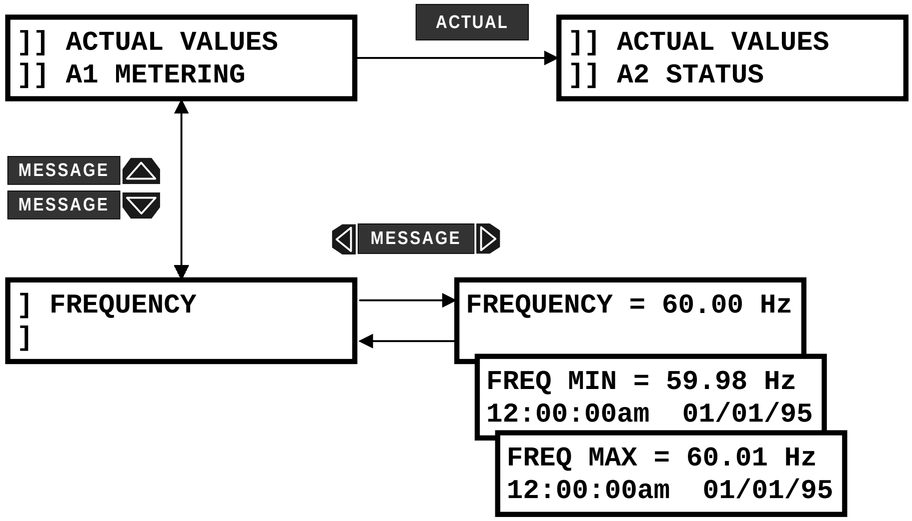


Figure 5–9: ACTUAL VALUES PAGE 1 – METERING / FREQUENCY

FREQUENCY: This message displays the frequency (in Hz). Frequency is calculated from the phase A-N voltage (when setpoint **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING** is WYE) or from phase A-B voltage (when setpoint **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING** is DELTA). A value of 0.00 is displayed if there is insufficient voltage applied to the PQM's terminals (less than 30 V on phase A).

FREQUENCY MIN: This message displays the minimum frequency measured as well as the time and date at which the minimum frequency occurred. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX FREQUENCY VALUES** setpoint clears these values.

FREQUENCY MAX: This message displays the maximum frequency measured as well as the time and date at which the maximum frequency occurred. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR MIN/MAX FREQUENCY VALUES** setpoint clears these values.

5.2.8 PULSE COUNTER

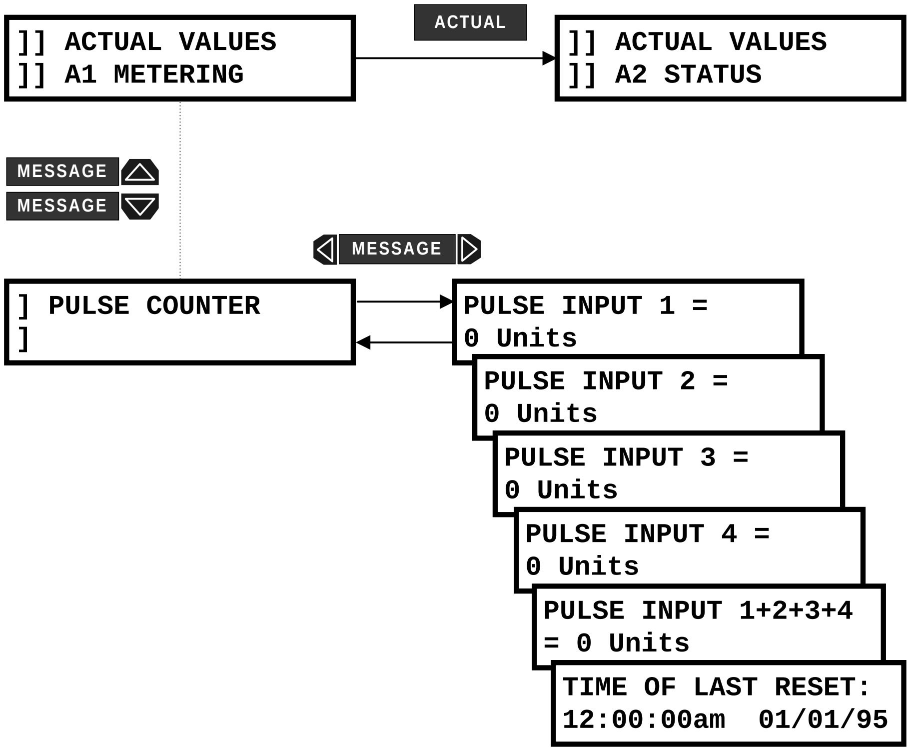


Figure 5–10: ACTUAL VALUES PAGE 1 – METERING / PULSE COUNTER

PULSE INPUT 1: This message displays the accumulated value based on total number of pulses counted since the last reset. One switch input pulse is equal to the value assigned in the **S2 SYSTEM SETUP \ PULSE INPUT \ PULSE INPUT 1 VALUE** setpoint. The units shown after the value are as defined in the **S2 SYSTEM SETUP \ PULSE INPUT \ PULSE INPUT UNITS** setpoint. The displayed value will roll over to 0 once the value 4294967295 (FFFFFFFFh) has been reached. To use this feature, the “C” (control) option must be installed and one of the PQM switch inputs must be assigned to PULSE INPUT 1 function. The switch input will then count the number of closures or openings depending upon how the switch is configured. See setpoints page **S2 SYSTEM SETUP \ SWITCH INPUT A/B/C/D** for details on programming the switch inputs. The minimum timing requirements are shown below in Figure 5.11.

PULSE INPUT 2: See the **PULSE INPUT 1** description above and replace all references to **PULSE INPUT 1** with **PULSE INPUT 2**.

PULSE INPUT 3: See the **PULSE INPUT 1** description above and replace all references to **PULSE INPUT 1** with **PULSE INPUT 3**.

PULSE INPUT 4: See the **PULSE INPUT 1** description above and replace all references to **PULSE INPUT 1** with **PULSE INPUT 4**.

PULSE IN 1+2+3+4: The totalized pulse input value is displayed here. The pulse inputs totalized is based on the **S2 SYSTEM SETUP \ PULSE INPUT \ PULSE INPUT TOTAL** setpoint.

TIME OF LAST RESET: This message displays the time and date when the pulse input values were last cleared. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR PULSE INPUT VALUES** setpoint clears the pulse input values.

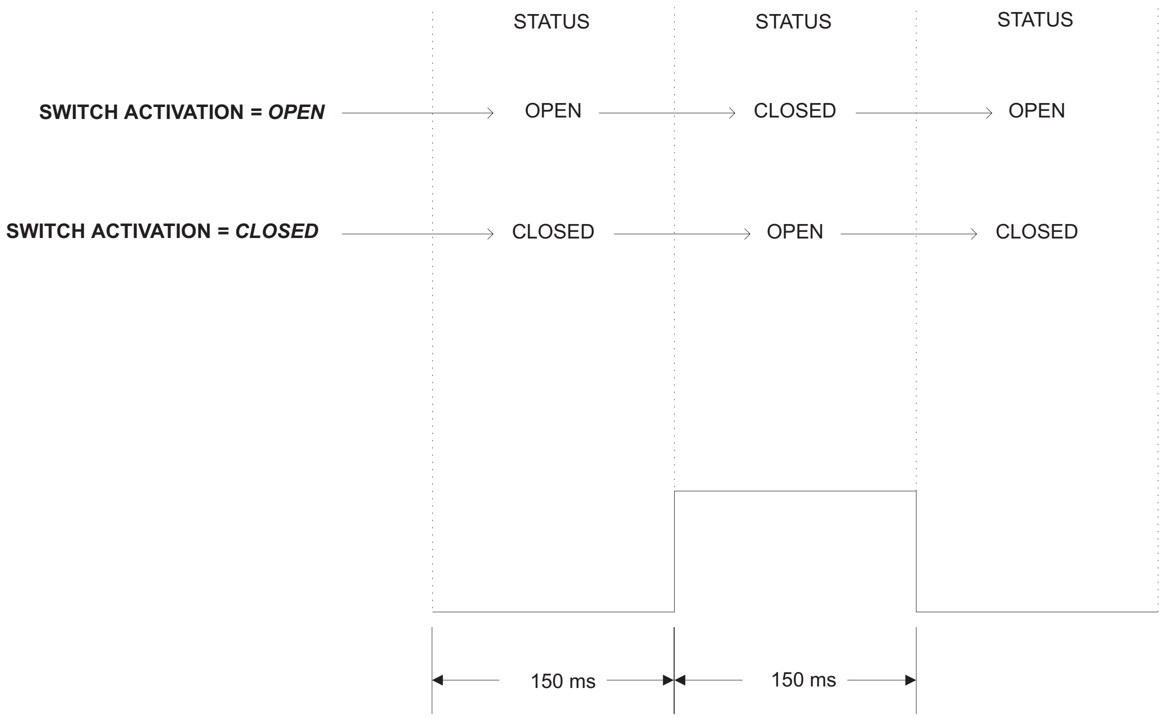


Figure 5–11: PULSE INPUT TIMING

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5.2.9 ANALOG INPUT

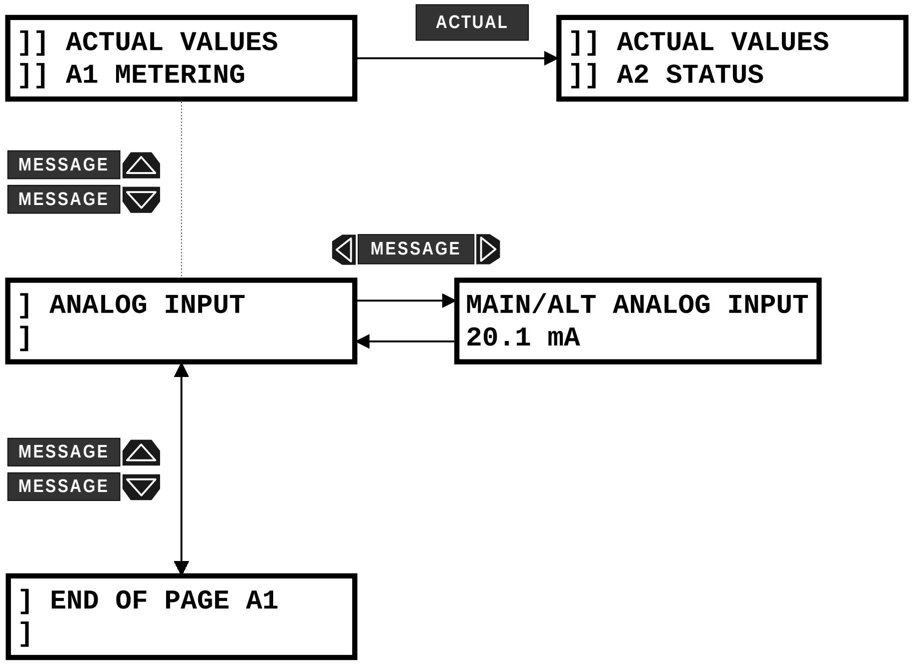

Figure 5–12: ACTUAL VALUES PAGE 1 – METERING / ANALOG INPUT

ANALOG INPUT: This message displays the measured 4 to 20 mA analog input scaled to the user defined name and units. The analog input can be configured via a switch input and output relay to multiplex two analog input signals. The displayed user defined name and units will change to the corresponding values depending upon which analog input is connected. Refer to chapter 4, Analog Input, for information regarding user defined names and units as well as analog input multiplexing.

5.3.1 ALARMS

]] ACTUAL VALUES
]] A2 STATUS

MESSAGE
MESSAGE

MESSAGE

] ALARMS
]

PHASE UNDERCURRENT ALARM

PHASE OVERCURRENT ALARM

NEUTRAL OVERCURRENT ALARM

UNDERVOLTAGE ALARM

OVERVOLTAGE ALARM

VOLTAGE UNBALANCE ALARM

CURRENT UNBALANCE ALARM

PHASE REVERSAL ALARM

POWER FACTOR LEAD 1 ALARM

POWER FACTOR LEAD 2 ALARM

POWER FACTOR LAG 1 ALARM

POWER FACTOR LAG 2 ALARM

POSITIVE REAL POWER ALARM

NEGATIVE REAL POWER ALARM

POSITIVE REACTIVE POWER ALARM

NEGATIVE REACTIVE POWER ALARM

UNDERFREQUENCY ALARM

OVERFREQUENCY ALARM

PHASE A CURRENT DEMAND ALARM

PHASE B CURRENT DEMAND ALARM

CONTINUED ON NEXT PAGE

CONTINUED FROM PREVIOUS PAGE

PHASE C CURRENT DEMAND ALARM

DATA LOG 1 ALARM

DATA LOG 2 ALARM

NEUTRAL CURRENT DEMAND ALARM

POSITIVE REAL POWER DEMAND ALARM

NEGATIVE REAL POWER DEMAND ALARM

POSITIVE REACTIVE POWER DEMAND ALARM

NEGATIVE REACTIVE POWER DEMAND ALARM

APPARENT POWER DEMAND ALARM

SWITCH INPUT A ALARM

SWITCH INPUT B ALARM

SWITCH INPUT C ALARM

SWITCH INPUT D ALARM

SELF-TEST FAILURE ALARM

SERIAL COM1 FAILURE ALARM

SERIAL COM2 FAILURE ALARM

CLOCK NOT SET ALARM

MAIN ANALOG INPUT ALARM

ALT ANALOG INPUT ALARM

CRITICAL SETPOINTS NOT STORED

CURRENT THD ALARM

VOLTAGE THD ALARM

MESSAGE △
MESSAGE ▽

CONTINUED ON NEXT PAGE

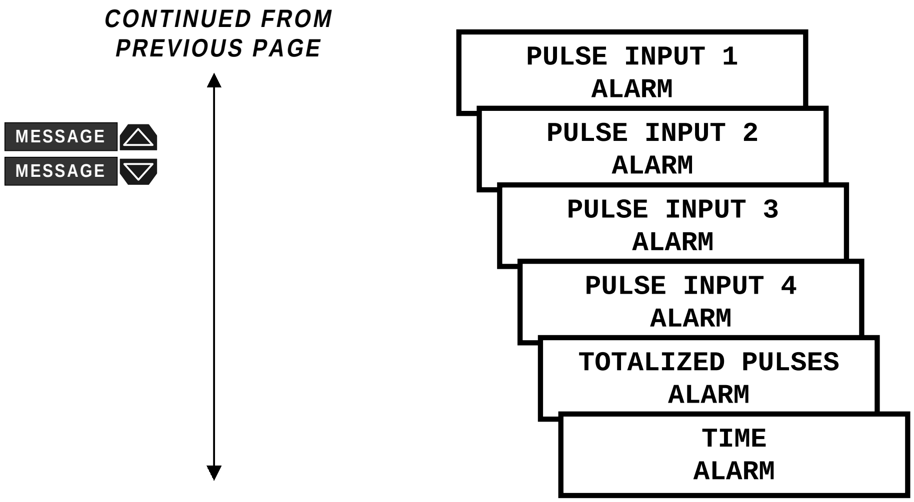

Figure 5–13: ACTUAL VALUES PAGE 2 – STATUS / ALARMS

The alarm messages appear only when the alarm threshold has been exceeded for the programmed time. When an alarm is assigned to an output relay, the relay can be set to be unlatched or latched. When the alarm is set as unlatched, it automatically resets when the alarm condition no longer exists. If the alarm is set as latched, a keypad reset or a serial port reset is required.

NOTE

The **SELF TEST ALARM** occurs if a fault in the PQM hardware is detected. This alarm is permanently assigned to the alarm output relay and is not user configurable. If this alarm is present, contact the GE Power Management Service Department.

5.3.2 SWITCH STATUS

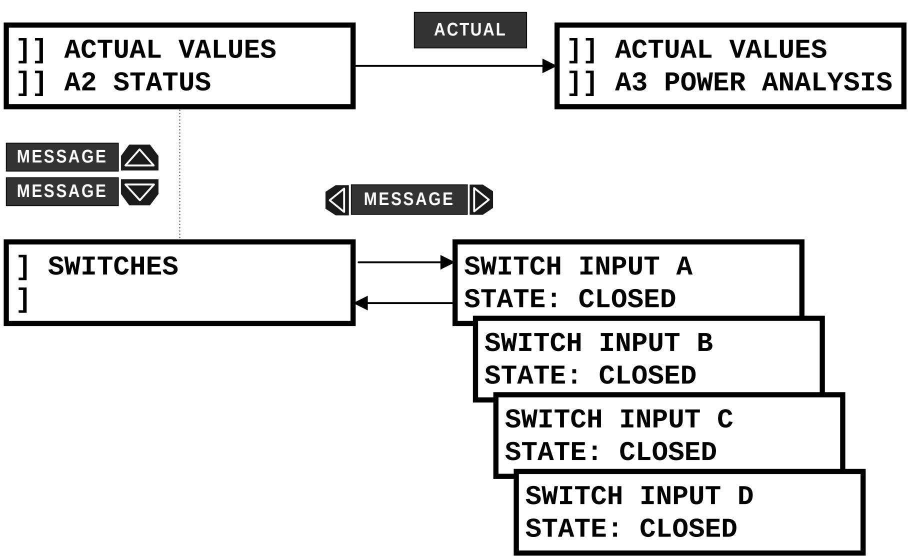

Figure 5–14: ACTUAL VALUES PAGE 2 – SWITCH STATUS

SWITCH INPUT A/B/C/D STATE: To assist in troubleshooting, the state of each switch can be verified using these messages. A separate message displays the status of each input identified by the corresponding name as shown in the wiring diagrams in chapter 2. For a dry contact closure across the corresponding switch terminals the message will read CLOSED.

5.3.3 CLOCK

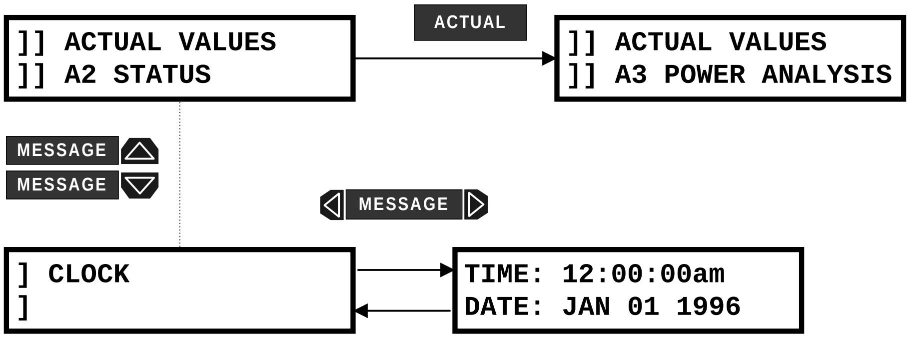

Figure 5–15: ACTUAL VALUES PAGE 2 – CLOCK

TIME/DATE: The current time and date is displayed in this message. The PQM uses an internally generated software clock which runs for at least one hour after the control power has been removed. To set the clock, see setpoints page **S1 PQM SETUP \ CLOCK**. The **S4 ALARMS/CONTROL \ MISCELLANEOUS \ CLOCK NOT SET ALARM** alarm occurs if power has been removed for longer than 1 hour and the clock value has been lost.

5.3.4 PROGRAMMABLE MESSAGE

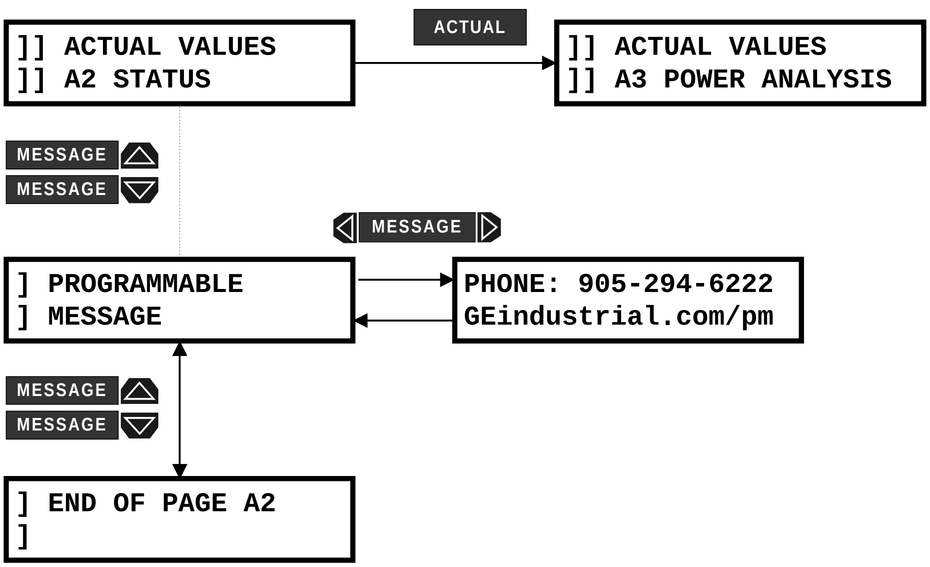

Figure 5–16: ACTUAL VALUES PAGE 2 – PROGRAMMABLE MESSAGE

A 40-character user defined message is displayed. The message is programmed using the keypad or via the serial port using PQMPC. See **S1 PQM SETUP \ PROGRAMMABLE MESSAGE** for programming details.

5.4.1 POWER QUALITY

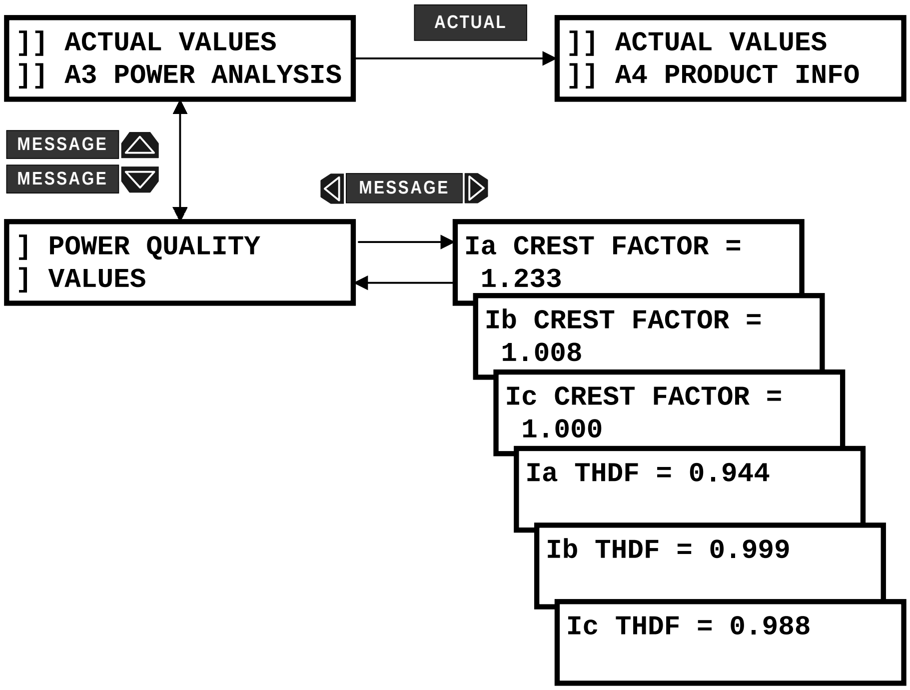

Figure 5–17: ACTUAL VALUES PAGE 3 – POWER QUALITY VALUES

Ia / Ib / Ic CREST FACTOR: The crest factor describes how much the load current can vary from a pure sine wave while maintaining the system's full rating. A completely linear load (pure sine wave) has a crest factor of $\sqrt{2}$ $(1/0.707)$, which is the ratio of the peak value of sine wave to its rms value. Typically, the crest factor can range from $\sqrt{2}$ to 2.5.

Ia/Ib/Ic THDF: Transformer Harmonic Derating Factor (THDF), also known as CBEMA factor, is defined as the crest factor of a pure sine wave $(\sqrt{2})$ divided by the measured crest factor. This method is useful in cases where lower order harmonics are dominant. In a case where higher order harmonics are present, it may be necessary to use a more precise method (K-factor) of calculating the derating factor. This method also does not take into consideration the losses associated with rated eddy current in the transformer. The PQMPC software provides the K-factor method of calculating the derating factor, which is defined on a per unit basis as follows:

$$K = \sum_{h=1}^{h_{max}} I_h \times h^2$$

where: I_h = rms current at harmonic h, in per unit of rated rms load current

5.4.2 TOTAL HARMONIC DISTORTION

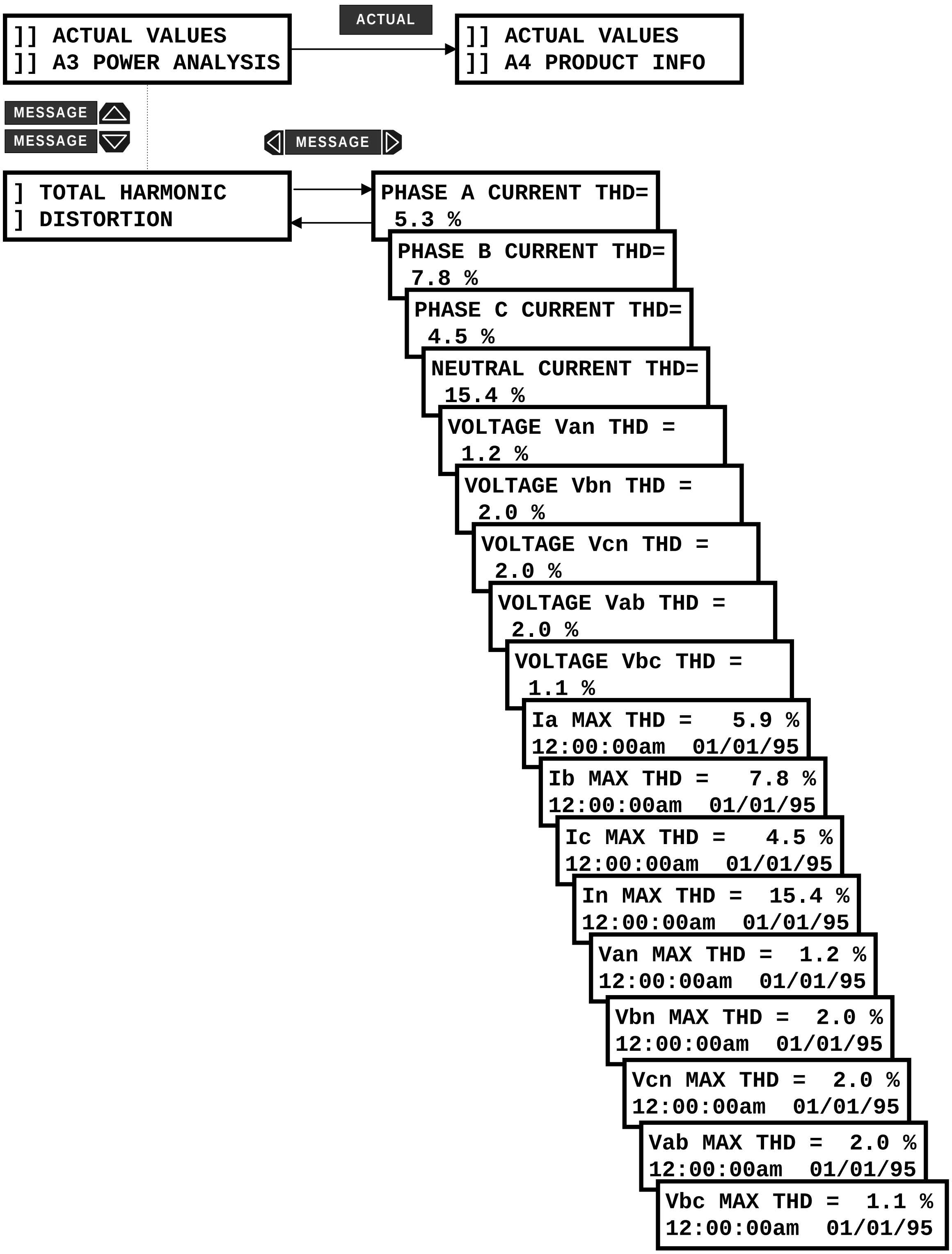

Figure 5–18: ACTUAL VALUES PAGE 3 – TOTAL HARMONIC DISTORTION

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PHASE A/B/C/N CURRENT THD: These messages display the calculated total harmonic distortion for each current input.

VOLTAGE Van/Vbn/Vcn/Vab/Vbc THD: These messages display the calculated total harmonic distortion for each voltage input. Phase to neutral voltages will appear when the setpoint **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING** is stored as WYE. Line to line voltages will appear when the setpoint **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING** is stored as DELTA.

Ia/Ib/Ic/In MAX THD: The maximum total harmonic value for each current input and the time and date which the maximum value occurred are displayed. The **S1 PQM SETUP \ CLEAR DATA \ CLEAR MAX THD VALUES** setpoint clears this value.

Van/Vbn/Vcn/Vab/Vbc MAX THD: These messages display the maximum total harmonic value for each voltage input and the time and date at which the maximum value occurred. The setpoint **S1 PQM SETUP \ CLEAR DATA \ CLEAR MAX THD VALUES** is used to clear this value. Phase to neutral voltages will appear when the setpoint **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING** is set to WYE. Line to line voltages will appear when the setpoint **S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT WIRING** is set to DELTA.

5.4.3 DATA LOGGER

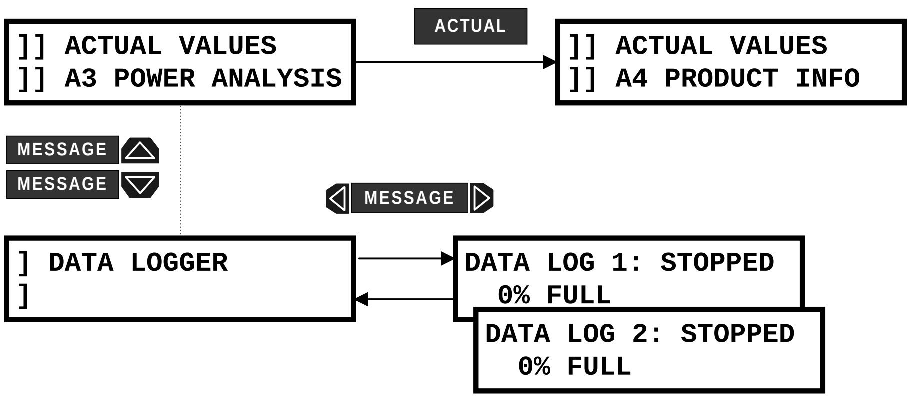

Figure 5–19: ACTUAL VALUES PAGE 3 – DATA LOGGER

DATA LOG 1: This message display the current status of the Data Logger 1. The Data Logger can be set up and run only from PQMPC. See Sections 6.6.4: DATA LOGGER on page 6–18 and A.1.6: DATA LOGGER IMPLEMENTATION on page A–12 for a details on the Data Logger feature.

NOTE

It is possible to stop the data logger from the PQM front panel using the **S2 SYSTEM SETUP/DATA LOGGER/STOP DATA LOGGER 1** setpoint.

DATA LOG 2: See DATA LOG 1 description above and replace all references to DATA LOGGER 1 with DATA LOGGER 2.

5.4.4 EVENT RECORDER

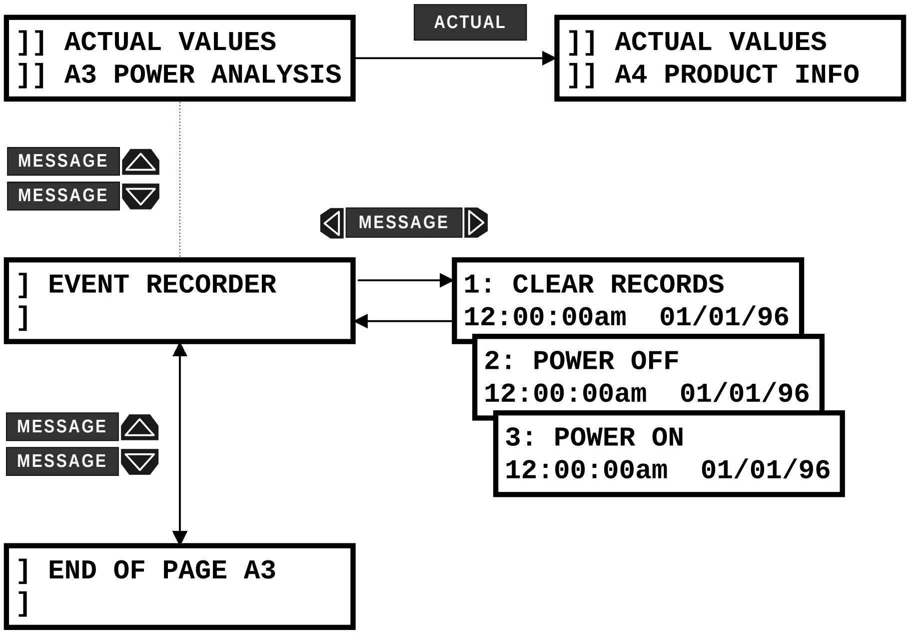

Figure 5–20: ACTUAL VALUES PAGE 3 – EVENT RECORDER

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The PQM Event Recorder runs continuously and records the number, cause, time, date, and metering quantities present at the occurrence of each event. This data is stored in non-volatile memory and is not lost when power to the PQM is removed. The Event Recorder must be enabled in **S1 PQM SETUP \ EVENT RECORDER \ EVENT RECORDER OPERATION**. The Event Recorder can be cleared in **S1 PQM SETUP \ CLEAR DATA \ CLEAR EVENT RECORD**. Data for the 40 most recent events is stored. Event data for older events is lost. Note that the event number, cause, time, and date is available in the messages as shown in the following table, but the associated metering data is available only via serial communications.

EVENT RECORDS- EVENT NUMBER, EVENT CAUSE, TIME, DATE: These messages display the 40 most recent events recorded by the event recorder.

Table 5–1: LIST OF POSSIBLE EVENTS (Sheet 1 of 3)

EVENT NAME	DISPLAYED EVENT NAME
Undercurrent Alarm/Control Pickup	UNDERCURRENT ↑
Undercurrent Alarm/Control Dropout	UNDERCURRENT ↓
Overcurrent Alarm/Control Pickup	OVERCURRENT ↑
Overcurrent Alarm/Control Dropout	OVERCURRENT ↓
Neutral Overcurrent Alarm/Control Pickup	NEUTRAL ↑
Neutral Overcurrent Alarm/Control Dropout	NEUTRAL ↓
Undervoltage Alarm/Control Pickup	UNDERVOLTAGE ↑
Undervoltage Alarm/Control Dropout	UNDERVOLTAGE ↓
Overvoltage Alarm/Control Pickup	OVERVOLTAGE ↑
Overvoltage Alarm/Control Dropout	OVERVOLTAGE ↓
Current Unbalance Alarm/Control Pickup	CURRENT U/B ↑
Current Unbalance Alarm/Control Dropout	CURRENT U/B ↓
Voltage Unbalance Alarm/Control Pickup	VOLTAGE U/B ↑
Voltage Unbalance Alarm/Control Dropout	VOLTAGE U/B ↓
Phase Reversal Alarm/Control Pickup	PHASE REVERSAL↑
Phase Reversal Alarm/Control Dropout	PHASE REVERSAL↓
Power Factor Lead 1 Alarm/Control Pickup	PF LEAD 1 ↑
Power Factor Lead 1 Alarm/Control Dropout	PF LEAD 1 ↓
Power Factor Lag 1 Alarm/Control Pickup	PF LAG 1 ↑
Power Factor Lag 1 Alarm/Control Dropout	PF LAG 1 ↓
Power Factor Lead 2 Alarm/Control Pickup	PF LEAD 2 ↑
Power Factor Lead 2 Alarm/Control Dropout	PF LEAD 2 ↓
Power Factor Lag 2 Alarm/Control Pickup	PF LAG 2 ↑
Power Factor Lag 2 Alarm/Control Dropout	PF LAG 2 ↓
Positive Real Power Alarm/Control Pickup	POS kW ↑
Positive Real Power Alarm/Control Dropout	POS kW ↓
Negative Real Power Alarm/Control Pickup	NEG kW ↑
Negative Real Power Alarm/Control Dropout	NEG kW ↓
Positive Reactive Power Alarm/Control Pickup	POS kvar ↑
Positive Reactive Power Alarm/Control Dropout	POS kvar ↓
Negative Reactive Power Alarm/Control Pickup	NEG kvar ↑
Negative Reactive Power Alarm/Control Dropout	NEG kvar ↓
Underfrequency Alarm/Control Pickup	UNDRFREQUENCY ↑
Underfrequency Alarm/Control Dropout	UNDRFREQUENCY ↓
Overfrequency Alarm/Control Pickup	OVERFREQUENCY ↑
Overfrequency Alarm/Control Dropout	OVERFREQUENCY ↓
Positive Real Power Demand Alarm/Control Pickup	3Φ +kW DMD ↑
Positive Real Power Demand Alarm/Control Dropout	3Φ +kW DMD ↓
Negative Real Power Demand Alarm/Control Pickup	3Φ –kW DMD ↑

Table 5–1: LIST OF POSSIBLE EVENTS (Sheet 2 of 3)

EVENT NAME	DISPLAYED EVENT NAME
Negative Real Power Demand Alarm/Control Dropout	3Φ –kW DMD ↓
Positive Reactive Power Demand Alarm/Control Pickup	3Φ +kvar DMD ↑
Positive Reactive Power Demand Alarm/Control Dropout	3Φ +kvar DMD ↓
Negative Reactive Power Demand Alarm/Control Pickup	3Φ –kvar DMD ↑
Negative Reactive Power Demand Alarm/Control Dropout	3Φ –kvar DMD ↓
Apparent Power Demand Alarm/Control Pickup	3Φ kVA DEMAND ↑
Apparent Power Demand Alarm/Control Dropout	3Φ kVA DEMAND ↓
Phase A Current Demand Alarm/Control Pickup	Ia DEMAND ↑
Phase A Current Demand Alarm/Control Dropout	Ia DEMAND ↓
Phase B Current Demand Alarm/Control Pickup	Ib DEMAND ↑
Phase B Current Demand Alarm/Control Dropout	Ib DEMAND ↓
Phase C Current Demand Alarm/Control Pickup	Ic DEMAND ↑
Phase C Current Demand Alarm/Control Dropout	Ic DEMAND ↓
Neutral Current Demand Alarm/Control Pickup	In DEMAND ↑
Neutral Current Demand Alarm/Control Dropout	In DEMAND ↓
Switch Input A Alarm/Control Pickup	SW A ACTIVE ↑
Switch Input A Alarm/Control Dropout	SW A ACTIVE ↓
Switch Input B Alarm/Control Pickup	SW B ACTIVE ↑
Switch Input B Alarm/Control Dropout	SW B ACTIVE ↓
Switch Input C Alarm/Control Pickup	SW C ACTIVE ↑
Switch Input C Alarm/Control Dropout	SW C ACTIVE ↓
Switch Input D Alarm/Control Pickup	SW D ACTIVE ↑
Switch Input D Alarm/Control Dropout	SW D ACTIVE ↓
Pulse Input 1 Alarm/Control Pickup	PULSE IN 1 ↑
Pulse Input 1 Alarm/Control Dropout	PULSE IN 1 ↓
Pulse Input 2 Alarm/Control Pickup	PULSE IN 2 ↑
Pulse Input 2 Alarm/Control Dropout	PULSE IN 2 ↓
Pulse Input 3 Alarm/Control Pickup	PULSE IN 3 ↑
Pulse Input 3 Alarm/Control Dropout	PULSE IN 3 ↓
Pulse Input 4 Alarm/Control Pickup	PULSE IN 4 ↑
Pulse Input 4 Alarm/Control Dropout	PULSE IN 4 ↓
Totalized Pulses Alarm/Control Pickup	PULSE TOTAL ↑
Totalized Pulses Alarm/Control Dropout	PULSE TOTAL ↓
Current THD Alarm/Control Pickup	CURRENT THD ↑
Current THD Alarm/Control Dropout	CURRENT THD ↓
Voltage THD Alarm/Control Pickup	VOLTAGE THD ↑
Voltage THD Alarm/Control Dropout	VOLTAGE THD ↓
Main Analog Input Alarm/Control Pickup	AN INPUT MAIN ↑
Main Analog Input Alarm/Control Dropout	AN INPUT MAIN ↓

5

Table 5–1: LIST OF POSSIBLE EVENTS (Sheet 3 of 3)

EVENT NAME	DISPLAYED EVENT NAME
Alternate Analog Input Alarm/Control Pickup	AN INPUT ALT ↑
Alternate Analog Input Alarm/Control Dropout	AN INPUT ALT ↓
Self Test Failure Alarm Pickup	SELF TEST ↑
Self Test Failure Alarm Dropout	SELF TEST ↓
COM1 Failure Alarm Pickup	COM1 FAILURE ↑
COM1 Failure Alarm Dropout	COM1 FAILURE ↓
COM2 Failure Alarm Pickup	COM2 FAILURE ↑
COM2 Failure Alarm Dropout	COM2 FAILURE ↓
Clock Not Set Alarm Pickup	CLOCK NOT SET ↑
Clock Not Set Alarm Dropout	CLOCK NOT SET ↓
Critical Setpoints Not Stored Alarm Pickup	PARAM NOT SET ↑
Critical Setpoints Not Stored Alarm Dropout	PARAM NOT SET ↓
Data Log 1 Alarm Pickup	DATA LOG 1 ↑
Data Log 1 Alarm Dropout	DATA LOG 1 ↓
Data Log 2 Alarm Pickup	DATA LOG 2 ↑
Data Log 2 Alarm Dropout	DATA LOG 2 ↓
Time Alarm/Control Pickup	TIME ↑
Time Alarm/Control Dropout	TIME ↓
Power On	POWER ON
Power Off	POWER OFF
Latched Alarm/Auxiliary Reset	ALARM RESET
Setpoint Access On	PROGRAM ENABLE
Trace Memory Triggered	TRACE TRIG ↑

5.5.1 SOFTWARE VERSIONS & MODEL INFORMATION

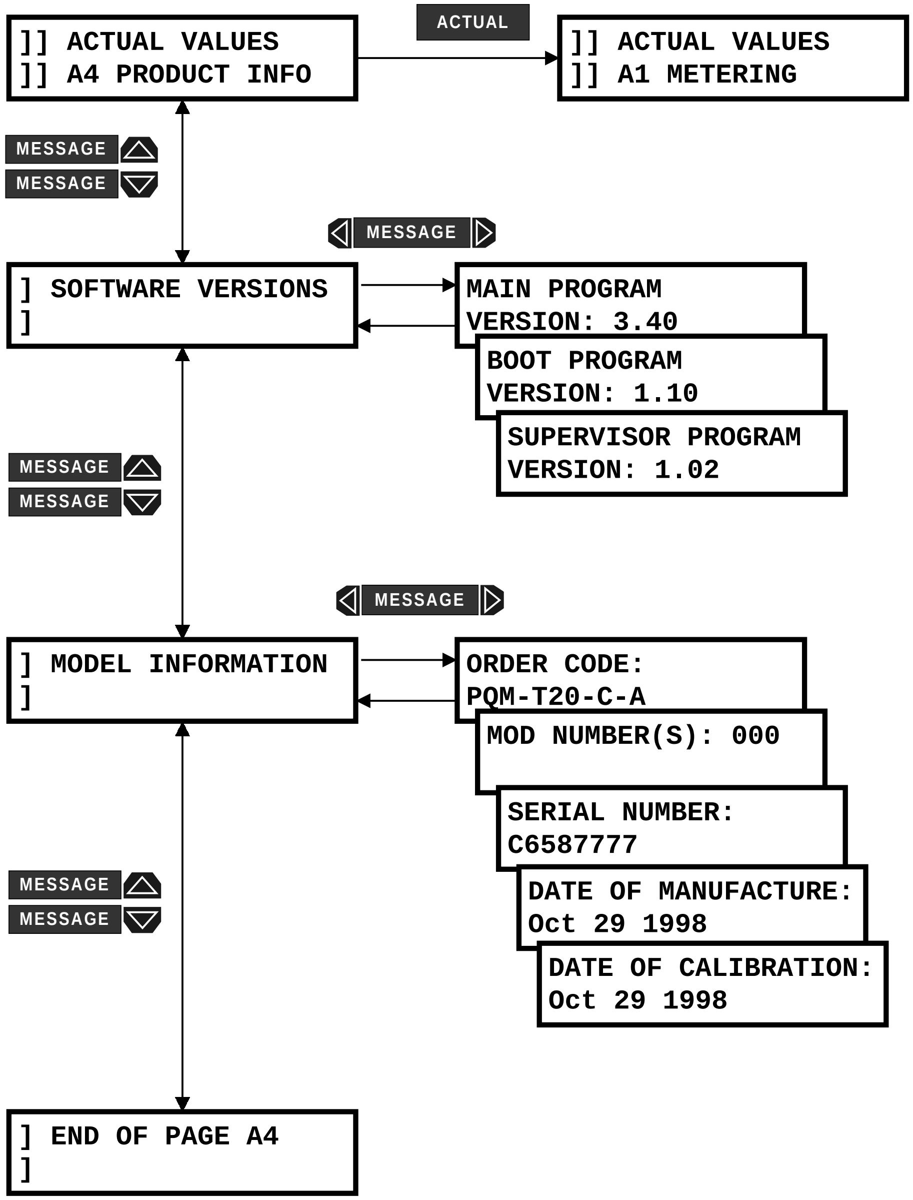

Figure 5–21: ACTUAL VALUES PAGE 4 – SOFTWARE VERSIONS

a) SOFTWARE VERSIONS

Product software revision information is contained in these messages.

MAIN PROGRAM VERSION: When referring to documentation or requesting technical assistance from the factory, record the **MAIN PROGRAM VERSION** and **MODIFICATION FILE NUMBER**. The **MAIN PROGRAM VERSION** identifies the firmware installed internally in the flash memory. The title page of this instruction manual states the main program revision code for which the manual is written. There may be differences in the product and manual if the revision codes do not match.

BOOT PROGRAM VERSION: This identifies the firmware installed internally in the memory of the PQM. This does not affect the functionality of the PQM.

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SUPERVISOR PROGRAM VERSION: This identifies the firmware installed internally in the supervisor (power fail) processor of the PQM. This does not affect the functionality of the PQM.

b) MODEL INFORMATION

Product identification information is contained in these messages.

ORDER CODE: This indicates which features were ordered with this PQM. T = Transducer option (T20=4-20 mA, T1=0-1 mA Analog Outputs), C = Control option, A = Power Analysis option.

MOD NUMBER(S): If unique features have been installed for special customer orders, the **MOD NUMBER** will be used by factory personnel to identify the matching product records. If an exact replacement model is required, the **MAIN PROGRAM VERSION**, **MOD NUMBER**, **ORDER CODE**, **SERIAL NUNBER** should be specified with the order.

SERIAL NUMBER: This is the serial number of the PQM. This should match the number on the label located on the back of the PQM.

DATE OF MANUFACTURE: This is the date the PQM was final tested at GE Power Management.

DATE OF CALIBRATION: This is the date the PQM was last calibrated.

6.1.1 OVERVIEW

Although setpoints can be entered manually using the front panel keys, it is much easier to use a computer to download values through the communications port. A free program called PQMPC is available from GE Power Management to make this as convenient as possible. With PQMPC running on your personal computer under Windows it is possible to:

- Program/modify setpoints
- Load/save setpoint files from/to disk
- Read actual values
- Monitor status
- Perform waveform capture
- Perform harmonic analysis
- log data
- triggered trace memory
- Get help on any topic
- Print the instruction manual from compact disc

PQMPC allows immediate access to all the features of the PQM with easy to use pull down menus in the familiar Windows environment. PQMPC can also run without a PQM connected. This allows you to edit and save setpoints to a file for later use. If a PQM is connected to a serial port on a computer and communication is enabled, the PQM can be programmed from the Setpoint screens. In addition, measured values, status and alarm messages can be displayed with the Actual screens.

6.1.2 HARDWARE CONFIGURATION

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The PQM communication can be set up two ways. The figure below shows the connection using the RS232 front port. Figure 6–2: PQMPC COMMUNICATIONS USING REAR RS485 PORT shows the connection through the RS485 port. If the RS232 option is installed, this port will be visible on the front panel.

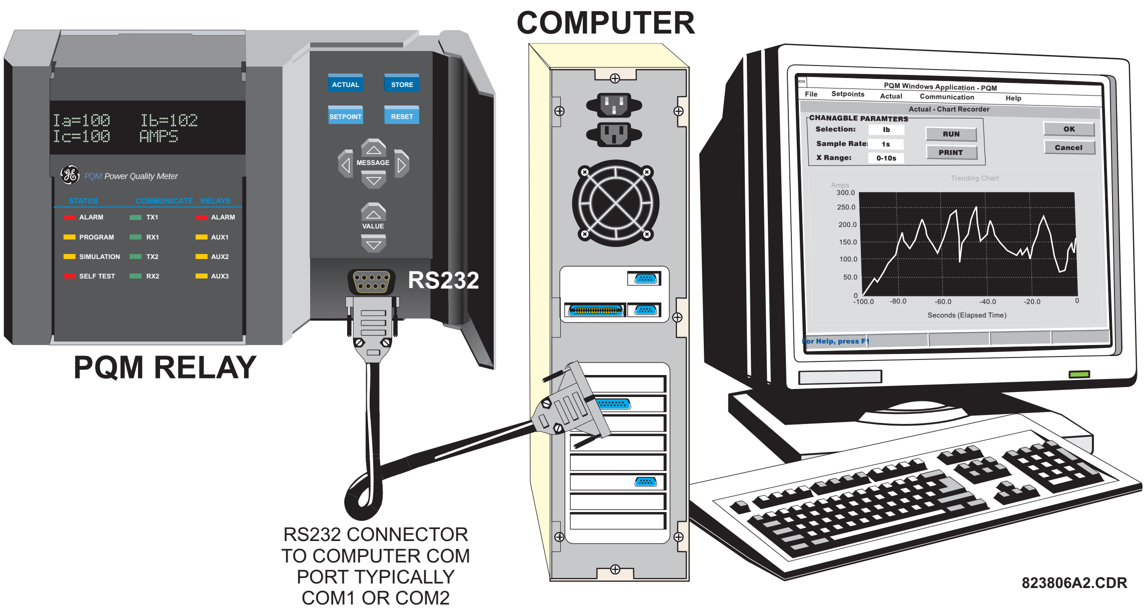


Figure 6–1: PQMPC COMMUNICATIONS USING THE FRONT RS232 PORT

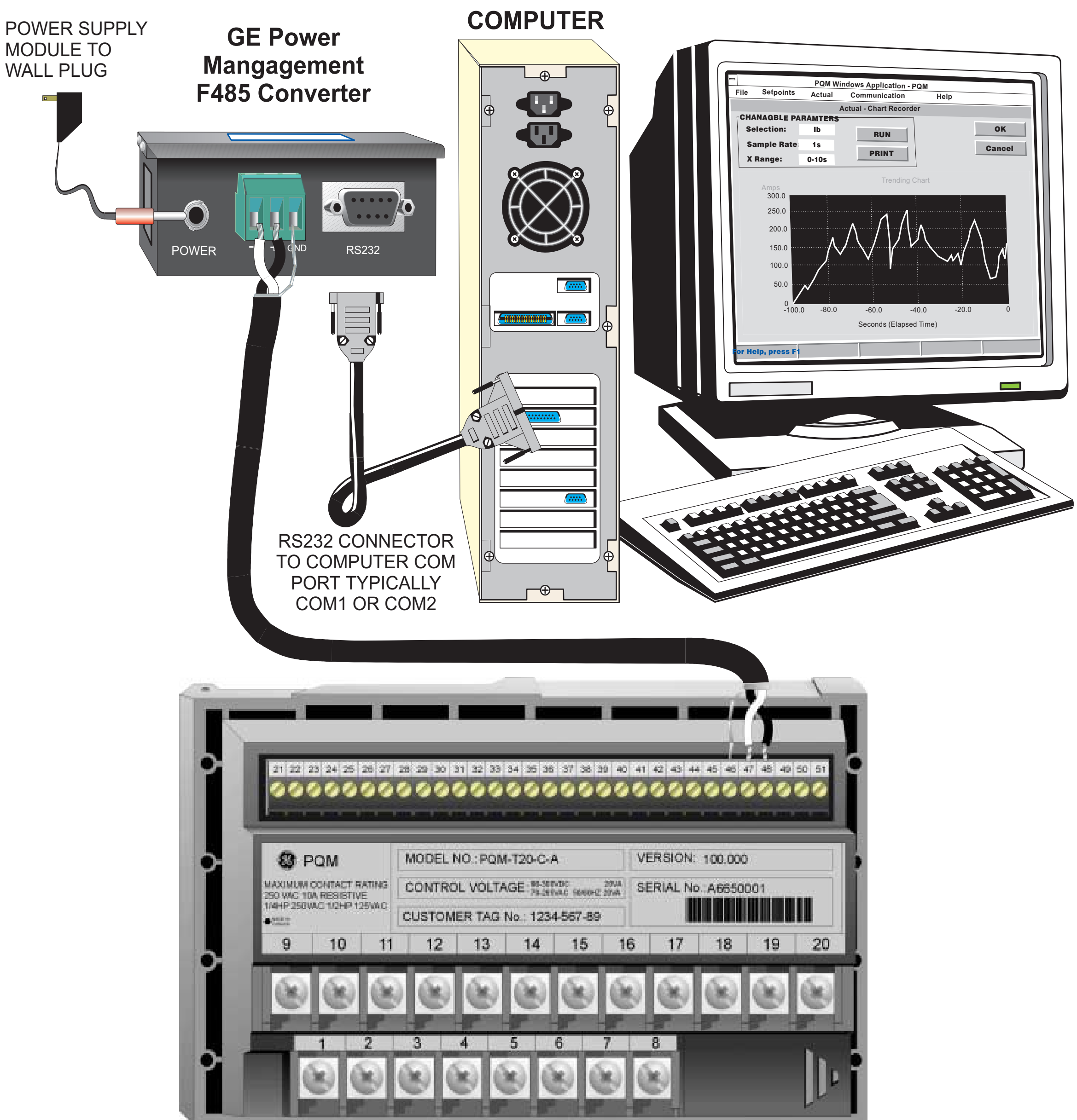


Figure 6–2: PQMPC COMMUNICATIONS USING REAR RS485 PORT

6.2.1 CHECKING IF INSTALLATION/UPGRADE IS REQUIRED

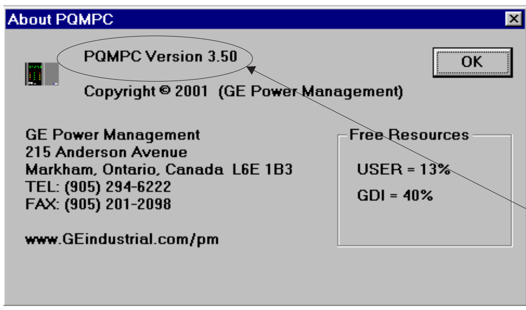
If PQMPC is already installed, run the program and check if it needs to be upgraded as described in the following procedure:

1. While PQMPC is running, insert the GE Power Management Products CD and allow it to autostart (alternately, load the D:\index.htm file into your browser), *OR*

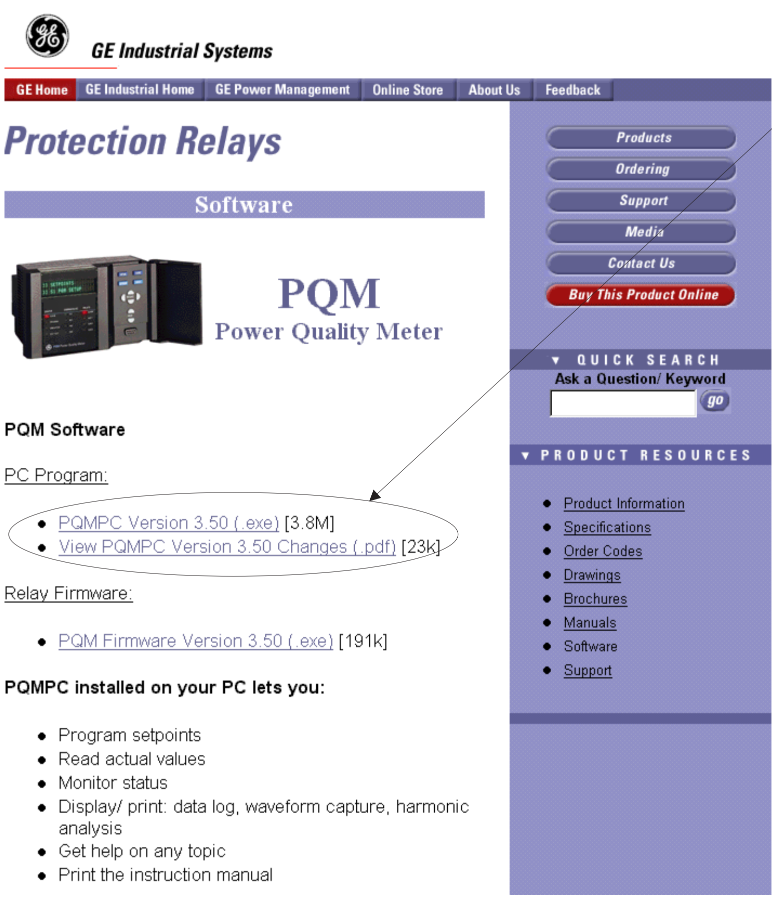
   Go to the GE Power Management website at www.ge.com/indsys/pm.

2. Click the “Software” menu item and select “PQM Power Quality Meter” from the list of products.

3. Verify that the version shown on this page is identical to the installed version as shown below. Select the **Help > About PQMPC** menu item to determine the version running on the local PC.



No upgrade required if these two numbers match



6

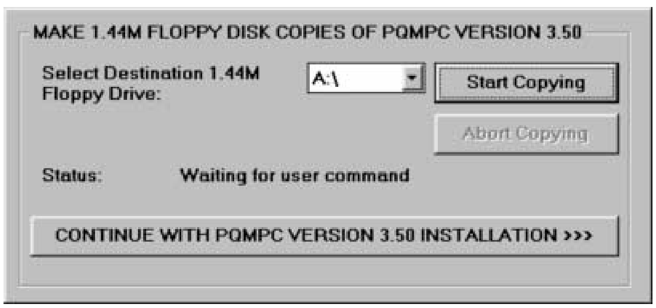
6.2.2 INSTALLING/UPGRADING PQMPC

The following minimum requirements must be met for PQMPC to operate on your computer.

- 486 PC with at least 8MB RAM, more recommended
- Windows^{TM} 3.1 or higher is installed and running
- Minimum of 10MB hard disk space

If PQMPC is being upgraded, then note the exact path and directory name of the current installation as it will be required during the new installation process. Follow the procedure below to install PQMPC.

1. With windows running, insert the GE Power Management Products CD into the local CD-ROM drive **or** go to the GE Power Management website at www.ge.com/indsys.pm. If the CD does not autostart, use your web browser to open the file `index.htm` in the Products CD root directory.
2. Select the “Software” link and choose “PQM Power Quality Meter” from the list of products.
3. Click on “PQMPC Version 3.xx” and save the installation program to the local PC.
4. Start the PQMPC installation program by double-clicking its icon. The installation program will request whether or not you wish to create a 3.5” floppy disk set as shown below. If so, click on the **Start Copying** button and follow the instructions; if not, click on **CONTINUE WITH PQMPC VERSION 3.50 INSTALLATION**.



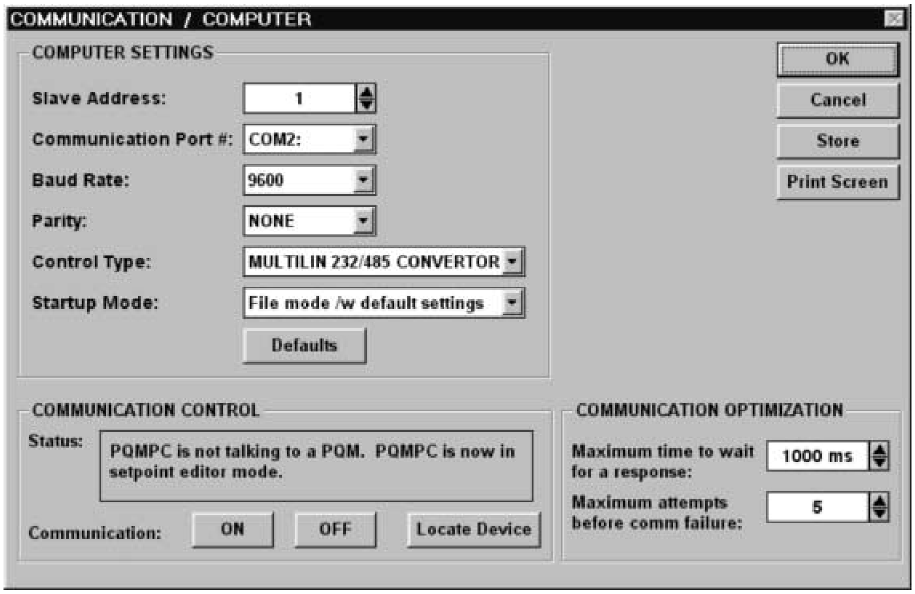
5. Enter the complete path including the new directory name indicating where PQMPC program is to be installed (see below).

   If an earlier version of PQMPC has been installed and is to be upgraded, enter the complete path and directory name of its current location on the local PC. The installation program will automatically update the older files.
6. Click on **Next** to begin the installation. The files will be installed in the directory indicated and the installation program will automatically create icons and add PQMPC to the Windows start menu. Click **Finish** to end the installation.

6.2.3 CONFIGURING PQMPC COMMUNICATIONS

1. Start PQMPC. Once the program starts to execute, it will attempt communications with the PQM. If communication is established, the screen will display the same information displayed on the PQM display.
2. If PQMPC cannot establish communications with the PQM, the following message is displayed:

3. Click **OK** to edit the communications settings. PQMPC opens the COMMUNICATION/COMPUTER window shown below:



4. Set **Slave Address** to match the PQM address setpoint.
5. Set **Communication Port #** to the COM port number (on the local PC) where the PQM is connected.
6. Set **Baud Rate** to match the PQM **BAUD RATE** setpoint.
7. Set **Parity** to match the PQM **PARITY** setpoint.
8. Select the **Control Type** being used for communication.
9. Set **Startup Mode** to **Communicate with Relay**.
10. Click the **ON** button to communicate with the PQM. The PQMPC software will notify when it has established a communication link with the PQM. If communication does not succeed, check the following:
    - Review the settings above to ensure they match the PQM settings
    - Ensure the **Communication Port #** setting matches the COM port being used
    - Ensure the hardware connection is correct – refer to the connection diagrams in Section 6.1.2: HARDWARE CONFIGURATION on page 6–1
    - If using RS485 communications, ensure that the wire's polarity is correct and it is connected to the correct PQM terminals
11. Once communication has been established, click **OK** to return to the main screen.

6.3.1 DESCRIPTION

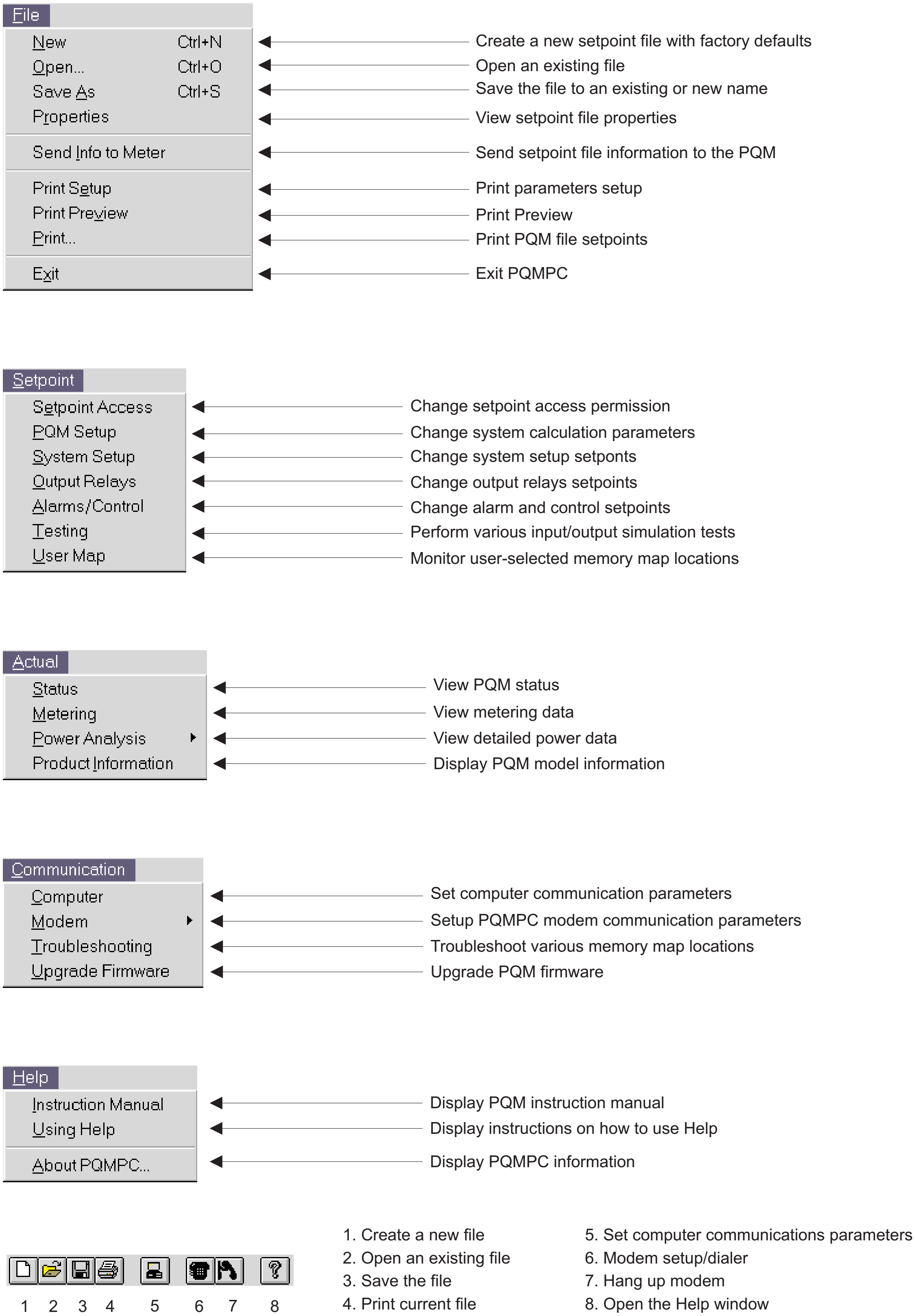


Figure 6–3: PQMPC MENUS

6.4.1 DESCRIPTION

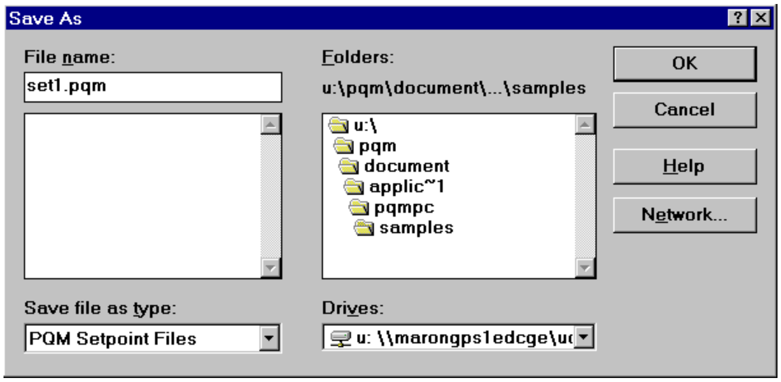
To upgrade the PQM firmware, follow the procedures listed in this section.

Upon successful completion of this procedure, the PQM will have new firmware installed with the original setpoints.

NOTE: The latest firmware files are available from the GE Power Management website at www.GEindustrial.com/pm.

6.4.2 SAVE/PRINT PQM SETPOINTS TO A FILE

1. To save setpoints to a file, select the **File > Save As** menu item.
2. Enter the filename to save the current setpoints and click **OK**. Use the extension ".pqm" for PQM setpoint files.

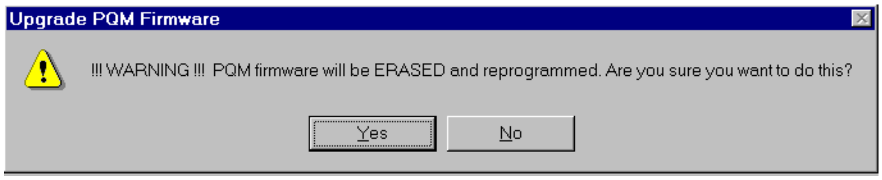


3. To print setpoints or actual values, select the **File > Print Setup** menu item. Select one of **Setpoints (Enabled Features)**, **Setpoints (All)**, **Actual Values**, or **User Definable Memory Map** and click **OK**.
4. Ensure the printer is setup and on-line. Select the **File > Print** menu item and click **OK** to print the setpoints

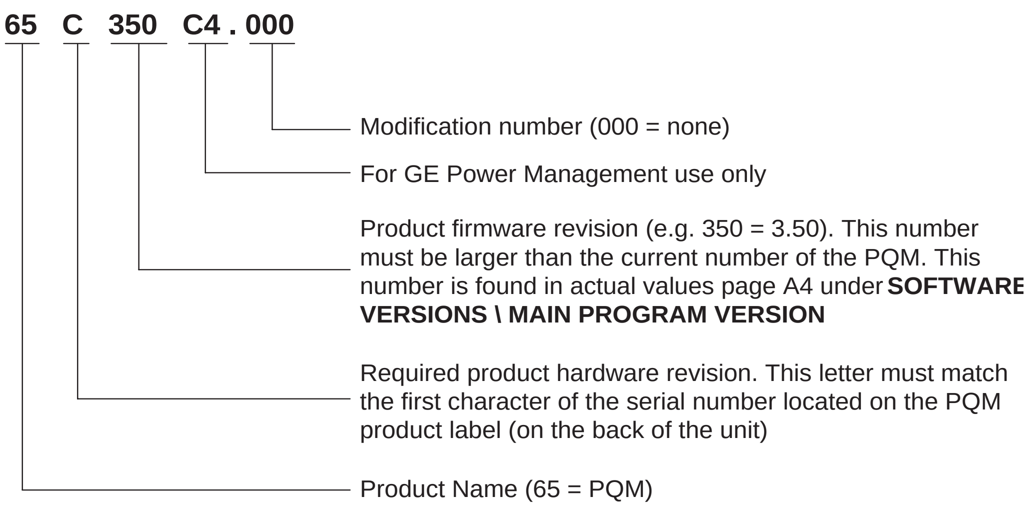
6

6.4.3 LOADING NEW FIRMWARE INTO THE PQM

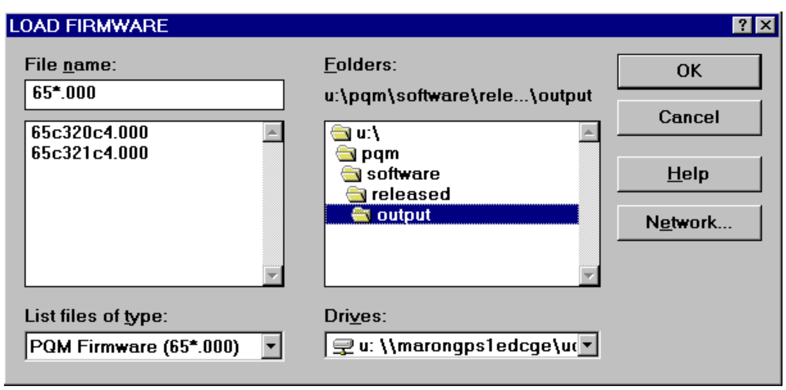
1. Select the **Communication > Upgrade Firmware** menu item.
2. A warning window will appear. Select **Yes** to proceed or **No** the abort the process. Do not proceed unless you have saved the current setpoints as shown in Section 6.4.2: SAVE/PRINT PQM SETPOINTS TO A FILE above.



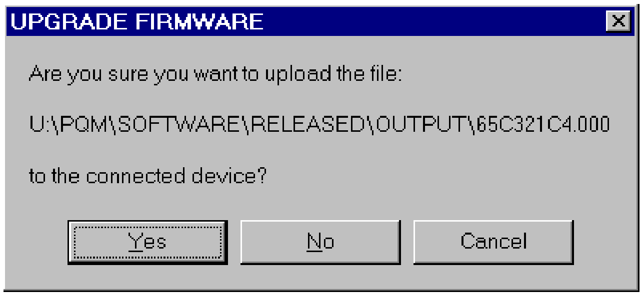
3. Locate the file to load into the PQM. The firmware filename has the following format:



4. Select the required file and click on **OK** to proceed or **Cancel** to abort the firmware upgrade.



5. The final warning shown below will appear. This will be the last chance to abort the firmware upgrade. Select **Yes** to proceed, **No** to load a different file, or **Cancel** to abort the process.



6. PQMPC now prepares the PQM to receive the new firmware file. The PQM will display a message indicating that it is in UPLOAD MODE. While the file is being loaded into the PQM, a status box appears showing how much of the new firmware file has been transferred and how much is remaining. The entire transfer process takes approximately five minutes.

7. PQMPC will notify the user when the PQM has finished loading the file. Carefully read any notes and click **OK** to return the main screen.

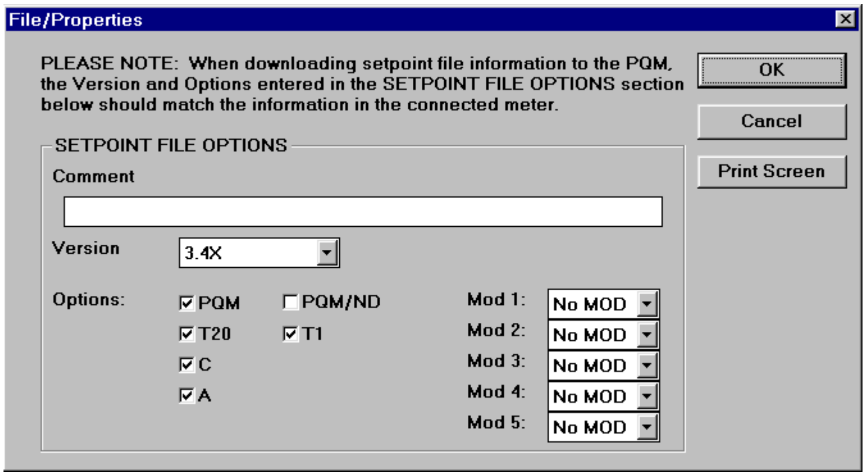
8. If the PQM does not communicate with the PQMPC software, ensure that the following PQM setpoints correspond with the PQMPC settings:

   - **MODBUS COMMUNICATION ADDRESS**
   - **BAUD RATE**
   - **PARITY** (if applicable)

   Also, ensure that the correct COM port is being used

6.4.4 LOADING SAVED SETPOINTS INTO THE PQM

1. Select the **File > Open** menu item.
2. Select the file containing the setpoints to be loaded into the PQM and click **OK**.
3. Select the **File > Properties** menu item and change the file version of the setpoint file to match the firmware version of the PQM.



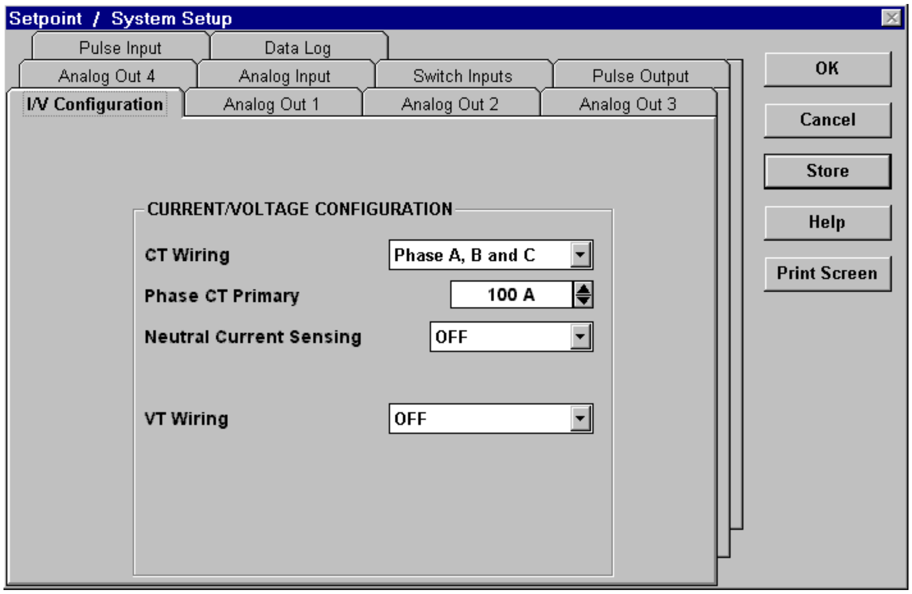
4. Select the **File > Send Info to Meter** menu item to load the setpoint file into the PQM.
5. A dialog box will appear to confirm the request to download setpoints. Click **Yes** to send the setpoints to the PQM now or **No** to abort the process.
6. PQMPC now loads the setpoint file into the PQM. If new setpoints were added in the upgrade software, they will be set to factory defaults.

6

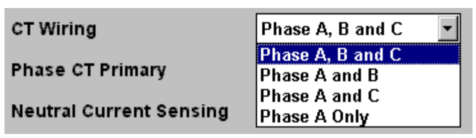
6.5.1 ENTERING SETPOINTS

The **System Setup** page will be used as an example to illustrate the entering of setpoints.

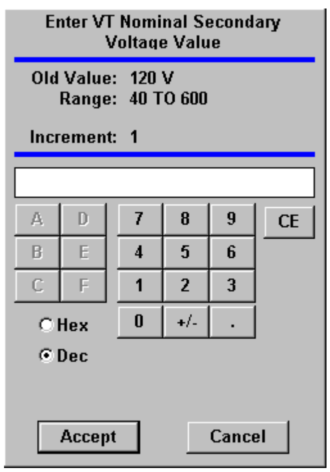
Select the **Setpoint > System Setup** menu item. The following window will appear:



- When a non-numeric setpoint such as **CT WIRING** is selected, PQMPC displays a drop-down menu:



- When a numeric setpoint such as **NOMINAL INPUT DIRECT VOLTAGE** is selected, PQMPC displays a keypad that allows the user to enter a value within the setpoint range displayed near the top of the keypad:



- Click **Accept** to exit from the keypad and keep the new value. Click on **Cancel** to exit from the keypad and retain the old value.

Click on **Store** to save the values into the PQM. Click **OK** to accept any changes and exit the **Setpoint / System Setup** dialog box. Click **Cancel** to retain previous values and exit.

6.5.2 VIEWING ACTUAL VALUES

If a PQM is connected to a computer via the serial port, any measured value, status and alarm information can be displayed. Use the **Actual** pull-down menu to select various measured value screens. Monitored values will be displayed and continuously updated.

6.5.3 SETPOINT FILES

a) SAVING/PRINTING SETPOINT FILES

To print and save all the setpoints to a file follow the steps outlined in Section 6.4.2: SAVE/PRINT PQM SETPOINTS TO A FILE on page 6–7.

b) LOADING SETPOINT FILES

To load an existing setpoints file to a PQM and/or send the setpoints to the PQM follow the steps outlined in Section 6.4.4: LOADING SAVED SETPOINTS INTO THE PQM on page 6–10.

6.5.4 GETTING HELP

The complete instruction manual, including diagrams, is available on the GE Power Management Products CD and through the PQMPC Help menu.

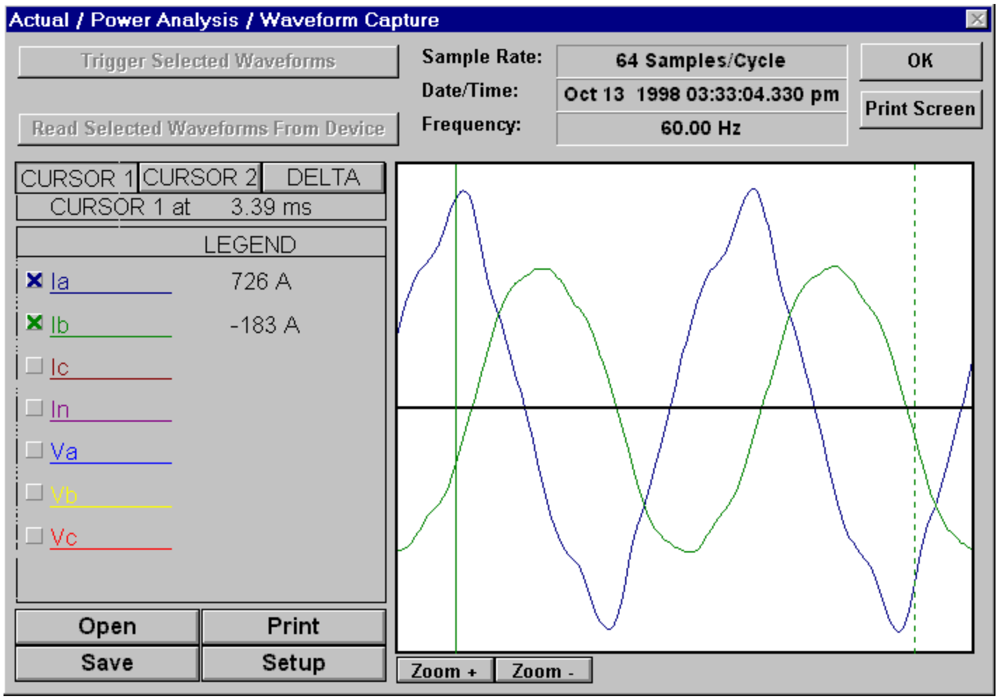
Select the **Help > Instruction Manual** menu item and select the desired topic. Consult PQMPC Help for an explanation of any feature, specifications, wiring, installation, etc. Context-sensitive help can also be activated by clicking on the desired function.

For easy reference, any topic can be printed by selecting **File > Print Topic** item from the Help file menu bar. For printing illustrations, it is recommended that the user download the instruction manual PDF files from the GE Power Management CD or from the GE Power Management website at `www.GEindustrial.com/pm`. Screen colors will appear in the printout if a color printer is used.

6.6.1 WAVEFORM CAPTURE

Two cycles (64 samples/cycle) of voltage and current waveforms can be captured and displayed on a PC using PQMPC or third party software. Distorted peaks or notches from SCR switching provides clues for taking corrective action. Waveform capture is also a useful tool when investigating possible wiring problems due to its ability to display the phase relationship of the various inputs. The waveform capture feature is implemented into PQMPC as shown below.

Select the **Actual > Power Analysis > Waveform Capture** menu item. PQMPC will open the Waveform Capture dialog box.



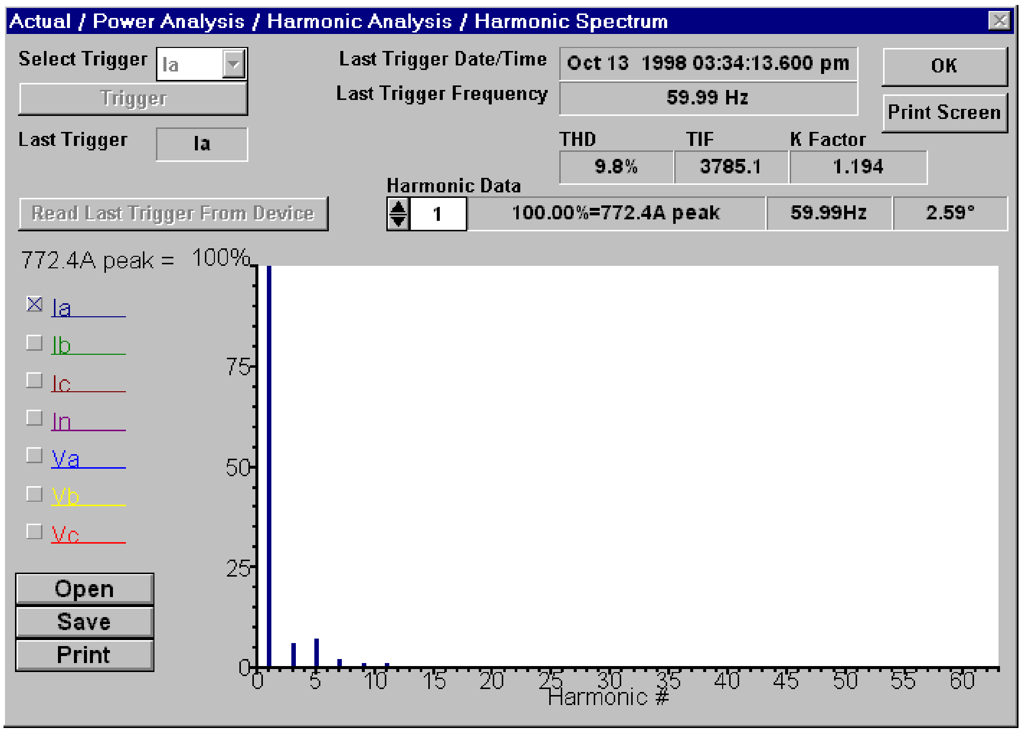
- Check the boxes on the left to display the desired waveforms. The waveform values for the current cursor line position are displayed to the right of any checked boxes.
- The **Trigger Selected Waveforms** button captures new waveforms from the PQM.
- The **Read Selected Waveforms From Device** button loads and views previously selected waveforms.
- The **Open** button loads and views previously saved waveforms
- The **Save** button saves the captured waveforms to a file
- The **Print** button prints the currently displayed waveforms
- The **Setup** button allows for the setup of capture attributes

6.6.2 HARMONIC ANALYSIS

Non-linear loads such as variable speed drives, computers, and electronic ballasts can cause harmonics which may lead to problems such as nuisance breaker tripping, telephone interference, transformer, capacitor or motor overheating. For fault diagnosis such as detecting undersized neutral wiring, need for a harmonic rated transformer or effectiveness of harmonic filters; details of the harmonic spectrum are useful and available with the PQM and PQMPC.

PQMPC can perform a harmonic analysis on any of the four current inputs or any of the three voltage inputs by placing the PQM in a high speed sampling mode (256 samples/cycle) where it will sample one cycle of the user defined parameter. PQMPC then takes this data and performs a FFT (Fast Fourier Transform) to extract the harmonic information. The harmonic analysis feature is implemented into PQMPC as shown below.

1. Select the **Actual > Power Analysis > Harmonic Analysis** menu item, then select the desired output type: **Waveform** or **Spectrum** format.
2. Selecting **Spectrum** PQMPC displays Harmonic Analysis Spectrum window including the harmonic spectrum up to and including the 62nd harmonic. Select the trigger parameter from the **Select Trigger** box and press **Trigger** to display the harmonic spectrum.

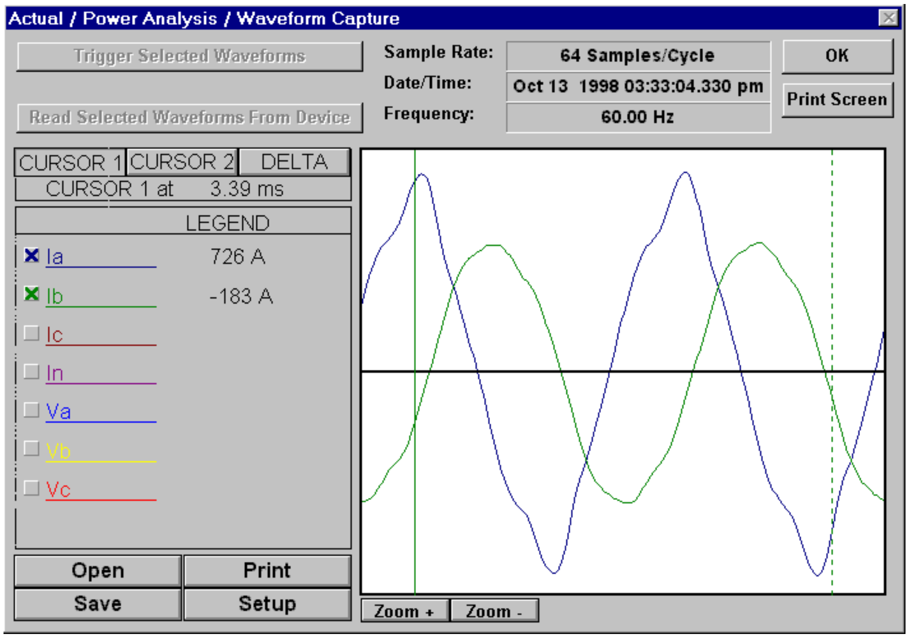


The window includes details of the currently selected harmonic and other harmonic analysis related data (for example, THD, K Factor, etc.).

Select **Read Last Trigger From Device** to load previous acquired spectra from the PQM.

Open loads and views previously save spectra, **Save** saves the captured spectrum to a file, and **Print** prints the currently displayed spectrum.

3. Selecting **Actual Values > Power Analysis > Harmonic Analysis > Waveform** displays the Harmonic Analysis Waveform window. Select the trigger parameter from the **Select Trigger** box and press **Trigger** to capture new waveforms from the PQM.

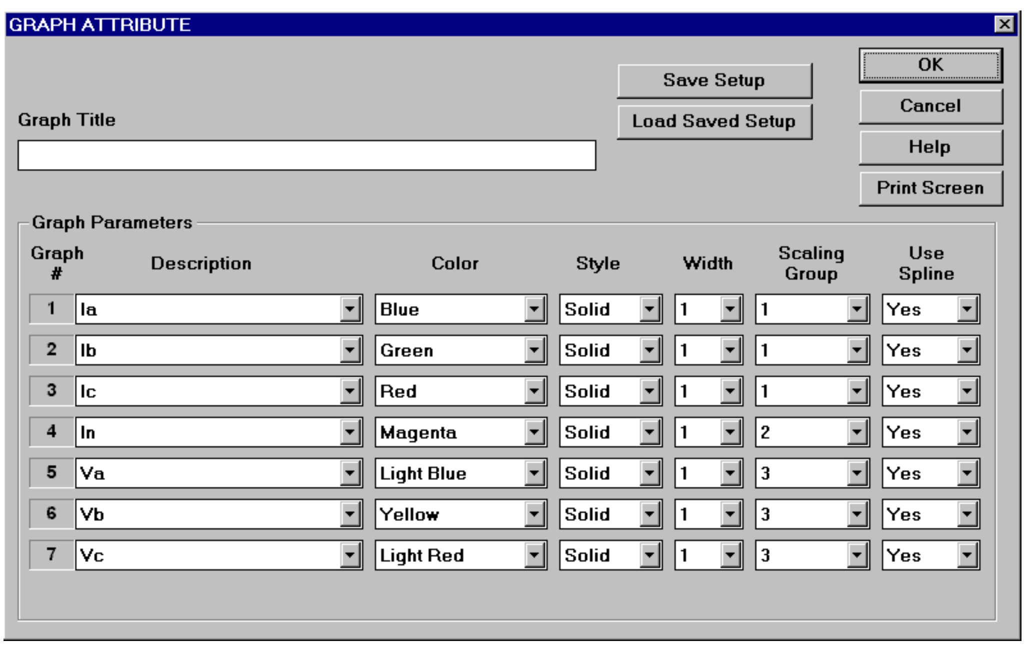


The window includes waveform values for the current cursor line position and check boxes to display the desired waveforms.

Select **Read Last Trigger From Device** to load previous acquired waveforms from the PQM.

Open loads and views previously save waveforms, **Save** saves the captured waveforms, **Print** prints the currently displayed waveforms, and **Setup** allows the user to change the capture parameters.

4. Clicking **Setup** displays the GRAPH ATTRIBUTE window:

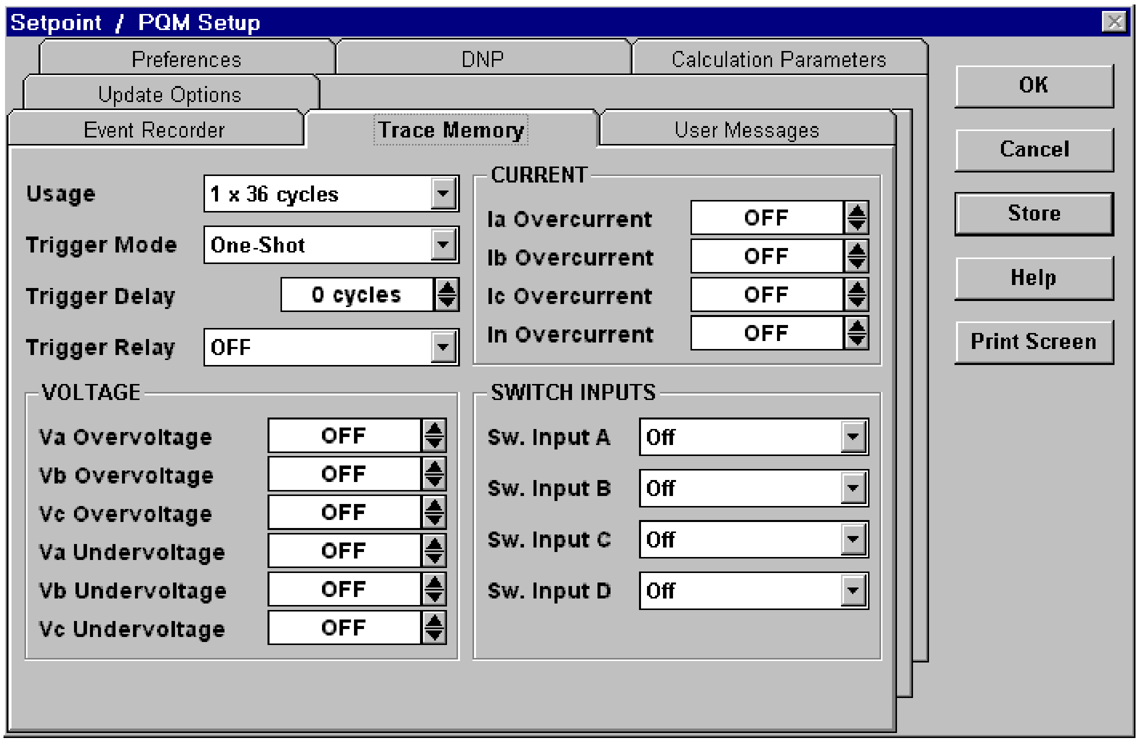


From this window, the waveforms appearance and format can be modified.

6.6.3 TRACE MEMORY

The trace memory feature allows the PQM to be setup to trigger on various conditions. The trace memory can record maximum of 36 cycles of data (16 samples per cycle) for all voltage and current inputs simultaneously. A Total Trace Triggers Counter has been implemented in the PQM Memory Map at Register 0x0B83. This register will keep a running total of all valid Trace Memory Triggers from the last time power was applied to the PQM. The Total Trace Triggers counter will rollover to 0 at 65536. The trace memory feature is implemented into PQMPC as shown below.

1. Select the **Setpoint > PQM Setup** menu item to setup the trace memory feature. This launches the PQM Setup dialog box shown below. Click on the **Trace Memory** tab to display the trace memory parameters.



The **Memory Usage** is set as follows:

- **1 x 36 cycles**: upon trigger, the entire buffer is filled with 36 cycles of data
- **2 x 18 cycles**: 2 separate 18-cycle buffers are created and each is filled upon a trigger
- **3 x 12 cycles**: 3 separate 12 cycle buffers are created and each is filled upon a trigger

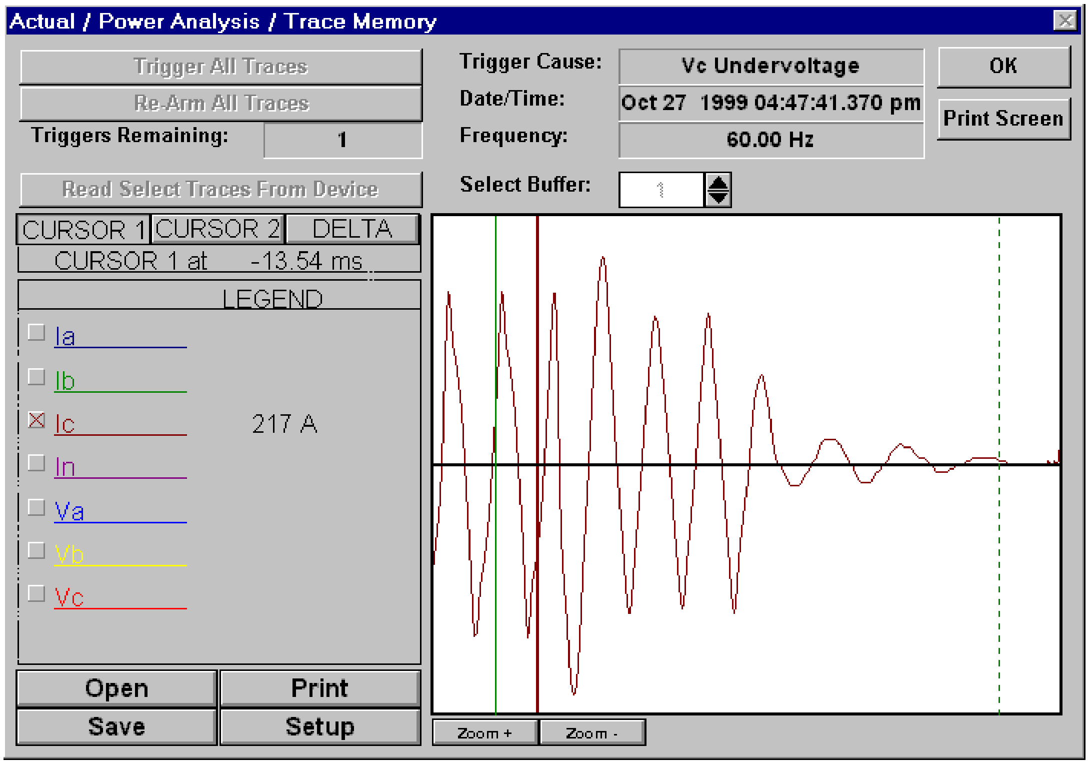
If the **Trigger Mode** is set to **One-Shot**, then the trace memory is triggered once per buffer; if it is set to **Retrigger**, then it automatically retriggers and overwrites the previous data.

The **Trigger Delay** delays the trigger by the number of cycles specified.

The **VOLTAGE**, **CURRENT**, and **SWITCH INPUTS** selections are the parameters and levels that are used to trigger the trace memory.

Clicking **Store** sends the current settings to the PQM.

2. Select the **Actual > Power Analysis > Trace Memory** menu item to view the trace memory data. This launches the Trace Memory Waveform window shown below.



Use the **Trigger Selected Traces** button to force a trace memory trigger.

Use the **Re-Arm All Traces** button to re-trigger after all the buffers have been filled if the **Trigger Mode** has been set to **One-Shot**. Pressing this button causes the trace memory to default back to the first buffer.

The **Read Selected Traces From Device** button loads and views previously captured data.

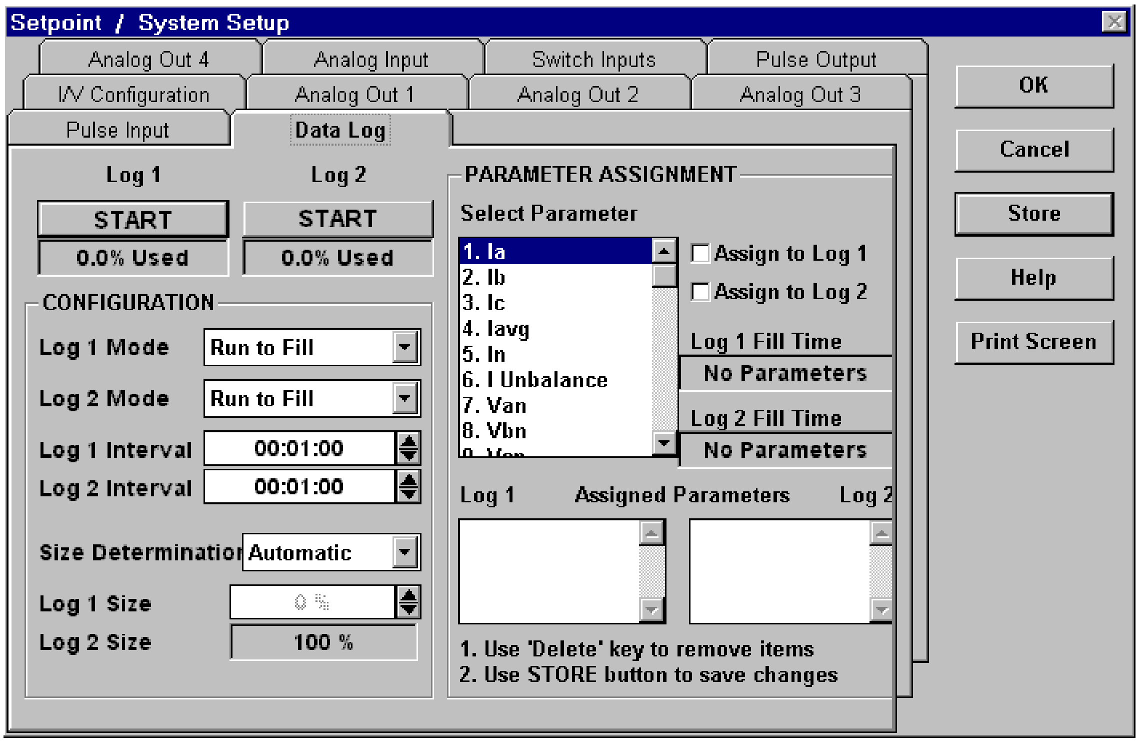
For the **Select Buffer** option, select **1**, **2**, or **3** to display one of the three different buffers. This option is dependent on the Trigger Mode selected in the **Setpoint > PQM Options** menu item.

Open loads previously saved waveforms for viewing, **Save** saves the captured waveforms to a file, **Print** prints the current waveforms, and **Setup** allows for the configuration of capture parameters.

6.6.4 DATA LOGGER

The data logger feature allows the PQM to continuously log various specified parameters at the specified rate. The data logger uses the 64 samples/cycle data. This feature is implemented into PQMPC as shown below.

1. Select the **Setpoint > System Setup** menu item to setup the data logger feature. This launches the System Setup dialog box shown below. Select the **Data Log** tab to display the data logger parameters.



The state of each data logger and percent filled is shown. Use the **START** and **STOP** buttons to start and stop the logs.

In the **CONFIGURATION** settings, the **Log Mode** is set as follows:

- **Run to Fill**: when the data logger is full (100%) it will stop logging
- **Circulate**: when the data logger is full, it will start from the beginning and overwrite the previous data (under development).

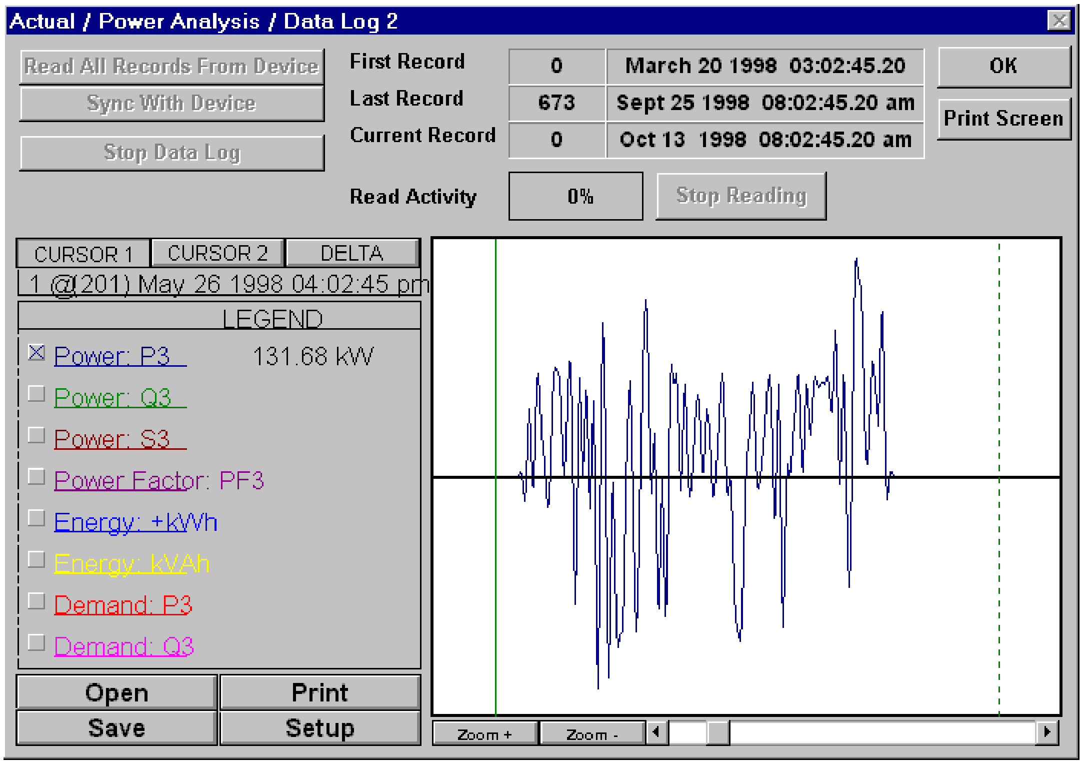
The **Log 1/2 Interval** value determines how frequently the PQM logs each piece of data.

The total log size is approximately 64KB. The allotment of this memory can be varied between the two logs to maximize the overall log time. Set the preference in **Size Determination** to let the PQM automatically optimize the memory. If desired, the optimization can also be performed manually by the user.

In the **PARAMETER ASSIGNMENTS** settings, the **Log 1/2 Fill Time** values represent the amount of time the data logger takes to fill to 100%. This time is dependent on the logging interval and the number of parameters being logged.

Set the parameters to be logged by Log 1 and Log 2 by highlighting the selection in the **Assigned Parameters** menu and checking the check box to assign it to the desired log.

2. Select the **Actual > Power Analysis > Data Logger > Log 1** (or **Log 2**) item to view the respective data logger.



The Data Log 1/2 dialog box displays the record numbers, data log start time, the current time, and parameter values for the current cursor line position.

The **Read All Records from Device** button views all previously acquired data up to the present time.

The **Sync With Device** button retrieves all data from the PQM as it is acquired.

The **Stop Data Log** button de-activates the PQM data log.

The **Stop Reading** button stops the data acquisition from the PQM, but the log continues to acquire values.

Open loads previously saved logs for viewing, **Save** saves captured log values to a file, **Print** prints the currently displayed log values, and **Setup** allows for the configuration of the graph display parameters.

7.1.1 MODBUS PROTOCOL

The GE Power Management PQM implements a subset of the AEG Modicon Modbus RTU serial communication standard. Many popular programmable controllers support this protocol directly with a suitable interface card allowing direct connection of the PQM. Although the Modbus protocol is hardware independent, the PQM interface uses 2-wire RS485 and 9-pin RS232 interfaces. Modbus is a single-master multiple-slave protocol suitable for a multi-drop configuration provided by RS485 hardware. In this configuration, up to 32 slaves can be daisy-chained together on a single communication channel.

The PQM is always a Modbus slave; it cannot be programmed as a Modbus master. Computers or PLCs are commonly programmed as masters. The Modbus protocol exists in two versions: Remote Terminal Unit (RTU, binary) and ASCII. Only the RTU version is supported by the PQM. Monitoring, programming and control functions are possible using read and write register commands.

7.1.2 ELECTRICAL INTERFACE

The electrical interface is 2-wire RS485 and 9-pin RS232. In a 2-wire RS485 link, data flow is bi-directional and half duplex. That is, data is never transmitted and received at the same time. RS485 lines should be connected in a daisy-chain configuration (avoid star connections) with a terminating network installed at each end of the link, i.e. at the master end and the slave farthest from the master. The terminating network should consist of a 120 Ω resistor in series with a 1 nF ceramic capacitor when used with Belden 9841 RS485 wire. The value of the terminating resistors should be equal to the characteristic impedance of the line. This is approximately 120 Ω for standard #22 AWG twisted-pair wire. Shielded wire should always be used to minimize noise. Polarity is important in RS485 communications: each '+' terminal of every device must be connected together for the system to operate. See Section 2.2.9: RS485 SERIAL PORTS on page 2–18 for details on serial port wiring.

7.1.3 DATA FORMAT & DATA RATE

One data frame of an asynchronous transmission to or from a PQM consists of 1 start bit, 8 data bits, and 1 stop bit, resulting in a 10-bit data frame. This is important for high-speed modem transmission, since 11-bit data frames are not supported by Hayes modems at bit rates greater than 300 bps. The Modbus protocol can be implemented at any standard communication speed. The PQM supports operation at 1200, 2400, 4800, 9600, and 19200 baud.

7.1.4 DATA PACKET FORMAT

A complete request/response sequence consists of the following bytes (transmitted as separate data frames):

Master Request Transmission:

SLAVE ADDRESS: 1 byte
FUNCTION CODE: 1 byte
DATA: variable number of bytes depending on FUNCTION CODE
CRC: 2 bytes

Slave Response Transmission:

SLAVE ADDRESS: 1 byte
FUNCTION CODE: 1 byte
DATA: variable number of bytes depending on FUNCTION CODE
CRC: 2 bytes

- **SLAVE ADDRESS**: The first byte of every transmission. It represents the user-assigned address of the slave device assigned to receive the message sent by the master. Each slave device must be assigned a unique address so only it responds to a transmission that starts with its address. In a master request transmission, the SLAVE ADDRESS represents the address to which the request is being sent. In a slave response transmission the SLAVE ADDRESS represents the address sending the response.

  NOTE A master transmission with a SLAVE ADDRESS of 0 indicates a broadcast command. Broadcast commands can be used only to store setpoints or perform commands.

- **FUNCTION CODE**: This is the second byte of every transmission. Modbus defines function codes of 1 to 127. The PQM implements some of these functions. See section 3 for details of the supported function codes. In a master request transmission the FUNCTION CODE tells the slave what action to perform. In a slave response transmission if the FUNCTION CODE sent from the slave is the same as the FUNCTION CODE sent from the master then the slave performed the function as requested. If the high order bit of the FUNCTION CODE sent from the slave is a 1 (i.e. if the FUNCTION CODE is > 127) then the slave did not perform the function as requested and is sending an error or exception response.
- **DATA**: This will be a variable number of bytes depending on the FUNCTION CODE. This may be Actual Values, Setpoints, or addresses sent by the master to the slave or by the slave to the master. See section 3 for a description of the supported functions and the data required for each.
- **CRC**: This is a two byte error checking code.

7.1.5 ERROR CHECKING

The RTU version of Modbus includes a 2-byte CRC-16 (16-bit cyclic redundancy check) with every transmission. The CRC-16 algorithm essentially treats the entire data stream (data bits only; start, stop and parity are ignored) as one continuous binary number. This number is first shifted left 16 bits and then divided by a characteristic polynomial (11000000000000101B). The 16-bit remainder is appended to the end of the transmission, MSByte first. The resulting message including CRC, when divided by the same polynomial at the receiver, results in a zero remainder if no transmission errors have occurred.

If a PQM Modbus slave device receives a transmission in which an error is indicated by the CRC-16 calculation, the slave device will not respond to the transmission. A CRC-16 error indicates that one or more bytes of the transmission were received incorrectly and thus the entire transmission should be ignored in order to avoid the PQM performing any incorrect operation.

The CRC-16 calculation is an industry standard method used for error detection. An algorithm is included here to assist programmers in situations where no standard CRC-16 calculation routines are available.

7.1.6 CRC-16 ALGORITHM

Once the following algorithm is complete, the working register "A" will contain the CRC value to be transmitted. Note that this algorithm requires the characteristic polynomial to be reverse bit ordered. The MSbit of the characteristic polynomial is dropped since it does not affect the value of the remainder. The following symbols are used in the algorithm:

`-->`	data transfer
`A`	16 bit working register
`AL`	low order byte of A
`AH`	high order byte of A
`CRC`	16 bit CRC-16 value
`i,j`	loop counters
`(+)`	logical exclusive-or operator
`Di`	i-th data byte (i = 0 to N-1)
`G`	16-bit characteristic polynomial = 1010000000000001 with MSbit dropped & bit order reversed
`shr(x)`	shift right (the LSbit of the low order byte of x shifts into a carry flag, a '0' is shifted into the MSbit of the high order byte of x, all other bits shift right one location

ALGORITHM:

```
1. FFFF hex --> A
2. 0 --> i
3. 0 --> j
4. Di (+) AL --> AL
5. j+1 --> j
6. shr(A)
7. is there a carry?    No: go to 8.
                        Yes: G (+) A --> A
8. is j = 8?      No: go to 5.
                  Yes: go to 9.
9. i+1 --> i
10. is i = N?     No: go to 3.
                  Yes: go to 11.
11. A --> CRC
```

7

7.1.7 TIMING

Data packet synchronization is maintained by timing constraints. The receiving device must measure the time between the reception of characters. If three and one half character times elapse without a new character or completion of the packet, then the communication link must be reset (i.e. all slaves start listening for a new transmission from the master). Thus at 9600 baud a delay of greater than $3.5 \times 1/9600 \times 10 = 3.65$ ms will cause the communication link to be reset.

7.2.1 PQM SUPPORTED MODBUS FUNCTIONS

The following functions are supported by the PQM:

- 03: Read Setpoints and Actual Values
- 04: Read Setpoints and Actual Values
- 05: Execute Operation
- 06: Store Single Setpoint
- 07: Read Device Status
- 08: Loopback Test
- 16: Store Multiple Setpoints

7.2.2 FUNCTION CODES 03/04 – READ SETPOINTS/ACTUAL VALUES

Modbus implementation: Read Input and Holding Registers
PQM Implementation: Read Setpoints and Actual Values

For the PQM Modbus implementation, these commands are used to read any setpoint ("holding registers") or actual value ("input registers"). Holding and input registers are 16-bit (two byte) values with the high-order byte transmitted first. Thus, all setpoints and actual values are sent as two bytes. A maximum of 125 registers can be read in one transmission. Function codes 03 and 04 are configured to read setpoints or actual values interchangeably since some PLCs do not support both of them.

The slave response to function codes 03/04 is the slave address, function code, number of data bytes to follow, the data, and the CRC. Each data item is sent as a 2 byte number with the high order byte first.

MESSAGE FORMAT AND EXAMPLE:

Request slave 11 to respond with 3 registers starting at address 006B. For this example the register data in these addresses is:

Address:	006B	006C	006D
Data:	022B	0000	0064

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Table 7–1: MASTER/SLAVE PACKET FORMAT FOR FUNCTION CODE 03H/04H

MASTER TRANSMISSION	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message for slave 17
FUNCTION CODE	1	03	read registers
DATA STARTING ADDRESS	2	00 6B	data starting at 006B
NUMBER OF SETPOINTS	2	00 03	3 registers = 6 bytes total
CRC	2	9D 8D	CRC error code

SLAVE RESPONSE	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message from slave 17
FUNCTION CODE	1	03	read registers
BYTE COUNT	1	06	3 registers = 6 bytes
DATA 1 (see definition above)	2	02 2B	value in address 006B
DATA 2 (see definition above)	2	00 00	value in address 006C
DATA 3 (see definition above)	2	00 64	value in address 006D
CRC	2	C8 B8	CRC error code

7.2.3 FUNCTION CODE 05 - EXECUTE OPERATION

Modbus Implementation: Force Single Coil
PQM Implementation: Execute Operation

This function code allows the master to request a PQM to perform specific command operations. The command numbers listed in the Commands area of the memory map correspond to operation codes for function code 05.

The operation commands can also be initiated by writing to the Commands area of the memory map using function code 16. Refer to FUNCTION 16 - PERFORMING COMMANDS section for complete details.

MESSAGE FORMAT AND EXAMPLE:

Reset PQM (operation code 1).

Table 7–2: MASTER/SLAVE PACKET FORMAT FOR FUNCTION CODE 05H

MASTER TRANSMISSION	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message for slave 17
FUNCTION CODE	1	05	execute operation
OPERATION CODE	2	00 01	reset command (operation code 1)
CODE VALUE	2	FF 00	perform function
CRC	2	DF 6A	CRC error code

SLAVE RESPONSE	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message from slave 17
FUNCTION CODE	1	05	execute operation
OPERATION CODE	2	00 01	operation code 1
CODE VALUE	2	FF 00	perform function
CRC	2	DF 6A	CRC error code

7.2.4 FUNCTION CODE 05 – BROADCAST COMMAND

Modbus Implementation: Force Single Coil
PQM Implementation: Execute Operation

This function code allows the master to request all PQMs on a particular communications link to Clear All Demand Data. The PQM will recognize a packet as being a broadcast command if the SLAVE ADDRESS is transmitted as 0. Below is an example of the Broadcast Command to Clear All Demand Data.

MESSAGE FORMAT AND EXAMPLE:

Clear All Demand Data on all PQMs (operation code 34).

Table 7–3: MASTER/SLAVE PACKET FORMAT FOR BROADCAST COMMAND

MASTER TRANSMISSION	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message for slave 17
FUNCTION CODE	1	05	execute operation
OPERATION CODE	2	00 22	clear all demand data (operation code 34)
CODE VALUE	2	FF 00	perform function
CRC	2	2D E1	CRC error code

SLAVE RESPONSE	BYTES	EXAMPLE	DESCRIPTION
Slave does not respond back to the master.			

7.2.5 FUNCTION CODE 06 – STORE SINGLE SETPOINT

Modbus Implementation: Preset Single Register
PQM Implementation: Store Single Setpoint

This command allows the master to store a single setpoint into the memory of a PQM. The slave response to this function code is to echo the entire master transmission.

MESSAGE FORMAT AND EXAMPLE:

Request slave 11 to store the value 01E4 in setpoint address 1020. After the transmission in this example is complete, setpoint address 1020 will contain the value 01F4.

Table 7–4: MASTER/SLAVE PACKET FORMAT FOR FUNCTION CODE 06H

MASTER TRANSMISSION	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message for slave 17
FUNCTION CODE	1	06	store single setpoint
DATA STARTING ADDRESS	2	10 20	setpoint address 1020
DATA	2	01 E4	data for setpoint address 1020
CRC	2	8E 47	CRC error code

SLAVE RESPONSE	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message from slave 17
FUNCTION CODE	1	06	store single setpoint
DATA STARTING ADDRESS	2	10 20	setpoint address 1020
DATA	2	01 E4	data stored in setpoint address 1020
CRC	2	8E 47	CRC error code

7.2.6 FUNCTION CODE 07 – READ DEVICE STATUS

Modbus Implementation: Read Exception Status
PQM Implementation: Read Device Status

This is a function used to quickly read the status of a selected device. A short message length allows for rapid reading of status. The status byte returned will have individual bits set to 1 or 0 depending on the status of the slave device.

PQM General Status Byte:

LSBit B0: Alarm condition = 1
B1: Self test failure = 1
B2: Alarm relay energized = 1
B3: Aux 1 relay energized = 1
B4: Aux 2 relay energized = 1
B5: Aux 3 relay energized = 1
B6: Not used

MSBit B7: Not used

MESSAGE FORMAT AND EXAMPLE:

Request status from slave 11.

Table 7–5: MASTER/SLAVE PACKET FORMAT FOR FUNCTION CODE 07H

MASTER TRANSMISSION	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message for slave 17
FUNCTION CODE	1	07	read device status
CRC	2	4C 22	CRC error code

SLAVE RESPONSE	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message from slave 17
FUNCTION CODE	1	07	read device status
DEVICE STATUS (see definition above)	1	2C	status = 00101100 (in binary)
CRC	2	22 28	CRC error code

7.2.7 FUNCTION CODE 08 – LOOPBACK TEST

Modbus Implementation: Loopback Test
PQM Implementation: Loopback Test

This function is used to test the integrity of the communication link. The PQM will echo the request.

MESSAGE FORMAT AND EXAMPLE:

Loopback test from slave 11.

Table 7–6: MASTER/SLAVE PACKET FORMAT FOR FUNCTION CODE 08H

MASTER TRANSMISSION	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message for slave 17
FUNCTION CODE	1	08	loopback test
DIAG CODE	2	00 00	must be 00 00
DATA	2	00 00	must be 00 00
CRC	2	E0 0B	CRC error code

SLAVE RESPONSE	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message from slave 17
FUNCTION CODE	1	08	loopback test
DIAG CODE	2	00 00	must be 00 00
DATA	2	00 00	must be 00 00
CRC	2	E0 0B	CRC error code

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7.2.8 FUNCTION CODE 16 – STORE MULTIPLE SETPOINTS

Modbus Implementation: Preset Multiple Registers
PQM Implementation: Store Multiple Setpoints

This function code allows multiple Setpoints to be stored into the PQM memory. Modbus "registers" are 16 bit (two byte) values transmitted high order byte first. Thus all PQM setpoints are sent as two bytes. The maximum number of Setpoints that can be stored in one transmission is dependent on the slave device. Modbus allows up to a maximum of 60 holding registers to be stored. The PQM allows 60 registers to be stored in one transmission. The PQM response to this function code is to echo the slave address, function code, starting address, the number of Setpoints stored, and the CRC.

MESSAGE FORMAT AND EXAMPLE:

Request slave 11 to store the value 01F4 to Setpoint address 1028 and the value 2710 to setpoint address 1029. After the transmission in this example is complete, PQM slave 11 will have the following Setpoints information stored:

Address	**Data**
1028	01F4
1029	2710

Table 7–7: MASTER/SLAVE PACKET FORMAT FOR FUNCTION CODE 10H

MASTER TRANSMISSION	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message for slave 17
FUNCTION CODE	1	10	store setpoints
DATA STARTING ADDRESS	2	10 28	setpoint address 1028
NUMBER OF SETPOINTS	2	00 02	2 setpoints = 4 bytes total
BYTE COUNT	1	04	4 bytes of data
DATA 1	2	01 F4	data for setpoint address 1028
DATA 2	2	27 10	data for setpoint address 1029
CRC	2	33 23	CRC error code

SLAVE RESPONSE	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message from slave 17
FUNCTION CODE	1	10	store setpoints
DATA STARTING ADDRESS	2	10 28	setpoint address 1028
NUMBER OF SETPOINTS	2	00 02	2 setpoints
CRC	2	C7 90	CRC error code

7.2.9 FUNCTION CODE 16 - PERFORMING COMMANDS

Some PLCs may not support execution of commands using function code 5 but do support storing multiple setpoints using function code 16. To perform this operation using function code 16 (10H), a certain sequence of commands must be written at the same time to the PQM. The sequence consists of: Command Function register, Command operation register and Command Data (if required). The Command Function register must be written with the value of 5 indicating an execute operation is requested. The Command Operation register must then be written with a valid command operation number from the list of commands shown in the memory map. The Command Data registers must be written with valid data if the command operation requires data. The selected command will be executed immediately upon receipt of a valid transmission.

MESSAGE FORMAT AND EXAMPLE:

Perform a reset on PQM (operation code 1).

Table 7–8: MASTER/SLAVE PACKET FORMAT FOR PERFORMING COMMANDS

MASTER TRANSMISSION	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message for slave 17
FUNCTION CODE	1	10	store multiple setpoints
DATA STARTING ADDRESS	2	00 80	setpoint address 1028
NUMBER OF SETPOINTS	2	00 02	2 setpoints = 4 bytes total
BYTE COUNT	1	04	4 bytes of data
DATA 1	2	00 05	data for address 0080
DATA 2	2	00 01	data for address 0081
CRC	2	B0 D6	CRC error code

SLAVE RESPONSE	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message from slave 17
FUNCTION CODE	1	10	store multiple setpoints
DATA STARTING ADDRESS	2	00 80	setpoint address 00 80
NUMBER OF SETPOINTS	2	00 02	2 setpoints
CRC	2	46 7A	CRC error code

7.2.10 FUNCTION CODE 16 - BROADCAST COMMAND

In applications where multiple devices are daisy chained, it may be necessary to synchronize the clocks (date and/or time) in all the devices by sending one command. The broadcast command allows such synchronization as shown in an example below. The PQM will recognize a packet as being a broadcast command if the SLAVE ADDRESS is transmitted as 0.

MESSAGE FORMAT AND EXAMPLE:

Send broadcast command to the PQM to store 1:27:10.015 pm, October 29, 1997.

Table 7–9: PACKET FORMAT FOR FUNCTION CODE 16 BROADCAST COMMAND

MASTER TRANSMISSION	BYTES	EXAMPLE	DESCRIPTION
SLAVE ADDRESS	1	11	message for slave 17
FUNCTION CODE	1	10	store multiple setpoints
DATA STARTING ADDRESS	2	00 F0	start at address 00F0
NUMBER OF SETPOINTS	2	00 04	4 setpoints = 8 bytes total
BYTE COUNT	1	08	8 bytes of data
DATA 1	2	0D 1B	hours (24 hour format), minutes
DATA 2	2	27 1F	milliseconds
DATA 3	2	0A 1D	month, day
DATA 4	2	07 CD	year (four digits, i.e. 1997)
CRC	2	9D 8D	CRC error code

SLAVE RESPONSE	BYTES	EXAMPLE	DESCRIPTION
Slave does not respond back to the master.			

The PQM allows the date and time to be stored separately. In other word, a broadcast command can be sent to store just date or time.

7.2.11 ERROR RESPONSES

When a PQM detects an error other than a CRC error, a response will be sent to the master. The MSbit of the FUNCTION CODE byte will be set to 1 (i.e. the function code sent from the slave will be equal to the function code sent from the master plus 128). The following byte will be an exception code indicating the type of error that occurred.

Transmissions received from the master with CRC errors will be ignored by the PQM.

The slave response to an error (other than CRC error) will be:

- SLAVE ADDRESS: 1 byte
- FUNCTION CODE: 1 byte (with MSbit set to 1)
- EXCEPTION CODE: 1 byte
- CRC: 2 bytes

The PQM implements the following exception response codes.

01 - ILLEGAL FUNCTION

The function code transmitted is not one of the functions supported by the PQM.

02 - ILLEGAL DATA ADDRESS

The address referenced in the data field transmitted by the master is not an allowable address for the PQM.

03 - ILLEGAL DATA VALUE

The value referenced in the data field transmitted by the master is not within range for the selected data address.

7.3.1 MEMORY MAP INFORMATION

The data stored in the PQM is grouped as Setpoints and Actual Values. Setpoints can be read and written by a master computer. Actual Values can be read only. All Setpoints and Actual Values are stored as two byte values. That is, each register address is the address of a two byte value. Addresses are listed in hexadecimal. Data values (Setpoint ranges, increments, factory values) are in decimal.

7.3.2 USER-DEFINABLE MEMORY MAP

The PQM contains a User Definable area in the memory map. This area allows remapping of the addresses of all Actual Values and Setpoints registers. The User Definable area has two sections:

1. A Register Index area (memory map addresses 0180H-01F7H) that contains 120 Actual Values or Setpoints register addresses.
2. A Register area (memory map addresses 0100H-017FH) that contains the data at the addresses in the Register Index.

Register data that is separated in the rest of the memory map may be remapped to adjacent register addresses in the User Definable Registers area. This is accomplished by writing to register addresses in the User Definable Register Index area. This allows for improved throughput of data and can eliminate the need for multiple read command sequences.

For example, if the values of Phase A Current (register address 0220H) and Phase A Power Factor (register address 02DDH) are required to be read from a PQM, their addresses may be remapped as follows:

1. Write 0220H to address 0180H (User Definable Register Index 0000) using function code 06 or 16.
2. Write 02DDH to address 0181H (User Definable Register Index 0001) using function code 06 or 16.

A read (function code 03 or 04) of registers 0100H (User Definable Register 0000) and 0101H (User Definable Register 0001) will return the Phase A Current and Phase A Power Factor.

7.3.3 PQM MEMORY MAP

Table 7–10: PQM MEMORY MAP (Sheet 1 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
Product Information (Input Registers) Addresses - 0000-007F							
PRODUCT ID	0000	Product Device Code	---	---	---	F1	65
	0001	Hardware Version Code	---	---	---	F5	current version
	0002	Main Software Version Code	---	---	---	F1	current version
	0003	Modification File Number 1	---	---	---	F1	mod. file number 1
	0004	Boot Software Version Code	---	---	---	F1	current version
	0005	Supervisor Processor Version Code	---	---	---	F1	current version
	0006	Product options	---	---	---	F100	from order code
	0007	Modification File Number 2	---	---	---	F1	mod. file number 2
	0008	Modification File Number 3	---	---	---	F1	mod. file number 3
	0009	Modification File Number 4	---	---	---	F1	mod. file number 4
	000A	Modification File Number 5	---	---	---	F1	mod. file number 5
	000B	Reserved					
	to	↓					
	001F	Reserved					
	0020	Serial Number Character 1 and 2	---	---	ASCII	F10	1st, 2nd char.
	0021	Serial Number Character 3 and 4	---	---	ASCII	F10	3rd, 4th char.
	0022	Serial Number Character 5 and 6	---	---	ASCII	F10	5th, 6th char
	0023	Serial Number Character 7 and 8	---	---	ASCII	F10	7th, 8th char.
	0024	Reserved					
	to	↓					
	002F	Reserved					
	0030	Manufacture Month/Day	---	---	---	F24	manf. month/day
	0031	Manufacture Year	---	---	---	F25	manufacture year
	0032	Calibration Month/Day	---	---	---	F24	cal. month/day
	0033	Calibration Year	---	---	---	F25	calibration year
	0034	Reserved					
	0035	Reserved					
	to	↓					
	007F	Reserved					
Commands (Holding Registers) Addresses - 0080-00EF							
COMMANDS	0080	Command Function Code	5	---	---	F1	5
	0081	Command Operation Code	1 to 35	1	---	F7	0
	0082	Command Data 1	0 to 65535	1	---	*	0
	0083	Command Data 2	0 to 65535	1	---	F31	0
	0084	Command Data 3	0 to 65535	1	---	F8	0
	0085	Command Data 4	0 to 65535	1	---	F8	0
	0086	Command Data 5	0 to 65535	1	---	F8	0
	0087	Command Data 6	0 to 65535	1	---	F8	0
	0088	Command Data 7	0 to 65535	1	---	F8	0
	0089	Command Data 8	0 to 65535	1	---	F8	0

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 2 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
COMMANDS continued	008A	Command Data 9	0 to 65535	1	---	F8	0
	008B	Command Data 10	0 to 65535	1	---	F8	0
	008C	Command Data 11	0 to 65535	1	---	F8	0
	008D	Reserved					
	to	↓					
	00EF	Reserved					
Broadcast Command (Holding Registers) Addresses - 00F0-00FF							
BROADCAST COMMAND	00F0	Time Hours/Minutes	0 to 65535	1	hr/min	F22	N/A
	00F1	Time Seconds	0 to 59999	1	ms	F23	N/A
	00F2	Date Month/Day	0 to 65535	1	---	F24	N/A
	00F3	Date Year	0 to 59999	1	---	F25	N/A
	00F4	Reserved					
	to	↓					
	00FF	Reserved					
User Definable Register (Input Registers) Addresses - 0100-017F							
USER DEFINABLE REGISTERS	0100	User Definable Data 0000	---	---	---	---	---
	0101	User Definable Data 0001	---	---	---	---	---
	0102	User Definable Data 0002	---	---	---	---	---
	0103	User Definable Data 0003	---	---	---	---	---
	0104	User Definable Data 0004	---	---	---	---	---
	0105	User Definable Data 0005	---	---	---	---	---
	0106	User Definable Data 0006	---	---	---	---	---
	0107	User Definable Data 0007	---	---	---	---	---
	0108	User Definable Data 0008	---	---	---	---	---
	0109	User Definable Data 0009	---	---	---	---	---
	010A	User Definable Data 000A	---	---	---	---	---
	010B	User Definable Data 000B	---	---	---	---	---
	to	↓	↓	↓	↓	↓	↓
	0177	User Definable Data 0077	---	---	---	---	---
	0178	Reserved					
	to	↓					
	017F	Reserved					
User Definable Register Index (Holding Registers) Addresses - 0180-01FF							
USER DEFINABLE REGISTER INDEX	0180	Register address for User Data 0000	*****	1	---	F1	0
	0181	Register address for User Data 0001	*****	1	---	F1	0
	0182	Register address for User Data 0002	*****	1	---	F1	0
	0183	Register address for User Data 0003	*****	1	---	F1	0
	0184	Register address for User Data 0004	*****	1	---	F1	0
	0185	Register address for User Data 0005	*****	1	---	F1	0
	0186	Register address for User Data 0006	*****	1	---	F1	0
	0187	Register address for User Data 0007	*****	1	---	F1	0
	0188	Register address for User Data 0008	*****	1	---	F1	0
	0189	Register address for User Data 0009	*****	1	---	F1	0
	018A	Register address for User Data 000A	*****	1	---	F1	0

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 3 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
USER DEFINABLE REGISTER INDEX continued	018B	Register address for User Data 000B	*****	1	---	F1	0
	018C	Register address for User Data 000C	*****	1	---	F1	0
	018D	Register address for User Data 000D	*****	1	---	F1	0
	to	↓	↓	↓	↓	↓	↓
	01F7	Register address for User Data 0077	*****	1	---	F1	0
	01F8	Reserved					
	to	↓					
	01FF	Reserved					
Actual Values (Input Registers) Addresses - 0200-0E1F							
STATUS	0200	Switch Input Status	---	---	---	F101	N/A
	0201	LED Status Flags	---	---	---	F102	N/A
	0202	LED Attribute Flags	---	---	---	F103	N/A
	0203	Output Relay Status Flags	---	---	---	F104	N/A
	0204	Alarm Active Status Flags 1	---	---	---	F105	N/A
	0205	Alarm Pickup Status Flags 1	---	---	---	F105	N/A
	0206	Alarm Active Status Flags 2	---	---	---	F106	N/A
	0207	Alarm Pickup Status Flags 2	---	---	---	F106	N/A
	0208	Alarm Active Status Flags 3	---	---	---	F107	N/A
	0209	Alarm Pickup Status Flags 3	---	---	---	F107	N/A
	020A	Aux. 1 Active Status Flags 1	---	---	---	F105	N/A
	020B	Aux. 1 Pickup Status Flags 1	---	---	---	F105	N/A
	020C	Aux. 1 Active Status Flags 2	---	---	---	F106	N/A
	020D	Aux. 1 Pickup Status Flags 2	---	---	---	F106	N/A
	020E	Aux. 1 Active Status Flags 3	---	---	---	F107	N/A
	020F	Aux. 1 Pickup Status Flags 3	---	---	---	F107	N/A
	0210	Aux. 2 Active Status Flags 1	---	---	---	F105	N/A
	0211	Aux. 2 Pickup Status Flags 1	---	---	---	F105	N/A
	0212	Aux. 2 Active Status Flags 2	---	---	---	F106	N/A
	0213	Aux. 2 Pickup Status Flags 2	---	---	---	F106	N/A
	0214	Aux. 2 Active Status Flags 3	---	---	---	F107	N/A
	0215	Aux. 2 Pickup Status Flags 3	---	---	---	F107	N/A
	0216	Aux. 3 Active Status Flags 1	---	---	---	F105	N/A
	0217	Aux. 3 Pickup Status Flags 1	---	---	---	F105	N/A
	0218	Aux. 3 Active Status Flags 2	---	---	---	F106	N/A
	0219	Aux. 3 Pickup Status Flags 2	---	---	---	F106	N/A
	021A	Aux. 3 Active Status Flags 3	---	---	---	F107	N/A
	021B	Aux. 3 Pickup Status Flags 3	---	---	---	F107	N/A
	021C	General Status	---	---	---	F109	N/A
	021D	Encrypted Passcode	---	---	---	F1	N/A
	021E	Reserved					
	to	↓	↓	↓	↓	↓	↓
	022F	Reserved					

Notes: * Data type depends on the Command Operation Code.
** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”.
**** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 4 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
CLOCK	0230	Time - Hours/Minutes	---	---	---	F22	N/A
	0231	Time - Seconds	---	---	---	F23	N/A
	0232	Time - Month/Day	---	---	---	F24	N/A
	0233	Time Year	---	---	---	F25	N/A
	0234	Reserved					
	to	↓	↓	↓	↓	↓	↓
	023F	Reserved					
CURRENT	0240	Phase A Current	---	---	A	F1	N/A
	0241	Phase B Current	---	---	A	F1	N/A
	0242	Phase C Current	---	---	A	F1	N/A
	0243	Average Current	---	---	A	F1	N/A
	0244	Neutral Current	---	---	A	F1	N/A
	0245	Current Unbalance	---	---	0.1 x%	F1	N/A
	0246	Phase A Current - Minimum			A	F1	N/A
	0247	Phase B Current - Minimum			A	F1	N/A
	0248	Phase C Current - Minimum			A	F1	N/A
	0249	Neutral Current - Minimum			A	F1	N/A
	024A	Current Unbalance - Minimum			0.1 x%	F1	N/A
	024B	Phase A Current - Maximum			A	F1	N/A
	024C	Phase B Current - Maximum			A	F1	N/A
	024D	Phase C Current - Maximum			A	F1	N/A
	024E	Neutral Current - Maximum			A	F1	N/A
	024F	Current Unbalance - Maximum			0.1 x%	F1	N/A
	0250	Time - Hour/Minutes of Phase A Curr. Min	---	---	---	F22	N/A
	0251	Time - Seconds of Phase A Current Min	---	---	---	F23	N/A
	0252	Date - Month/Day of Phase A Current Min	---	---	---	F24	N/A
	0253	Date - Year of Phase A Current Min	---	---	---	F25	N/A
	0254	Time - Hour/Minutes of Phase B Curr. Min	---	---	---	F22	N/A
	0255	Time - Seconds of Phase B Current Min	---	---	---	F23	N/A
	0256	Date - Month/Day of Phase B Current Min	---	---	---	F24	N/A
	0257	Date - Year of Phase B Current Min	---	---	---	F25	N/A
	0258	Time - Hour/Minutes of Phase C Curr. Min	---	---	---	F22	N/A
	0259	Time - Seconds of Phase C Current Min	---	---	---	F23	N/A
	025A	Date - Month/Day of Phase C Current Min	---	---	---	F24	N/A
	025B	Date - Year of Phase C Current Min	---	---	---	F25	N/A
	025C	Time - Hour/Minutes of Neutral Current Min	---	---	---	F22	N/A
	025D	Time - Seconds of Neutral Current Min	---	---	---	F23	N/A
	025E	Date - Month/Day of Neutral Current Min	---	---	---	F24	N/A
	025F	Date - Year of Neutral Current Min	---	---	---	F25	N/A
	0260	Time - Hour/Minutes of Current Unbal. Min	---	---	---	F22	N/A
	0261	Time - Seconds of Current Unbalance Min	---	---	---	F23	N/A
	0262	Date - Month/Day of Current Unbal. Min	---	---	---	F24	N/A
	0263	Date - Year of Current Unbalance Min	---	---	---	F25	N/A
	0264	Time - Hour/Minutes of Phase A Curr. Max	---	---	---	F22	N/A

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 5 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
CURRENT continued	0265	Time - Seconds of Phase A Current Max	---	---	---	F23	N/A
	0266	Date - Month/Day of Phase A Current Max	---	---	---	F24	N/A
	0267	Date - Year of Phase A Current Max	---	---	---	F25	N/A
	0268	Time - Hour/Minutes of Phase B Curr. Max	---	---	---	F22	N/A
	0269	Time - Seconds of Phase B Current Max	---	---	---	F23	N/A
	026A	Date - Month/Day of Phase B Current Max	---	---	---	F24	N/A
	026B	Date - Year of Phase B Current Max	---	---	---	F25	N/A
	026C	Time - Hour/Minutes of Phase C Curr. Max	---	---	---	F22	N/A
	026D	Time - Seconds of Phase C Current Max	---	---	---	F23	N/A
	026E	Date - Month/Day of Phase C Current Max	---	---	---	F24	N/A
	026F	Date - Year of Phase C Current Max	---	---	---	F25	N/A
	0270	Time - Hour/Minutes of Neutral Current Max	---	---	---	F22	N/A
	0271	Time - Seconds of Neutral Current Max	---	---	---	F23	N/A
	0272	Date - Month/Day of Neutral Current Max	---	---	---	F24	N/A
	0273	Date - Year of Neutral Current Max	---	---	---	F25	N/A
	0274	Time - Hour/Minutes of Current Unbal. Max	---	---	---	F22	N/A
	0275	Time - Seconds of Current Unbal. Max	---	---	---	F23	N/A
	0276	Date - Month/Day of Current Unbal. Max	---	---	---	F24	N/A
	0277	Date - Year of Current Unbalance Max	---	---	---	F25	N/A
	0278	Reserved					
	to	↓	↓	↓	↓	↓	↓
	027F	Reserved					
VOLTAGE	0280	Voltage Van (High)	---	---	V	F3	N/A
	0281	Voltage Van (Low)	---	---	V	F3	N/A
	0282	Voltage Vbn (High)	---	---	V	F3	N/A
	0283	Voltage Vbn (Low)	---	---	V	F3	N/A
	0284	Voltage Vcn (High)	---	---	V	F3	N/A
	0285	Voltage Vcn (Low)	---	---	V	F3	N/A
	0286	Average Phase Voltage (High)	---	---	V	F3	N/A
	0287	Average Phase Voltage (Low)	---	---	V	F3	N/A
	0288	Voltage Vab (High)	---	---	V	F3	N/A
	0289	Voltage Vab (Low)	---	---	V	F3	N/A
	028A	Voltage Vbc (High)	---	---	V	F3	N/A
	028B	Voltage Vbc (Low)	---	---	V	F3	N/A
	028C	Voltage Vca (High)	---	---	V	F3	N/A
	028D	Voltage Vca (Low)	---	---	V	F3	N/A
	028E	Average Line Voltage (High)	---	---	V	F3	N/A
	028F	Average Line Voltage (Low)	---	---	V	F3	N/A
	0290	Voltage Unbalance	---	---	0.1 x %	F1	N/A
	0291	Voltage Van - Minimum (high)	---	---	V	F3	N/A
	0292	Voltage Van - Minimum (Low)	---	---	V	F3	N/A
	0293	Voltage Vbn - Minimum (high)	---	---	V	F3	N/A
	0294	Voltage Vbn - Minimum (Low)	---	---	V	F3	N/A
	0295	Voltage Vcn - Minimum (high)	---	---	V	F3	N/A

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**** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 6 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
VOLTAGE continued	0296	Voltage Vcn - Minimum (Low)	---	---	V	F3	N/A
	0297	Voltage Vab - Minimum (high)	---	---	V	F3	N/A
	0298	Voltage Vab - Minimum (Low)	---	---	V	F3	N/A
	0299	Voltage Vbc - Minimum (high)	---	---	V	F3	N/A
	029A	Voltage Vbc - Minimum (Low)	---	---	V	F3	N/A
	029B	Voltage Vca - Minimum (high)	---	---	V	F3	N/A
	029C	Voltage Vca - Minimum (Low)	---	---	V	F3	N/A
	029D	Voltage Unbalance - Minimum	---	---	0.1 x%	F1	N/A
	029E	Voltage Van - Maximum (high)	---	---	V	F3	N/A
	029F	Voltage Van - Maximum (Low)	---	---	V	F3	N/A
	02A0	Voltage Vbn - Maximum (high)	---	---	V	F3	N/A
	02A1	Voltage Vbn - Maximum (Low)	---	---	V	F3	N/A
	02A2	Voltage Vcn - Maximum (high)	---	---	V	F3	N/A
	02A3	Voltage Vcn - Maximum (Low)	---	---	V	F3	N/A
	02A4	Voltage Vab - Maximum (high)	---	---	V	F3	N/A
	02A5	Voltage Vab - Maximum (Low)	---	---	V	F3	N/A
	02A6	Voltage Vbc - Maximum (high)	---	---	V	F3	N/A
	02A7	Voltage Vbc - Maximum (Low)	---	---	V	F3	N/A
	02A8	Voltage Vca - Maximum (high)	---	---	V	F3	N/A
	02A9	Voltage Vca - Maximum (Low)	---	---	V	F3	N/A
	02AA	Voltage Unbalance - Maximum	---	---	0.1 x%	F1	N/A
	02AB	Time - Hour/Minutes of Voltage Van Min	---	---	---	F22	N/A
	02AC	Time - Seconds of Voltage Van Min	---	---	---	F23	N/A
	02AD	Date - Month/Day of Voltage Van Min	---	---	---	F24	N/A
	02AE	Date - Year of Voltage Van Min	---	---	---	F25	N/A
	02AF	Time - Hour/Minutes of Voltage Vbn Min	---	---	---	F22	N/A
	02B0	Time - Seconds of Voltage Vbn Min	---	---	---	F23	N/A
	02B1	Date - Month/Day of Voltage Vbn Min	---	---	---	F24	N/A
	02B2	Date - Year of Voltage Vbn Min	---	---	---	F25	N/A
	02B3	Time - Hour/Minutes of Voltage Vcn Min	---	---	---	F22	N/A
	02B4	Time - Seconds of Voltage Vcn Min	---	---	---	F23	N/A
	02B5	Date - Month/Day of Voltage Vcn Min	---	---	---	F24	N/A
	02B6	Date - Year of Voltage Vcn Min	---	---	---	F25	N/A
	02B7	Time - Hour/Minutes of Voltage Vab Min	---	---	---	F22	N/A
	02B8	Time - Seconds of Voltage Vab Min	---	---	---	F23	N/A
	02B9	Date - Month/Day of Voltage Vab Min	---	---	---	F24	N/A
	02BA	Date - Year of Voltage Vab Min	---	---	---	F25	N/A
	02BB	Time - Hour/Minutes of Voltage Vbc Min	---	---	---	F22	N/A
	02BC	Time - Seconds of Voltage Vbc Min	---	---	---	F23	N/A
	02BD	Date - Month/Day of Voltage Vbc Min	---	---	---	F24	N/A
	02BE	Date - Year of Voltage Vbc Min	---	---	---	F25	N/A
	02BF	Time - Hour/Minutes of Voltage Vca Min	---	---	---	F22	N/A
	02C0	Time - Seconds of Voltage Vca Min	---	---	---	F23	N/A
	02C1	Date - Month/Day of Voltage Vca Min	---	---	---	F24	N/A

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 7 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
VOLTAGE continued	02C2	Date - Year of Voltage Vca Min	---	---	---	F25	N/A
	02C3	Time - Hour/Minutes of Voltage Unbal. Min	---	---	---	F22	N/A
	02C4	Time - Seconds of Voltage Unbalance Min	---	---	---	F23	N/A
	02C5	Date - Month/Day of Voltage Unbal. Min	---	---	---	F24	N/A
	02C6	Date - Year of Voltage Unbalance Min	---	---	---	F25	N/A
	02C7	Time - Hour/Minutes of Voltage Van Max	---	---	---	F22	N/A
	02C8	Time - Seconds of Voltage Van Max	---	---	---	F23	N/A
	02C9	Date - Month/Day of Voltage Van Max	---	---	---	F24	N/A
	02CA	Date - Year of Voltage Van Max	---	---	---	F25	N/A
	02CB	Time - Hour/Minutes of Voltage Vbn Max	---	---	---	F22	N/A
	02CC	Time - Seconds of Voltage Vbn Max	---	---	---	F23	N/A
	02CD	Date - Month/Day of Voltage Vbn Max	---	---	---	F24	N/A
	02CE	Date - Year of Voltage Vbn Max	---	---	---	F25	N/A
	02CF	Time - Hour/Minutes of Voltage Vcn Max	---	---	---	F22	N/A
	02D0	Time - Seconds of Voltage Vcn Max	---	---	---	F23	N/A
	02D1	Date - Month/Day of Voltage Vcn Max	---	---	---	F24	N/A
	02D2	Date - Year of Voltage Vcn Max	---	---	---	F25	N/A
	02D3	Time - Hour/Minutes of Voltage Vab Max	---	---	---	F22	N/A
	02D4	Time - Seconds of Voltage Vab Max	---	---	---	F23	N/A
	02D5	Date - Month/Day of Voltage Vab Max	---	---	---	F24	N/A
	02D6	Date - Year of Voltage Vab Max	---	---	---	F25	N/A
	02D7	Time - Hour/Minutes of Voltage Vbc Max	---	---	---	F22	N/A
	02D8	Time - Seconds of Voltage Vbc Max	---	---	---	F23	N/A
	02D9	Date - Month/Day of Voltage Vbc Max	---	---	---	F24	N/A
	02DA	Date - Year of Voltage Vbc Max	---	---	---	F25	N/A
	02DB	Time - Hour/Minutes of Voltage Vca Max	---	---	---	F22	N/A
	02DC	Time - Seconds of Voltage Vca Max	---	---	---	F23	N/A
	02DD	Date - Month/Day of Voltage Vca Max	---	---	---	F24	N/A
	02DE	Date - Year of Voltage Vca Max	---	---	---	F25	N/A
	02DF	Time - Hour/Minutes of Voltage Unbal. Max	---	---	---	F22	N/A
	02E0	Time - Seconds of Voltage Unbalance Max	---	---	---	F23	N/A
	02E1	Date - Month/Day of Voltage Unbalance Max	---	---	---	F24	N/A
	02E2	Date - Year of Voltage Unbalance Max	---	---	---	F25	N/A
	02E3	Reserved					
	02E4	Reserved					
	02E5	Reserved					
	02D6	Reserved					
	02E7	Va Phasor Angle	---	---	° lag/lead	F2	
	02E8	Vb Phasor Angle	---	---	° lag/lead	F2	
	02E9	Vc Phasor Angle	---	---	° lag/lead	F2	
	02EA	Ia Phasor Angle	---	---	° lag/lead	F2	
	02EB	Ib Phasor Angle	---	---	° lag/lead	F2	
	02EC	Ic Phasor Angle	---	---	° lag/lead	F2	
	02ED	Reserved					

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
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***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 8 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
	02EE	Reserved					
	02EF	Reserved					
POWER	02F0	3 Phase Real Power (high)	---	---	0.01 x kW	F4	N/A
	02F1	3 Phase Real Power (low)	---	---	0.01 x kW	F4	N/A
	02F2	3 Phase Reactive Power (high)	---	---	0.01 x kvar	F4	N/A
	02F3	3 Phase Reactive Power (low)	---	---	0.01 x kvar	F4	N/A
	02F4	3 Phase Apparent Power (high)	---	---	0.01 x kVA	F3	N/A
	02F5	3 Phase Apparent Power (low)	---	---	0.01 x kVA	F3	N/A
	02F6	3 Phase Power Factor	---	---	0.01 x PF	F2	N/A
	02F7	Phase A Real Power (high)	---	---	0.01 x kW	F4	N/A
	02F8	Phase A Real Power (low)	---	---	0.01 x kW	F4	N/A
	02F9	Phase A Reactive Power (high)	---	---	0.01 x kvar	F4	N/A
	02FA	Phase A Reactive Power (low)	---	---	0.01 x kvar	F4	N/A
	02FB	Phase A Apparent Power (high)	---	---	0.01 x kVA	F3	N/A
	02FC	Phase A Apparent Power (low)	---	---	0.01 x kVA	F3	N/A
	02FD	Phase A Power Factor	---	---	0.01 x PF	F2	N/A
	02FE	Phase B Real Power (high)	---	---	0.01 x kW	F4	N/A
	02FF	Phase B Real Power (low)	---	---	0.01 x kW	F4	N/A
	0300	Phase B Reactive Power (high)	---	---	0.01 x kvar	F4	N/A
	0301	Phase B Reactive Power (low)	---	---	0.01 x kvar	F4	N/A
	0302	Phase B Apparent Power (high)	---	---	0.01 x kVA	F3	N/A
	0303	Phase B Apparent Power (low)	---	---	0.01 x kVA	F3	N/A
	0304	Phase B Power Factor	---	---	0.01 x PF	F2	N/A
	0305	Phase C Real Power (high)	---	---	0.01 x kW	F4	N/A
	0306	Phase C Real Power (low)	---	---	0.01 x kW	F4	N/A
	0307	Phase C Reactive Power (high)	---	---	0.01 x kvar	F4	N/A
	0308	Phase C Reactive Power (low)	---	---	0.01 x kvar	F4	N/A
	0309	Phase C Apparent Power (high)	---	---	0.01 x kVA	F3	N/A
	030A	Phase C Apparent Power (low)	---	---	0.01 x kVA	F3	N/A
	030B	Phase C Power Factor	---	---	0.01 x PF	F2	N/A
	030C	3 Phase Real Power - Minimum (high)	---	---	0.01 x kW	F4	N/A
	030D	3 Phase Real Power - Minimum (low)	---	---	0.01 x kW	F4	N/A
	030E	3 Phase Reactive Power - Minimum (high)	---	---	0.01 x kvar	F4	N/A
	030F	3 Phase Reactive Power - Minimum (low)	---	---	0.01 x kvar	F4	N/A
	0310	3 Phase Apparent Power - Minimum (high)	---	---	0.01 x kVA	F3	N/A
	0311	3 Phase Apparent Power - Minimum (low)	---	---	0.01 x kVA	F3	N/A
	0312	3 Phase Power Factor - Minimum	---	---	0.01 x PF	F2	N/A
	0313	3 Phase Real Power - Maximum (high)	---	---	0.01 x kW	F4	N/A
	0314	3 Phase Real Power - Maximum (low)	---	---	0.01 x kW	F4	N/A
	0315	3 Phase Reactive Power - Maximum (high)	---	---	0.01 x kvar	F4	N/A
	0316	3 Phase Reactive Power - Maximum (low)	---	---	0.01 x kvar	F4	N/A
	0317	3 Phase Apparent Power - Maximum (high)	---	---	0.01 x kVA	F3	N/A
	0318	3 Phase Apparent Power - Maximum (low)	---	---	0.01 x kVA	F3	N/A
	0319	3 Phase Power Factor - Maximum	---	---	0.01 x PF	F2	N/A

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Table 7–10: PQM MEMORY MAP (Sheet 9 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
POWER continued	031A	Phase A Real Power - Minimum (high)	---	---	0.01 x kW	F4	N/A
	031B	Phase A Real Power - Minimum (low)	---	---	0.01 x kW	F4	N/A
	031C	Phase A Reactive Power - Minimum (high)	---	---	0.01 x kvar	F4	N/A
	031D	Phase A Reactive Power - Minimum (low)	---	---	0.01 x kvar	F4	N/A
	031E	Phase A Apparent Power - Minimum (high)	---	---	0.01 x kVA	F3	N/A
	031F	Phase A Apparent Power - Minimum (low)	---	---	0.01 x kVA	F3	N/A
	0320	Phase A Power Factor - Minimum	---	---	0.01 xPF	F2	N/A
	0321	Phase A Real Power - Maximum (high)	---	---	0.01 x kW	F4	N/A
	0322	Phase A Real Power - Maximum (low)	---	---	0.01 x kW	F4	N/A
	0323	Phase A Reactive Power - Maximum (high)	---	---	0.01 x kvar	F4	N/A
	0324	Phase A Reactive Power - Maximum (low)	---	---	0.01 x kvar	F4	N/A
	0325	Phase A Apparent Power - Maximum (high)	---	---	0.01 x kVA	F3	N/A
	0326	Phase A Apparent Power - Maximum (low)	---	---	0.01 x kVA	F3	N/A
	0327	Phase A Power Factor - Maximum	---	---	0.01 x PF	F2	N/A
	0328	Phase B Real Power - Minimum (high)	---	---	0.01 x kW	F4	N/A
	0329	Phase B Real Power - Minimum (low)	---	---	0.01 x kW	F4	N/A
	032A	Phase B Reactive Power - Minimum (high)	---	---	0.01 x kvar	F4	N/A
	032B	Phase B Reactive Power - Minimum (low)	---	---	0.01 x kvar	F4	N/A
	032C	Phase B Apparent Power - Minimum (high)	---	---	0.01 x kVA	F3	N/A
	032D	Phase B Apparent Power - Minimum (low)	---	---	0.01 x kVA	F3	N/A
	032E	Phase B Power Factor - Minimum	---	---	0.01 x PF	F2	N/A
	032F	Phase B Real Power - Maximum (high)	---	---	0.01 x kW	F4	N/A
	0330	Phase B Real Power - Maximum (low)	---	---	0.01 x kW	F4	N/A
	0331	Phase B Reactive Power - Maximum (high)	---	---	0.01 x kvar	F4	N/A
	0332	Phase B Reactive Power - Maximum (low)	---	---	0.01 x kvar	F4	N/A
	0333	Phase B Apparent Power - Maximum (high)	---	---	0.01 x kVA	F3	N/A
	0334	Phase B Apparent Power - Maximum (low)	---	---	0.01 x kVA	F3	N/A
	0335	Phase B Power Factor - Maximum	---	---	0.01 x PF	F2	N/A
	0336	Phase C Real Power - Minimum (high)	---	---	0.01 x kW	F4	N/A
	0337	Phase C Real Power - Minimum (low)	---	---	0.01 x kW	F4	N/A
	0338	Phase C Reactive Power - Minimum (high)	---	---	0.01 x kvar	F4	N/A
	0339	Phase C Reactive Power - Minimum (low)	---	---	0.01 x kvar	F4	N/A
	033A	Phase C Apparent Power - Minimum (high)	---	---	0.01 x kVA	F3	N/A
	033B	Phase C Apparent Power - Minimum (low)	---	---	0.01 x kVA	F3	N/A
	033C	Phase C Power Factor - Minimum	---	---	0.01 x PF	F2	N/A
	033D	Phase C Real Power - Maximum (high)	---	---	0.01 x kW	F4	N/A
	033E	Phase C Real Power - Maximum (low)	---	---	0.01 x kW	F4	N/A
	033F	Phase C Reactive Power - Maximum (high)	---	---	0.01 x kvar	F4	N/A
	0340	Phase C Reactive Power - Maximum (low)	---	---	0.01 x kvar	F4	N/A
	0341	Phase C Apparent Power - Maximum (high)	---	---	0.01 x kVA	F3	N/A
	0342	Phase C Apparent Power - Maximum (low)	---	---	0.01 x kVA	F3	N/A
	0343	Phase C Power Factor - Maximum	---	---	0.01 x PF	F2	N/A
	0344	Time - Hour/Minutes of Real Power Min	---	---	---	F22	N/A
	0345	Time - Seconds of Real Power Min	---	---	---	F23	N/A

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**** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 10 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
POWER continued	0346	Date - Month/Day of Real Power Min	---	---	---	F24	N/A
	0347	Date - Year of Real Power Min	---	---	---	F25	N/A
	0348	Time - Hour/Minutes of Reactive Pwr Min	---	---	---	F22	N/A
	0349	Time - Seconds of Reactive Power Min	---	---	---	F23	N/A
	034A	Date - Month/Day of Reactive Power Min	---	---	---	F24	N/A
	034B	Date - Year of Reactive Power Min	---	---	---	F25	N/A
	034C	Time - Hour/Minutes of Apparent Pwr Min	---	---	---	F22	N/A
	034D	Time - Seconds of Apparent Power Min	---	---	---	F23	N/A
	034E	Date - Month/Day of Apparent Power Min	---	---	---	F24	N/A
	034F	Date - Year of Apparent Power Min	---	---	---	F25	N/A
	0350	Time - Hour/Minutes of Power Factor Min	---	---	---	F22	N/A
	0351	Time - Seconds of Power Factor Min	---	---	---	F23	N/A
	0352	Date - Month/Day of Power Factor Min	---	---	---	F24	N/A
	0353	Date - Year of Power Factor Min	---	---	---	F25	N/A
	0354	Time - Hour/Minutes of Real Power Max	---	---	---	F22	N/A
	0355	Time - Seconds of Real Power Max	---	---	---	F23	N/A
	0356	Date - Month/Day of Real Power Max	---	---	---	F24	N/A
	0357	Date - Year of Real Power Max	---	---	---	F25	N/A
	0358	Time - Hour/Minutes of Reactive Pwr Max	---	---	---	F22	N/A
	0359	Time - Seconds of Reactive Power Max	---	---	---	F23	N/A
	035A	Date - Month/Day of Reactive Pwr Max	---	---	---	F24	N/A
	035B	Date - Year of Reactive Power Max	---	---	---	F25	N/A
	035C	Time - Hour/Minutes of Apparent Pwr Max	---	---	---	F22	N/A
	035D	Time - Seconds of Apparent Pwr Max	---	---	---	F23	N/A
	035E	Date - Month/Day of Apparent Pwr Max	---	---	---	F24	N/A
	035F	Date - Year of Apparent Power Max	---	---	---	F25	N/A
	0360	Time - Hour/Minutes of Power Factor Max	---	---	---	F22	N/A
	0361	Time - Seconds of Power Factor Max	---	---	---	F23	N/A
	0362	Date - Month/Day of Power Factor Max	---	---	---	F24	N/A
	0363	Date - Year of Power Factor Max	---	---	---	F25	N/A
	0364	Time - Hour/Min of Phase A Real Pwr Min	---	---	---	F22	N/A
	0365	Time - Seconds of Phase A Real Pwr Min	---	---	---	F23	N/A
	0366	Date - Month/Day of Phase A Real Pwr Min	---	---	---	F24	N/A
	0367	Date - Year of Phase A Real Pwr Min	---	---	---	F25	N/A
	0368	Time - Hour/Min of Phase A React Pwr Min	---	---	---	F22	N/A
	0369	Time - Seconds of Phase A React Pwr Min	---	---	---	F23	N/A
	036A	Date - Month/Day of Phase A React Pwr Min	---	---	---	F24	N/A
	036B	Date - Year of Phase A Reactive Pwr Min	---	---	---	F25	N/A
	036C	Time - Hour/Minutes of Phase A App Pwr Min	---	---	---	F22	N/A
	036D	Time - Seconds of Phase A App Pwr Min	---	---	---	F23	N/A
	036E	Date - Month/Day of Phase A App Pwr Min	---	---	---	F24	N/A
	036F	Date - Year of Phase A Apparent Pwr Min	---	---	---	F25	N/A
	0370	Time - Hour/Minutes of Phase A PF Min	---	---	---	F22	N/A
	0371	Time - Seconds of Phase A PF Min	---	---	---	F23	N/A

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 11 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
POWER continued	0372	Date - Month/Day of Phase A PF Min	---	---	---	F24	N/A
	0373	Date - Year of Phase A Power Factor Min	---	---	---	F25	N/A
	0374	Time - Hour/Min of Phase A Real Pwr Max	---	---	---	F22	N/A
	0375	Time - Seconds of Phase A Real Pwr Max	---	---	---	F23	N/A
	0376	Date - Month/Day of Phase A Real Pwr Max	---	---	---	F24	N/A
	0377	Date - Year of Phase A Real Power Max	---	---	---	F25	N/A
	0378	Time - Hour/Min of Phase A React Pwr Max	---	---	---	F22	N/A
	0379	Time - Seconds of Phase A React Pwr Max	---	---	---	F23	N/A
	037A	Date - Mnth/Day of Phase A React Pwr Max	---	---	---	F24	N/A
	037B	Date - Year of Phase A Reactive Pwr Max	---	---	---	F25	N/A
	037C	Time - Hour/Min of Phase A App Pwr Max	---	---	---	F22	N/A
	037D	Time - Seconds of Phase A App Pwr Max	---	---	---	F23	N/A
	037E	Date - Month/Day of Phase A App Pwr Max	---	---	---	F24	N/A
	037F	Date - Year of Phase A Apparent Pwr Max	---	---	---	F25	N/A
	0380	Time - Hour/Minutes of Phase A PF Max	---	---	---	F22	N/A
	0381	Time - Seconds of Phase A PF Max	---	---	---	F23	N/A
	0382	Date - Month/Day of Phase A PF Max	---	---	---	F24	N/A
	0383	Date - Year of Phase A Power Factor Max	---	---	---	F25	N/A
	0384	Time - Hour/Min of Phase B Real Pwr Min	---	---	---	F22	N/A
	0385	Time - Seconds of Phase B Real Pwr Min	---	---	---	F23	N/A
	0386	Date - Month/Day of Phase B Real Pwr Min	---	---	---	F24	N/A
	0387	Date - Year of Phase B Real Power Min	---	---	---	F25	N/A
	0388	Time - Hour/Min of Phase B React Pwr Min	---	---	---	F22	N/A
	0389	Time - Seconds of Phase B React Pwr Min	---	---	---	F23	N/A
	038A	Date - Month/Day of Phase B React Pwr Min	---	---	---	F24	N/A
	038B	Date - Year of Phase B Reactive Pwr Min	---	---	---	F25	N/A
	038C	Time - Hour/Min of Phase B App Pwr Min	---	---	---	F22	N/A
	038D	Time - Seconds of Phase B App Pwr Min	---	---	---	F23	N/A
	038E	Date - Month/Day of Phase B App Pwr Min	---	---	---	F24	N/A
	038F	Date - Year of Phase B Apparent Pwr Min	---	---	---	F25	N/A
	0390	Time - Hour/Minutes of Phase B PF Min	---	---	---	F22	N/A
	0391	Time - Seconds of Phase B PF Min	---	---	---	F23	N/A
	0392	Date - Month/Day of Phase B PF Min	---	---	---	F24	N/A
	0393	Date - Year of Phase B PF Min	---	---	---	F25	N/A
	0394	Time - Hour/Min of Phase B Real Pwr Max	---	---	---	F22	N/A
	0395	Time - Seconds of Phase B Real Pwr Max	---	---	---	F23	N/A
	0396	Date - Month/Day of Phase B Real Pwr Max	---	---	---	F24	N/A
	0397	Date - Year of Phase B Real Power Max	---	---	---	F25	N/A
	0398	Time - Hour/Min of Phase B React Pwr Max	---	---	---	F22	N/A
	0399	Time - Seconds of Phase B React Pwr Max	---	---	---	F23	N/A
	039A	Date - Mnth/Day of Phase B React Pwr Max	---	---	---	F24	N/A
	039B	Date - Year of Phase B Reactive Pwr Max	---	---	---	F25	N/A
	039C	Time - Hour/Min of Phase B App Pwr Max	---	---	---	F22	N/A
	039D	Time - Seconds of Phase B App Pwr Max	---	---	---	F23	N/A

Notes: * Data type depends on the Command Operation Code.
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*** Maximum Setpoint value represents “OFF”.
**** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 12 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
POWER continued	039E	Date - Month/Day of Phase B App Pwr Max	---	---	---	F24	N/A
	039F	Date - Year of Phase B Apparent Pwr Max	---	---	---	F25	N/A
	03A0	Time - Hour/Minutes of Phase B PF Max	---	---	---	F22	N/A
	03A1	Time - Seconds of Phase B PF Max	---	---	---	F23	N/A
	03A2	Date - Month/Day of Phase B PF Max	---	---	---	F24	N/A
	03A3	Date - Year of Phase B Power Factor Max	---	---	---	F25	N/A
	03A4	Time - Hour/Min of Phase C Real Pwr Min	---	---	---	F22	N/A
	03A5	Time - Seconds of Phase C Real Pwr Min	---	---	---	F23	N/A
	03A6	Date - Month/Day of Phase C Real Pwr Min	---	---	---	F24	N/A
	03A7	Date - Year of Phase C Real Power Min	---	---	---	F25	N/A
	03A8	Time - Hour/Min of Phase C React Pwr Min	---	---	---	F22	N/A
	03A9	Time - Seconds of Phase C React Pwr Min	---	---	---	F23	N/A
	03AA	Date - Mnth/Day of Phase C React Pwr Min	---	---	---	F24	N/A
	03AB	Date - Year of Phase C Reactive Pwr Min	---	---	---	F25	N/A
	03AC	Time - Hour/Min of Phase C App Pwr Min	---	---	---	F22	N/A
	03AD	Time - Seconds of Phase C App Pwr Min	---	---	---	F23	N/A
	03AE	Date - Month/Day of Phase C App Pwr Min	---	---	---	F24	N/A
	03AF	Date - Year of Phase C Apparent Pwr Min	---	---	---	F25	N/A
	03B0	Time - Hour/Minutes of Phase C PF Min	---	---	---	F22	N/A
	03B1	Time - Seconds of Phase C PF Min	---	---	---	F23	N/A
	03B2	Date - Month/Day of Phase C PF Min	---	---	---	F24	N/A
	03B3	Date - Year of Phase C Power Factor Min	---	---	---	F25	N/A
	03B4	Time - Hour/Min of Phase C Real Pwr Max	---	---	---	F22	N/A
	03B5	Time - Seconds of Phase C Real Pwr Max	---	---	---	F23	N/A
	03B6	Date - Month/Day of Phase C Real Pwr Max	---	---	---	F24	N/A
	03B7	Date - Year of Phase C Real Power Max	---	---	---	F25	N/A
	03B8	Time - Hour/Min of Phase C React Pwr Max	---	---	---	F22	N/A
	03B9	Time - Seconds of Phase C React Pwr Max	---	---	---	F23	N/A
	03BA	Date - Mnth/Day of Phase C React Pwr Max	---	---	---	F24	N/A
	03BB	Date - Year of Phase C Reactive Pwr Max	---	---	---	F25	N/A
	03BC	Time - Hour/Min of Phase C App Pwr Max	---	---	---	F22	N/A
	03BD	Time - Seconds of Phase C App Pwr Max	---	---	---	F23	N/A
	03BE	Date - Month/Day of Phase C App Pwr Max	---	---	---	F24	N/A
	03BF	Date - Year of Phase C Apparent Pwr Max	---	---	---	F25	N/A
	03C0	Time - Hour/Minutes of Phase C PF Max	---	---	---	F22	N/A
	03C1	Time - Seconds of Phase C PF Max	---	---	---	F23	N/A
	03C2	Date - Month/Day of Phase C PF Max	---	---	---	F24	N/A
	03C3	Date - Year of Phase C Power Factor Max	---	---	---	F25	N/A
	03C4	Reserved					
	to	↓	↓	↓	↓	↓	↓
	03CF	Reserved					

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
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Table 7–10: PQM MEMORY MAP (Sheet 13 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
ENERGY	03D0	3 Phase Positive Real Energy Used (high)	---	---	kWh	F3	N/A
	03D1	3 Phase Positive Real Energy Used (low)	---	---	kWh	F3	N/A
	03D2	3 Phase Negative Real Energy Used (high)	---	---	kWh	F3	N/A
	03D3	3 Phase Negative Real Energy Used (low)	---	---	kWh	F3	N/A
	03D4	3 Phase Positive React. Energy Used (high)	---	---	kvarh	F3	N/A
	03D5	3 Phase Positive React. Energy Used (low)	---	---	kvarh	F3	N/A
	03D6	3 Phase Negative React. Energy Used (high)	---	---	kvarh	F3	N/A
	03D7	3 Phase Negative React. Energy Used (low)	---	---	kvarh	F3	N/A
	03D8	3 Phase Apparent Energy Used (high)	---	---	kVAh	F3	N/A
	03D9	3 Phase Apparent Energy Used (low)	---	---	kVAh	F3	N/A
	03DA	3 Phase Energy Used in Last 24 h (high)	---	---	kWh	F3	N/A
	03DB	3 Phase Energy Used in Last 24 h (low)	---	---	kWh	F3	N/A
	03DC	3 Phase Energy Cost Since Reset (high)	---	---	$ x 0.01	F3	N/A
	03DD	3 Phase Energy Cost Since Reset (low)	---	---	$ x 0.01	F3	N/A
	03DE	3 Phase Energy Cost Per Day (high)	---	---	$ x 0.01	F3	N/A
	03DF	3 Phase Energy Cost Per Day (low)	---	---	$ x 0.01	F3	N/A
	03E0	Time - Hours/Minutes of Last Reset	---	---	---	F22	N/A
	03E1	Time - Seconds of Last Reset	---	---	---	F23	N/A
	03E2	Date - Month/Day of Last Reset	---	---	---	F24	N/A
	03E3	Date - Year of Last Reset	---	---	---	F25	N/A
	03E4	Tariff Period 1 Positive Real Energy (high)	---	---	kWh	F3	N/A
	03E5	Tariff Period 1 Positive Real Energy (low)	---	---	kWh	F3	N/A
	03E6	Tariff Period 1 Negative Real Energy (high)	---	---	kWh	F3	N/A
	03E7	Tariff Period 1 Negative Real Energy (low)	---	---	kWh	F3	N/A
	03E8	Tariff Period 2 Positive Real Energy (high)	---	---	kWh	F3	N/A
	03E9	Tariff Period 2 Positive Real Energy (low)	---	---	kWh	F3	N/A
	03EA	Tariff Period 2 Negative Real Energy (high)	---	---	kWh	F3	N/A
	03EB	Tariff Period 2 Negative Real Energy (low)	---	---	kWh	F3	N/A
	03EC	Tariff Period 3 Positive Real Energy (high)	---	---	kWh	F3	N/A
	03ED	Tariff Period 3 Positive Real Energy (low)	---	---	kWh	F3	N/A
	03EE	Tariff Period 3 Negative Real Energy (high)	---	---	kWh	F3	N/A
	03EF	Tariff Period 3 Negative Real Energy (low)	---	---	kWh	F3	N/A
	03F0	Tariff Period 1 Cost (high)	---	---	$ x 0.01	F3	N/A
	03F1	Tariff Period 1 Cost (low)	---	---	$ x 0.01	F3	N/A
	03F2	Tariff Period 2 Cost (high)	---	---	$ x 0.01	F3	N/A
	03F3	Tariff Period 2 Cost (low)	---	---	$ x 0.01	F3	N/A
	03F4	Tariff Period 3 Cost (high)	---	---	$ x 0.01	F3	N/A
	03F5	Tariff Period 3 Cost (low)	---	---	$ x 0.01	F3	N/A
	03F6	Tariff Period 1 Net Energy Used (high)	---	---	kWh	F3	N/A
	03F7	Tariff Period 1 Net Energy Used (low)	---	---	kWh	F3	N/A
	03F8	Tariff Period 2 Net Energy Used (high)	---	---	kWh	F3	N/A
	03F9	Tariff Period 2 Net Energy Used (low)	---	---	kWh	F3	N/A
	03FA	Tariff Period 3 Net Energy Used (high)	---	---	kWh	F3	N/A
	03FB	Tariff Period 3 Net Energy Used (low)	---	---	kWh	F3	N/A

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 14 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
	03FC	Reserved					
	to	↓	↓	↓	↓	↓	↓
	03FF	Reserved					
DEMAND	0400	Phase A Current Demand	---	---	A	F1	N/A
	0401	Phase B Current Demand	---	---	A	F1	N/A
	0402	Phase C Current Demand	---	---	A	F1	N/A
	0403	Neutral Current Demand	---	---	A	F1	N/A
	0404	3 Phase Real Power Demand (high)	---	---	0.01 x kW	F4	N/A
	0405	3 Phase Real Power Demand (low)	---	---	0.01 x kW	F4	N/A
	0406	3 Phase React Power Demand (high)	---	---	0.01 x kvar	F4	N/A
	0407	3 Phase React Power Demand (low)	---	---	0.01 x kvar	F4	N/A
	0408	3 Phase Apparent Power Demand (high)	---	---	0.01 x kVA	F3	N/A
	0409	3 Phase Apparent Power Demand (low)	---	---	0.01 x kVA	F3	N/A
	040A	Phase A Current Demand - Maximum	---	---	A	F1	N/A
	040B	Phase B Current Demand - Maximum	---	---	A	F1	N/A
	040C	Phase C Current Demand - Maximum	---	---	A	F1	N/A
	040D	Neutral Current Demand - Maximum	---	---	A	F1	N/A
	040E	3 Phase Real Power Dmd (high) - Max	---	---	0.01 x kW	F4	N/A
	040F	3 Phase Real Power Dmd (low) - Max	---	---	0.01 x kW	F4	N/A
	0410	3 Phase React Power Dmd (high) - Max	---	---	0.01 x kvar	F4	N/A
	0411	3 Phase React Power Dmd (low) - Max	---	---	0.01 x kvar	F4	N/A
	0412	3 Phase Apparent Power Dmd (high) - Max	---	---	0.01 x kVA	F3	N/A
	0413	3 Phase Apparent Power Dmd (low) - Max	---	---	0.01 x kVA	F3	N/A
	0414	Time - Hours/Min of Phase A Cur. Dmd Max	---	---	---	F22	N/A
	0415	Time - Seconds of Phase A Cur. Dmd Max	---	---	---	F23	N/A
	0416	Date - Mnth/Day of Phase A Cur. Dmd Max	---	---	---	F24	N/A
	0417	Date - Year of Phase A Cur. Dmd Max	---	---	---	F25	N/A
	0418	Time - Hours/Min of Phase B Cur. Dmd Max	---	---	---	F22	N/A
	0419	Time - Seconds of Phase B Cur. Dmd Max	---	---	---	F23	N/A
	041A	Date - Mnth/Day of Phase B Cur. Dmd Max	---	---	---	F24	N/A
	041B	Date - Year of Phase B Cur. Dmd Max	---	---	---	F25	N/A
	041C	Time - Hours/Min of Phase C Cur. Dmd Max	---	---	---	F22	N/A
	041D	Time - Seconds of Phase C Cur. Dmd Max	---	---	---	F23	N/A
	041E	Date - Mnth/Day of Phase C Cur. Dmd Max	---	---	---	F24	N/A
	041F	Date - Year of Phase C Cur. Dmd Max	---	---	---	F25	N/A
	0420	Time - Hours/Min of Neutral Cur. Dmd Max	---	---	---	F22	N/A
	0421	Time - Seconds of Neutral Cur. Dmd Max	---	---	---	F23	N/A
	0422	Date - Month/Day of Neutral Cur. Dmd Max	---	---	---	F24	N/A
	0423	Date - Year of Neutral Cur. Dmd Max	---	---	---	F25	N/A
	0424	Time - Hours/Min of Real Pwr Dmd Max	---	---	---	F22	N/A
	0425	Time - Seconds of Real Pwr Dmd Max	---	---	---	F23	N/A
	0426	Date - Month/Day of Real Pwr Dmd Max	---	---	---	F24	N/A
	0427	Date - Year of Real Pwr Dmd Max	---	---	---	F25	N/A
	0428	Time - Hours/Min of React Pwr Dmd Max	---	---	---	F22	N/A

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Table 7–10: PQM MEMORY MAP (Sheet 15 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
DEMAND continued	0429	Time - Seconds of React Pwr Dmd Max	---	---	---	F23	N/A
	042A	Date - Month/Day of React Pwr Dmd Max	---	---	---	F24	N/A
	042B	Date - Year of React Pwr Dmd Max	---	---	---	F25	N/A
	042C	Time - Hour/Min of App. Pwr Dmd Max	---	---	---	F22	N/A
	042D	Time - Seconds of Apparent Pwr Dmd Max	---	---	---	F23	N/A
	042E	Date - Month/Day of App. Pwr Dmd Max	---	---	---	F24	N/A
	042F	Date - Year of Apparent Pwr Dmd Max	---	---	---	F25	N/A
	0430	Reserved					
	to	↓	↓	↓	↓	↓	↓
	043F	Reserved					
FREQUENCY	0440	Frequency	---	---	0.01 x Hz	F1	N/A
	0441	Frequency Minimum	---	---	0.01 x Hz	F1	N/A
	0442	Frequency Maximum	---	---	0.01 x Hz	F1	N/A
	0443	Time - Hours/Min of Frequency Max	---	---	---	F22	N/A
	0444	Time - Seconds of Frequency Max	---	---	---	F23	N/A
	0445	Date - Month/Day of Frequency Max	---	---	---	F24	N/A
	0446	Date - Year of Frequency Max	---	---	---	F25	N/A
	0447	Time - Hours/Min of Frequency Min	---	---	---	F22	N/A
	0448	Time - Seconds of Frequency Min	---	---	---	F23	N/A
	0449	Date - Month/Day of Frequency Min	---	---	---	F24	N/A
	044A	Date - Year of Frequency Min	---	---	---	F25	N/A
	044B	Reserved					
	to	↓	↓	↓	↓	↓	↓
	044F	Reserved					
PULSE INPUT COUNTERS	0450	Pulse Input 1 (high)	---	---	---	F3	N/A
	0451	Pulse Input 1 (low)	---	---	---	F3	N/A
	0452	Pulse Input 2 (high)	---	---	---	F3	N/A
	0453	Pulse Input 2 (low)	---	---	---	F3	N/A
	0454	Pulse Input 3 (high)	---	---	---	F3	N/A
	0455	Pulse Input 3 (low)	---	---	---	F3	N/A
	0456	Pulse Input 4 (high)	---	---	---	F3	N/A
	0457	Pulse Input 4 (low)	---	---	---	F3	N/A
ANALOG INPUT	0458	Main/Alternate Analog Input (High)	---	---	---	F3	N/A
	0459	Main/Alternate Analog Input (low)	---	---	---	F3	N/A
	045A	Reserved					
	to	↓	↓	↓	↓	↓	↓
	045F	Reserved					
PULSE INPUT COUNTERS	0460	Totalized Pulse Input (high)	---	---	---	F3	N/A
	0461	Totalized Pulse Input (low)	---	---	---	F3	N/A
	0462	Pulse Count Cleared Time – Hours/Min	---	---	---	F22	N/A
	0463	Pulse Count Cleared Time – Seconds	---	---	---	F23	N/A
	0464	Pulse Count Cleared Date – Month/Day	---	---	---	F24	N/A
	0465	Pulse Count Cleared Date – Year	---	---	---	F25	N/A

Notes: * Data type depends on the Command Operation Code.
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**** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 16 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
	0466	Reserved					
	to	↓	↓	↓	↓	↓	↓
	046F	Reserved					
POWER QUALITY	0470	Ia Crest Factor	---	---	0.001 xCF	F1	N/A
	0471	Ib Crest Factor	---	---	0.001 xCF	F1	N/A
	0472	Ic Crest Factor	---	---	0.001 xCF	F1	N/A
	0473	Ia Transformer Harmonic Derating Factor	---	---	0.01xTHDF	F1	N/A
	0474	Ib Transformer Harmonic Derating Factor	---	---	0.01xTHDF	F1	N/A
	0475	Ic Transformer Harmonic Derating Factor	---	---	0.01xTHDF	F1	N/A
	0476	Reserved					
	0477	Reserved					
HARMONIC DISTORTION	0478	Phase A Current THD	---	---	0.1 x%	F1	N/A
	0479	Phase B Current THD	---	---	0.1 x%	F1	N/A
	047A	Phase C Current THD	---	---	0.1 x%	F1	N/A
	047B	Neutral Current THD	---	---	0.1 x%	F1	N/A
	047C	Voltage Van THD	---	---	0.1 x%	F1	N/A
	047D	Voltage Vbn THD	---	---	0.1 x%	F1	N/A
	047E	Voltage Vcn THD	---	---	0.1 x%	F1	N/A
	047F	Voltage Vab THD	---	---	0.1 x%	F1	N/A
	0480	Voltage Vbc THD	---	---	0.1 x%	F1	N/A
	0481	Voltage Vca THD	---	---	0.1 x%	F1	N/A
	0482	Phase A Current THD - Maximum	---	---	0.1 x%	F1	N/A
	0483	Phase B Current THD - Maximum	---	---	0.1 x%	F1	N/A
	0484	Phase C Current THD - Maximum	---	---	0.1 x%	F1	N/A
	0485	Neutral Current THD - Maximum	---	---	0.1 x%	F1	N/A
	0486	Voltage Van THD - Maximum	---	---	0.1 x%	F1	N/A
	0487	Voltage Vbn THD - Maximum	---	---	0.1 x%	F1	N/A
	0488	Voltage Vcn THD - Maximum	---	---	0.1 x%	F1	N/A
	0489	Voltage Vab THD - Maximum	---	---	0.1 x%	F1	N/A
	048A	Voltage Vbc THD - Maximum	---	---	0.1 x %	F1	N/A
	048B	Voltage Vca THD - Maximum	---	---	0.1 x %	F1	N/A
	048C	Time - Hour/Min of Phase A Cur. THD Max	---	---	---	F22	N/A
	048D	Time - Seconds of Phase A Cur. THD Max	---	---	---	F23	N/A
	048E	Date - Mnth/Day of Phase A Cur. THD Max	---	---	---	F24	N/A
	048F	Date - Year of Phase A Cur. THD Max	---	---	---	F25	N/A
	0490	Time - Hour/Min of Phase B Cur. THD Max	---	---	---	F22	N/A
	0491	Time - Seconds of Phase B Cur. THD Max	---	---	---	F23	N/A
	0492	Date - Mnth/Day of Phase B Cur. THD Max	---	---	---	F24	N/A
	0493	Date - Year of Phase B Cur. THD Max	---	---	---	F25	N/A
	0494	Time - Hour/Min of Phase C Cur. THD Max	---	---	---	F22	N/A
	0495	Time - Seconds of Phase C Cur. THD Max	---	---	---	F23	N/A
	0496	Date - Mnth/Day of Phase C Cur. THD Max	---	---	---	F24	N/A
	0497	Date - Year of Phase C Cur. THD Max	---	---	---	F25	N/A
	0498	Time - Hour/Min of Neutral Cur. THD Max	---	---	---	F22	N/A

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 17 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
HARMONIC DISTORTION continued	0499	Time - Seconds of Neutral Cur. THD Max	---	---	---	F23	N/A
	049A	Date - Mnth/Day of Neutral Cur. THD Max	---	---	---	F24	N/A
	049B	Date - Year of Neutral Cur. THD Max	---	---	---	F25	N/A
	049C	Time - Hours/Min of Van THD Max	---	---	---	F22	N/A
	049D	Time - Seconds of Van THD Max	---	---	---	F23	N/A
	049E	Date - Month/Day of Van THD Max	---	---	---	F24	N/A
	049F	Date - Year of Van THD Max	---	---	---	F25	N/A
	04A0	Time - Hours/Min of Vbn THD Max	---	---	---	F22	N/A
	04A1	Time - Seconds of Vbn THD Max	---	---	---	F23	N/A
	04A2	Date - Month/Day of Vbn THD Max	---	---	---	F24	N/A
	04A3	Date - Year of Vbn THD Max	---	---	---	F25	N/A
	04A4	Time - Hours/Min of Vcn THD Max	---	---	---	F22	N/A
	04A5	Time - Seconds of Vcn THD Max	---	---	---	F23	N/A
	04A6	Date - Month/Day of Vcn THD Max	---	---	---	F24	N/A
	04A7	Date - Year of Vcn THD Max	---	---	---	F25	N/A
	04A8	Time - Hours/Min of Vab THD Max	---	---	---	F22	N/A
	04A9	Time - Seconds of Vab THD Max	---	---	---	F23	N/A
	04AA	Date - Month/Day of Vab THD Max	---	---	---	F24	N/A
	04AB	Date - Year of Vab THD Max	---	---	---	F25	N/A
	04AC	Time - Hours/Min of Vbc THD Max	---	---	---	F22	N/A
	04AD	Time - Seconds of Vbc THD Max	---	---	---	F23	N/A
	04AE	Date - Month/Day of Vbc THD Max	---	---	---	F24	N/A
	04AF	Date - Year of Vbc THD Max	---	---	---	F25	N/A
	04B0	Time - Hours/Min of Vca THD Max	---	---	---	F22	N/A
	04B1	Time - Seconds of Vca THD Max	---	---	---	F23	N/A
	04B2	Date - Month/Day of Vca THD Max	---	---	---	F24	N/A
	04B3	Date - Year of Vca THD Max	---	---	---	F25	N/A
	04B4	Average Current THD	---	---	0.1 x%	F1	N/A
	04B5	Average Voltage THD	---	---	0.1 x%	F1	N/A
	04B6	Reserved					
	to	↓	↓	↓	↓	↓	↓
	04C7	Reserved					
DEBUG DATA	04C8	ADC Reference	---	---	---	F1	N/A
	04C9	Power Loss Fine Time	---	---	10 ms	F1	N/A
	04CA	Power Loss Coarse Time	---	---	0.1 min	F1	N/A
	04CB	Current Key Press	---	---	---	F6	N/A
	04CC	Internal Fault Error Code	---	---	---	F108	N/A
	04CD	Reserved					
	to	↓	↓	↓	↓	↓	↓
	04D7	Reserved					
MESSAGE BUFFER	04D8	Message Buffer characters 1 and 2	---	---	ASCII	F10	N/A
	04D9	Message Buffer characters 3 and 4	---	---	ASCII	F10	N/A
	04DA	Message Buffer characters 5 and 6	---	---	ASCII	F10	N/A
	04DB	Message Buffer characters 7 and 8	---	---	ASCII	F10	N/A

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 18 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
MESSAGE BUFFER continued	04DC	Message Buffer characters 9 and 10	---	---	ASCII	F10	N/A
	04DD	Message Buffer characters 11 and 12	---	---	ASCII	F10	N/A
	04DE	Message Buffer characters 13 and 14	---	---	ASCII	F10	N/A
	04DF	Message Buffer characters 15 and 16	---	---	ASCII	F10	N/A
	04E0	Message Buffer characters 17 and 18	---	---	ASCII	F10	N/A
	04E1	Message Buffer characters 19 and 20	---	---	ASCII	F10	N/A
	04E2	Message Buffer characters 21 and 22	---	---	ASCII	F10	N/A
	04E3	Message Buffer characters 23 and 24	---	---	ASCII	F10	N/A
	04E4	Message Buffer characters 25 and 26	---	---	ASCII	F10	N/A
	04E5	Message Buffer characters 27 and 28	---	---	ASCII	F10	N/A
	04E6	Message Buffer characters 29 and 30	---	---	ASCII	F10	N/A
	04E7	Message Buffer characters 31 and 32	---	---	ASCII	F10	N/A
	04E8	Message Buffer characters 33 and 34	---	---	ASCII	F10	N/A
	04E9	Message Buffer characters 35 and 36	---	---	ASCII	F10	N/A
	04EA	Message Buffer characters 37 and 38	---	---	ASCII	F10	N/A
	04EB	Message Buffer characters 39 and 40	---	---	ASCII	F10	N/A
	04EC	Reserved					
	to	↓	↓	↓	↓	↓	↓
	04F7	Reserved					
HIGH SPEED SAMPLES FOR HARMONIC SPECTRUM	04F8	High Speed Sampling Parameter	---	---	---	F26	N/A
	04F9	High Speed Sampling Scale Factor (high)	---	---	A or V x 10000	F3	N/A
	04FA	High Speed Sampling Scale Factor (low)	---	---	A or V x 10000	F3	N/A
	04FB	Freq. of High Speed Sampling Waveform	---	---	0.01 xHz	F1	N/A
	04FC	Time - Hours/Minutes of Last Sampling	---	---	---	F22	N/A
	04FD	Time - Seconds of Last Sampling	---	---	---	F23	N/A
	04FE	Date - Month/Day of Last Sampling	---	---	---	F24	N/A
	04FF	Date - Year of Last Sampling	---	---	---	F25	N/A
	0500	High Speed Sample Buffer 1	---	---	ADC counts	F2	N/A
	0501	High Speed Sample Buffer 2	---	---	ADC counts	F2	N/A
	0502	High Speed Sample Buffer 3	---	---	ADC counts	F2	N/A
	0503	High Speed Sample Buffer 4	---	---	ADC counts	F2	N/A
	to	↓	↓	↓	↓	↓	↓
	05FD	High Speed Sample Buffer 254	---	---	ADC counts	F2	N/A
	05FE	High Speed Sample Buffer 255	---	---	ADC counts	F2	N/A
	05FF	High Speed Sample Buffer 256	---	---	ADC counts	F2	N/A
	0600	Reserved					
	to	↓	↓	↓	↓	↓	↓
	061F	Reserved					
WAVEFORM CAPTURE HEADER	0620	Time - Hours/Minutes of Last Capture	---	---	---	F22	N/A
	0621	Time - Seconds of Last Capture	---	---	---	F23	N/A
	0622	Date - Month/Day of Last Capture	---	---	---	F24	N/A
	0623	Date - Year of Last Capture	---	---	---	F25	N/A
	0624	Frequency of Last Capture	---	---	0.01 x Hz	F1	N/A
	0625	Reserved					

Notes: * Data type depends on the Command Operation Code.
*** Maximum Setpoint value represents "OFF".
***** Maximum Setpoint value represents "UNLIMITED".
** Any valid Actual Values or Setpoints address.
**** Minimum Setpoint value represents "OFF".

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Table 7–10: PQM MEMORY MAP (Sheet 19 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
	0626	Reserved					
	0627	Reserved					
WAVEFORM CAPTURE Ia	0628	Ia Waveform Capture Scale Factor (high)	---	---	A x 10000	F3	N/A
	0629	Ia Waveform Capture Scale Factor (low)	---	---	A x 10000	F3	N/A
	062A	Ia Sample Buffer 1	---	---	ADC counts	F2	N/A
	062B	Ia Sample Buffer 2	---	---	ADC counts	F2	N/A
	062C	Ia Sample Buffer 3	---	---	ADC counts	F2	N/A
	062D	Ia Sample Buffer 4	---	---	ADC counts	F2	N/A
	to	↓	↓	↓	↓	↓	↓
	06A6	Ia Sample Buffer 125	---	---	ADC counts	F2	N/A
	06A7	Ia Sample Buffer 126	---	---	ADC counts	F2	N/A
	06A8	Ia Sample Buffer 127	---	---	ADC counts	F2	N/A
	06A9	Ia Sample Buffer 128	---	---	ADC counts	F2	N/A
	06AA	Reserved					
	to	↓	↓	↓	↓	↓	↓
	06AF	Reserved					
WAVEFORM CAPTURE Ib	06B0	Ib Waveform Capture Scale Factor (high)	---	---	A x 10000	F3	N/A
	06B1	Ib Waveform Capture Scale Factor (low)	---	---	A x 10000	F3	N/A
	06B2	Ib Sample Buffer 1	---	---	ADC counts	F2	N/A
	06B3	Ib Sample Buffer 2	---	---	ADC counts	F2	N/A
	06B4	Ib Sample Buffer 3	---	---	ADC counts	F2	N/A
	06B5	Ib Sample Buffer 4	---	---	ADC counts	F2	N/A
	to	↓	↓	↓	↓	↓	↓
	072E	Ib Sample Buffer 125	---	---	ADC counts	F2	N/A
	072F	Ib Sample Buffer 126	---	---	ADC counts	F2	N/A
	0730	Ib Sample Buffer 127	---	---	ADC counts	F2	N/A
	0731	Ib Sample Buffer 128	---	---	ADC counts	F2	N/A
	0732	Reserved					
	to	↓	↓	↓	↓	↓	↓
	0737	Reserved					
WAVEFORM CAPTURE Ic	0738	Ic Waveform Capture Scale Factor (high)	---	---	A x 10000	F3	N/A
	0739	Ic Waveform Capture Scale Factor (low)	---	---	A x 10000	F3	N/A
	073A	Ic Sample Buffer 1	---	---	ADC counts	F2	N/A
	073B	Ic Sample Buffer 2	---	---	ADC counts	F2	N/A
	073C	Ic Sample Buffer 3	---	---	ADC counts	F2	N/A
	073D	Ic Sample Buffer 4	---	---	ADC counts	F2	N/A
	to	↓	↓	↓	↓	↓	↓
	07B6	Ic Sample Buffer 125	---	---	ADC counts	F2	N/A
	07B7	Ic Sample Buffer 126	---	---	ADC counts	F2	N/A
	07B8	Ic Sample Buffer 127	---	---	ADC counts	F2	N/A
	07B9	Ic Sample Buffer 128	---	---	ADC counts	F2	N/A
	07BA	Reserved					
	to	↓	↓	↓	↓	↓	↓
	07BF	Reserved					

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 20 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
WAVEFORM CAPTURE In	07C0	In Waveform Capture Scale Factor (high)	---	---	A x 10000	F3	N/A
	07C1	In Waveform Capture Scale Factor (low)	---	---	A x 10000	F3	N/A
	07C2	In Sample Buffer 1	---	---	ADC counts	F2	N/A
	07C3	In Sample Buffer 2	---	---	ADC counts	F2	N/A
	07C4	In Sample Buffer 3	---	---	ADC counts	F2	N/A
	07C5	In Sample Buffer 4	---	---	ADC counts	F2	N/A
	to	↓	↓	↓	↓	↓	↓
	083E	In Sample Buffer 125	---	---	ADC counts	F2	N/A
	083F	In Sample Buffer 126	---	---	ADC counts	F2	N/A
	0840	In Sample Buffer 127	---	---	ADC counts	F2	N/A
	0841	In Sample Buffer 128	---	---	ADC counts	F2	N/A
	0842	Reserved					
	to	↓	↓	↓	↓	↓	↓
	0847	Reserved					
WAVEFORM CAPTURE Van	0848	Van Waveform Capture Scale Factor (high)	---	---	V x 10000	F3	N/A
	0849	Van Waveform Capture Scale Factor (low)	---	---	V x 10000	F3	N/A
	084A	Van Sample Buffer 1	---	---	ADC counts	F2	N/A
	084B	Van Sample Buffer 2	---	---	ADC counts	F2	N/A
	084C	Van Sample Buffer 3	---	---	ADC counts	F2	N/A
	084D	Van Sample Buffer 4	---	---	ADC counts	F2	N/A
	to	↓	↓	↓	↓	↓	↓
	08C6	Van Sample Buffer 125	---	---	ADC counts	F2	N/A
	08C7	Van Sample Buffer 126	---	---	ADC counts	F2	N/A
	08C8	Van Sample Buffer 127	---	---	ADC counts	F2	N/A
	08C9	Van Sample Buffer 128	---	---	ADC counts	F2	N/A
	08CA	Reserved					
	to	↓	↓	↓	↓	↓	↓
	08CF	Reserved					
WAVEFORM CAPTURE Vbn	08D0	Vbn Waveform Capture Scale Factor (high)	---	---	V x 10000	F3	N/A
	08D1	Vbn Waveform Capture Scale Factor (low)	---	---	V x 10000	F3	N/A
	08D2	Vbn Sample Buffer 1	---	---	ADC counts	F2	N/A
	08D3	Vbn Sample Buffer 2	---	---	ADC counts	F2	N/A
	08D4	Vbn Sample Buffer 3	---	---	ADC counts	F2	N/A
	08D5	Vbn Sample Buffer 4	---	---	ADC counts	F2	N/A
	to	↓	↓	↓	↓	↓	↓
	094E	Vbn Sample Buffer 125	---	---	ADC counts	F2	N/A
	094F	Vbn Sample Buffer 126	---	---	ADC counts	F2	N/A
	0950	Vbn Sample Buffer 127	---	---	ADC counts	F2	N/A
	0951	Vbn Sample Buffer 128	---	---	ADC counts	F2	N/A
	0952	Reserved					
	to	↓	↓	↓	↓	↓	↓
	0957	Reserved					

Notes: * Data type depends on the Command Operation Code.
*** Maximum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.
** Any valid Actual Values or Setpoints address.
**** Minimum Setpoint value represents “OFF”.

Table 7–10: PQM MEMORY MAP (Sheet 21 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
WAVEFORM CAPTURE Vcn	0958	Vcn Waveform Capture Scale Factor (high)	---	---	V x 10000	F3	N/A
	0959	Vcn Waveform Capture Scale Factor (low)	---	---	V x 10000	F3	N/A
	095A	Vcn Sample Buffer 1	---	---	ADC counts	F2	N/A
	095B	Vcn Sample Buffer 2	---	---	ADC counts	F2	N/A
	095C	Vcn Sample Buffer 3	---	---	ADC counts	F2	N/A
	095D	Vcn Sample Buffer 4	---	---	ADC counts	F2	N/A
	to	↓	↓	↓	↓	↓	↓
	09D6	Vcn Sample Buffer 125	---	---	ADC counts	F2	N/A
	09D7	Vcn Sample Buffer 126	---	---	ADC counts	F2	N/A
	09D8	Vcn Sample Buffer 127	---	---	ADC counts	F2	N/A
	09D9	Vcn Sample Buffer 128	---	---	ADC counts	F2	N/A
	09DA	Reserved					
	to	↓	↓	↓	↓	↓	↓
	09FF	Reserved					
DATA LOGGER DATA	0A00	Data Log Memory Access Block Number	---	---	---	F1	0
	0A01	Data Log Register 1	---	---	---	F1	---
	0A02	Data Log Register 2	---	---	---	F1	---
	0A03	Data Log Register 3	---	---	---	F1	---
	0A04	Data Log Register 4	---	---	---	F1	---
	to	↓	↓	↓	↓	↓	↓
	0A3D	Data Log Register 61	---	---	---	F1	---
	0A3E	Data Log Register 62	---	---	---	F1	---
	0A3F	Data Log Register 63	---	---	---	F1	---
	0A40	Data Log Register 64	---	---	---	F1	---
	0A41	Reserved					
	to	↓	↓	↓	↓	↓	↓
	0A4F	Reserved					
DATA LOGGER LOG NUMBERS	0A50	Ia Log Number	---	---	---	F110	0 = not selected
	0A51	Ib Log Number	---	---	---	F110	0 = not selected
	0A52	Ic Log Number	---	---	---	F110	0 = not selected
	0A53	Iavg Log Number	---	---	---	F110	0 = not selected
	0A54	In Log Number	---	---	---	F110	0 = not selected
	0A55	I Unbalance Log Number	---	---	---	F110	0 = not selected
	0A56	Van Log Number	---	---	---	F110	0 = not selected
	0A57	Vbn Log Number	---	---	---	F110	0 = not selected
	0A58	Vcn Log Number	---	---	---	F110	0 = not selected
	0A59	Vpavg Log Number	---	---	---	F110	0 = not selected
	0A5A	Vab Log Number	---	---	---	F110	0 = not selected
	0A5B	Vbc Log Number	---	---	---	F110	0 = not selected
	0A5C	Vca Log Number	---	---	---	F110	0 = not selected
	0A5D	Vlavg Log Number	---	---	---	F110	0 = not selected
	0A5E	V Unbalance Log Number	---	---	---	F110	0 = not selected
	0A5F	Pa Log Number	---	---	---	F110	0 = not selected
	0A60	Qa Log Number	---	---	---	F110	0 = not selected

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 22 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
DATA LOGGER LOG NUMBERS continued	0A61	Sa Log Number	---	---	---	F110	0 = not selected
	0A62	PFa Log Number	---	---	---	F110	0 = not selected
	0A63	Pb Log Number	---	---	---	F110	0 = not selected
	0A64	Qb Log Number	---	---	---	F110	0 = not selected
	0A65	Sb Log Number	---	---	---	F110	0 = not selected
	0A66	PFb Log Number	---	---	---	F110	0 = not selected
	0A67	Pc Log Number	---	---	---	F110	0 = not selected
	0A68	Qc Log Number	---	---	---	F110	0 = not selected
	0A69	Sc Log Number	---	---	---	F110	0 = not selected
	0A6A	PFc Log Number	---	---	---	F110	0 = not selected
	0A6B	P3 Log Number	---	---	---	F110	0 = not selected
	0A6C	Q3 Log Number	---	---	---	F110	0 = not selected
	0A6D	S3 Log Number	---	---	---	F110	0 = not selected
	0A6E	PF3 Log Number	---	---	---	F110	0 = not selected
	0A6F	Frequency Log Number	---	---	---	F110	0 = not selected
	0A70	Positive kWh Log Number	---	---	---	F110	0 = not selected
	0A71	Negative kWh Log Number	---	---	---	F110	0 = not selected
	0A72	Positive kvarh Log Number	---	---	---	F110	0 = not selected
	0A73	Negative kvarh Log Number	---	---	---	F110	0 = not selected
	0A74	kVAh Log Number	---	---	---	F110	0 = not selected
	0A75	Ia Demand Log Number	---	---	---	F110	0 = not selected
	0A76	Ib Demand Log Number	---	---	---	F110	0 = not selected
	0A77	Ic Demand Log Number	---	---	---	F110	0 = not selected
	0A78	In Demand Log Number	---	---	---	F110	0 = not selected
	0A79	P3 Demand Log Number	---	---	---	F110	0 = not selected
	0A7A	Q3 Demand Log Number	---	---	---	F110	0 = not selected
	0A7B	S3 Demand Log Number	---	---	---	F110	0 = not selected
	0A7C	Ia THD Log Number	---	---	---	F110	0 = not selected
	0A7D	Ib THD Log Number	---	---	---	F110	0 = not selected
	0A7E	Ic THD Log Number	---	---	---	F110	0 = not selected
	0A7F	In THD Log Number	---	---	---	F110	0 = not selected
	0A80	Van THD Log Number	---	---	---	F110	0 = not selected
	0A81	Vbn THD Log Number	---	---	---	F110	0 = not selected
	0A82	Vcn THD Log Number	---	---	---	F110	0 = not selected
	0A83	Vab THD Log Number	---	---	---	F110	0 = not selected
	0A84	Vbc THD Log Number	---	---	---	F110	0 = not selected
	0A85	Analog Input Log Number	---	---	---	F110	0 = not selected
	0A86	Reserved					
	to	↓	↓	↓	↓	↓	↓
	0A8F	Reserved					

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 23 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
DATA LOGGER LOG 1 HEADER	0A90	Log 1 Time Interval (high)	---	---	s	F3	N/A
	0A91	Log 1 Time Interval (low)	---	---	s	F3	N/A
	0A92	Log 1 Time - Hours/Minutes	---	---	---	F22	N/A
	0A93	Log 1 Time - Seconds	---	---	---	F23	N/A
	0A94	Log 1 Date - Month/Year	---	---	---	F24	N/A
	0A95	Log 1 Date - Year	---	---	---	F25	N/A
	0A96	Log 1 Start Address	---	---	---	F1	0
	0A97	Log 1 Record Size	---	---	bytes	F1	0
	0A98	Log 1 Total Records	---	---	---	F1	0
	0A99	Log 1 Pointer to First Item of First Record	---	---	---	F1	0
	0A9A	Log 1 Pointer to 1st Item of Record After Last	---	---	---	F1	0
	0A9B	Log 1 Status	---	---	---	F35	0 = STOPPED
	0A9C	Log 1 Records Used	---	---	---	F1	0
	0A9D	Log 1 Time Until next Reading (high)	---	---	s	F3	N/A
	0A9E	Log 1 Time Until next Reading (low)	---	---	s	F3	N/A
	0A9F	Reserved					
	to	↓	↓	↓	↓	↓	↓
	0AA7	Reserved					
DATA LOGGER LOG 2 HEADER	0AA8	Log 2 Time Interval (high)	---	---	s	F3	N/A
	0AA9	Log 2 Time Interval (low)	---	---	s	F3	N/A
	0AAA	Log 2 Time - Hours/Minutes	---	---	---	F22	N/A
	0AAB	Log 2 Time - Seconds	---	---	---	F23	N/A
	0AAC	Log 2 Date - Month/Year	---	---	---	F24	N/A
	0AAD	Log 2 Date - Year	---	---	---	F25	N/A
	0AAE	Log 2 Start Address	---	---	---	F1	0
	0AAF	Log 2 Record Size	---	---	bytes	F1	0
	0AB0	Log 2 Total Records	---	---	---	F1	0
	0AB1	Log 2 Pointer to First Item of First Record	---	---	---	F1	0
	0AB2	Log 2 Pointer to 1st Item of Record After Last	---	---	---	F1	0
	0AB3	Log 2 Status	---	---	---	F35	0 = STOPPED
	0AB4	Log 2 Records Used	---	---	---	F1	0
	0AB5	Log 2 Time Until next Reading (high)	---	---	s	F3	N/A
	0AB6	Log 2 Time Until next Reading (low)	---	---	s	F3	N/A
	0AB7	Reserved					
	to	↓	↓	↓	↓	↓	↓
	0ACF	Reserved					
EVENT RECORD	0AD0	Total Number of Events Since Last Clear	---	---	---	F1	0
	0AD1	Event Record Last Cleared Time - Hrs./Min.	---	---	---	F22	N/A
	0AD2	Event Record Last Cleared Time - Seconds	---	---	---	F23	N/A
	0AD3	Event Record Last Cleared Date - Month/Day	---	---	---	F24	N/A
	0AD4	Event Record Last Cleared Date - Year	---	---	---	F25	N/A
	0AD5	Reserved					
	to	↓	↓	↓	↓	↓	↓
	0ADF	Reserved					

Notes: * Data type depends on the Command Operation Code.
*** Maximum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.
** Any valid Actual Values or Setpoints address.
**** Minimum Setpoint value represents “OFF”.

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Table 7–10: PQM MEMORY MAP (Sheet 24 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
EVENT RECORD continued	0AE0	Record #N Event Number	---	---	---	F1	N/A
	0AE1	Record #N Event Cause	---	---	---	F36	0 = NO EVENT
	0AE2	Record #N Time - Hours/Minutes	---	---	---	F22	N/A
	0AE3	Record #N Time - Seconds	---	---	---	F23	N/A
	0AE4	Record #N Date - Month/Day	---	---	---	F24	N/A
	0AE5	Record #N Date - Year	---	---	---	F25	N/A
	0AE6	Record #N Switches and Relays States	---	---	---	F111	N/A
	0AE7	Record #N Ia	---	---	A	F1	N/A
	0AE8	Record #N Ib	---	---	A	F1	N/A
	0AE9	Record #N Ic	---	---	A	F1	N/A
	0AEA	Record #N In	---	---	A	F1	N/A
	0AEB	Record #N I Unbalance	---	---	0.1 x%	F1	N/A
	0AEC	Record #N Van (high)	---	---	V	F3	N/A
	0AED	Record #N Van (low)	---	---	V	F3	N/A
	0AEE	Record #N Vbn (high)	---	---	V	F3	N/A
	0AEF	Record #N Vbn (low)	---	---	V	F3	N/A
	0AF0	Record #N Vcn (high)	---	---	V	F3	N/A
	0AF1	Record #N Vcn (low)	---	---	V	F3	N/A
	0AF2	Record #N Vab (high)	---	---	V	F3	N/A
	0AF3	Record #N Vab (low)	---	---	V	F3	N/A
	0AF4	Record #N Vbc (high)	---	---	V	F3	N/A
	0AF5	Record #N Vbc (low)	---	---	V	F3	N/A
	0AF6	Record #N Vca (high)	---	---	V	F3	N/A
	0AF7	Record #N Vca (low)	---	---	V	F3	N/A
	0AF8	Record #N V Unbalance	---	---	0.1 x%	F1	N/A
	0AF9	Record #N Pa (high)	---	---	0.01 x kW	F4	N/A
	0AFA	Record #N Pa (low)	---	---	0.01 x kW	F4	N/A
	0AFB	Record #N Qa (high)	---	---	0.01 x kvar	F4	N/A
	0AFC	Record #N Qa (low)	---	---	0.01 x kvar	F4	N/A
	0AFD	Record #N Sa (high)	---	---	0.01 x kVA	F3	N/A
	0AFE	Record #N Sa (low)	---	---	0.01 x kVA	F3	N/A
	0AFF	Record #N PFa	---	---	0.01 x PF	F2	N/A
	0B00	Record #N Pb (high)	---	---	0.01 x kW	F4	N/A
	0B01	Record #N Pb (low)	---	---	0.01 x kW	F4	N/A
	0B02	Record #N Qb (high)	---	---	0.01 x kvar	F4	N/A
	0B03	Record #N Qb (low)	---	---	0.01 x kvar	F4	N/A
	0B04	Record #N Sb (high)	---	---	0.01 x kVA	F3	N/A
	0B05	Record #N Sb (low)	---	---	0.01 x kVA	F3	N/A
	0B06	Record #N PFb	---	---	0.01 x PF	F2	N/A
	0B07	Record #N Pc (high)	---	---	0.01 x kW	F4	N/A
	0B08	Record #N Pc (low)	---	---	0.01 x kW	F4	N/A
	0B09	Record #N Qc (high)	---	---	0.01 x kvar	F4	N/A
	0B0A	Record #N Qc (low)	---	---	0.01 x kvar	F4	N/A
	0B0B	Record #N Sc (high)	---	---	0.01 x kVA	F3	N/A

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 25 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
EVENT RECORD continued	0B0C	Record #N Sc (low)	---	---	0.01 x kVA	F3	N/A
	0B0D	Record #N PFc	---	---	0.01 x PF	F2	N/A
	0B0E	Record #N P3 (high)	---	---	0.01 x kW	F4	N/A
	0B0F	Record #N P3 (low)	---	---	0.01 x kW	F4	N/A
	0B10	Record #N Q3 (high)	---	---	0.01 x kvar	F4	N/A
	0B11	Record #N Q3 (low)	---	---	0.01 x kvar	F4	N/A
	0B12	Record #N S3 (high)	---	---	0.01 x kVA	F3	N/A
	0B13	Record #N S3 (low)	---	---	0.01 x kVA	F3	N/A
	0B14	Record #N PF3	---	---	0.01 x PF	F2	N/A
	0B15	Record #N Frequency	---	---	0.01 x Hz	F1	N/A
	0B16	Record #N Positive kWh (high)	---	---	kWh	F3	N/A
	0B17	Record #N Positive kWh (low)	---	---	kWh	F3	N/A
	0B18	Record #N Negative kWh (high)	---	---	kWh	F3	N/A
	0B19	Record #N Negative kWh (low)	---	---	kWh	F3	N/A
	0B1A	Record #N Positive kvarh (high)	---	---	kvarh	F3	N/A
	0B1B	Record #N Positive kvarh (low)	---	---	kvarh	F3	N/A
	0B1C	Record #N Negative kvarh (high)	---	---	kvarh	F3	N/A
	0B1D	Record #N Negative kvarh (low)	---	---	kvarh	F3	N/A
	0B1E	Record #N kVAh (high)	---	---	kVAh	F3	N/A
	0B1F	Record #N kVAh (low)	---	---	kVAh	F3	N/A
	0B20	Record #N Ia Demand	---	---	A	F1	N/A
	0B21	Record #N Ib Demand	---	---	A	F1	N/A
	0B22	Record #N Ic Demand	---	---	A	F1	N/A
	0B23	Record #N In Demand	---	---	A	F1	N/A
	0B24	Record #N P3 Demand (high)	---	---	0.01 x kW	F4	N/A
	0B25	Record #N P3 Demand (low)	---	---	0.01 x kW	F4	N/A
	0B26	Record #N Q3 Demand (high)	---	---	0.01 x kvar	F4	N/A
	0B27	Record #N Q3 Demand (low)	---	---	0.01 x kvar	F4	N/A
	0B28	Record #N S3 Demand (high)	---	---	0.01 x kVA	F3	N/A
	0B29	Record #N S3 Demand (low)	---	---	0.01 x kVA	F3	N/A
	0B2A	Record #N Ia THD	---	---	0.1 x %	F1	N/A
	0B2B	Record #N Ib THD	---	---	0.1 x %	F1	N/A
	0B2C	Record #N Ic THD	---	---	0.1 x %	F1	N/A
	0B2D	Record #N In THD	---	---	0.1 x %	F1	N/A
	0B2E	Record #N Van THD	---	---	0.1 x %	F1	N/A
	0B2F	Record #N Vbn THD	---	---	0.1 x %	F1	N/A
	0B30	Record #N Vcn THD	---	---	0.1 x %	F1	N/A
	0B31	Record #N Vab THD	---	---	0.1 x %	F1	N/A
	0B32	Record #N Vbc THD	---	---	0.1 x %	F1	N/A
	0B33	Record #N Analog Input (high)	---	---	---	F3	N/A
	0B34	Record #N Analog Input (low)	---	---	---	F3	N/A
	0B35	Record #N Trace Memory Trigger Cause	---	---	---	F41	N/A
	0B36	Record #N Internal Fault Error Code	---	---	---	F108	N/A
	0B37	Reserved					

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 26 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
	to	↓	↓	↓	↓	↓	↓
	0B7F	Reserved					
TRACE MEMORY	0B80	Trace Memory Usage	---	---	---	F37	N/A
	0B81	Trace Memory Trigger Flag	---	---	---	F113	N/A
	0B82	Trace Memory Trigger Counter	---	---	---	F1	N/A
	0B83	Total Trace Memory Triggers	---	---	---	F1	N/A
	0B88	Trigger Cause - Trace 1	---	---	---	F41	N/A
	0B89	Time - Hours/Minutes - Trace 1	---	---	---	F22	N/A
	0B8A	Time - Seconds - Trace 1	---	---	---	F23	N/A
	0B8B	Date - Month/Day - Trace 1	---	---	---	F24	N/A
	0B8C	Date - Year - Trace 1	---	---	---	F25	N/A
	0B8D	Trigger Sample Number 1	---	---	---	F1	N/A
	0B8E	Frequency 1	---	---	0.01 x Hz	F1	N/A
	0B98	Trigger Cause - Trace 2	---	---	---	F41	N/A
	0B99	Time - Hours/Minutes - Trace 2	---	---	---	F22	N/A
	0B9A	Time - Seconds - Trace 2	---	---	---	F23	N/A
	0B9B	Date - Month/Day - Trace 2	---	---	---	F24	N/A
	0B9C	Date - Year - Trace 2	---	---	---	F25	N/A
	0B9D	Trigger Sample Number 2	---	---	---	F1	N/A
	0B9E	Frequency 2	---	---	0.01 x Hz	F1	N/A
	0BA8	Trigger Cause - Trace 3	---	---	---	F41	N/A
	0BA9	Time - Hours/Minutes - Trace 3	---	---	---	F22	N/A
	0BAA	Time - Seconds - Trace 3	---	---	---	F23	N/A
	0BAB	Date - Month/Day - Trace 3	---	---	---	F24	N/A
	0BAC	Date - Year - Trace 3	---	---	---	F25	N/A
	0BAD	Trigger Sample Number 3	---	---	---	F1	N/A
	0BAE	Frequency 3	---	---	0.01xHz	F1	N/A
	0BB8	Trace Memory Waveform Selection	---	---	---	F40	N/A
	0BB9	Waveform Scale Factor (high)	---	---	A/Vx10000	F3	N/A
	0BBA	Waveform Scale Factor (low)	---	---	A/Vx10000	F3	N/A
	0BBB	Data Buffer 1	---	---	ADCcounts/2	F2	N/A
	0BBC	Data Buffer 2	---	---	ADCcounts/2	F2	N/A
	to	↓	↓	↓	↓	↓	↓
	0DF9	Data Buffer 575	---	---	ADCcounts/2	F2	N/A
	0DFA	Data Buffer 576	---	---	ADCcounts/2	F2	N/A
	0DFB	Reserved					
	to	↓	↓	↓	↓	↓	↓
	0DFF	Reserved					
	0E00	Invalid Serial Number Flag	---	---	---	F117	N/A
Setpoint Values (Holding Registers) Addresses - 1000-131F							
METER ID	1000	Meter ID characters 1 and 2	---	---	ASCII	F10	N/A
	1001	Meter ID characters 3 and 4	---	---	ASCII	F10	N/A
	1002	Meter ID characters 5 and 6	tototo	---	ASCII	F10	N/A
	1003	Meter ID characters 7 and 8	tototo	---	ASCII	F10	N/A

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 27 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
METER ID continued	1004	Meter ID characters 9 and 10	tototo	---	ASCII	F10	N/A
	1005	Meter ID characters 11 and 12	tototo	---	ASCII	F10	N/A
	1006	Meter ID characters 13 and 14	tototo	---	ASCII	F10	N/A
	1007	Meter ID characters 15 and 16	tototo	---	ASCII	F10	N/A
	1008	Meter ID characters 17 and 18	tototo	---	ASCII	F10	N/A
	1009	Meter ID characters 19 and 20	tototo	---	ASCII	F10	N/A
	100A	Reserved					
	to	↓	↓	↓	↓	↓	↓
	100F	Reserved					
PREFERENCES	1010	Default Message Time	1 to 1201***	1	min x0.1	F1	10 = 1.0 min
	1011	Default Message Brightness	0 to 100	20	%	F1	60 %
	1012	Display Filter Constant	1 to 10	1	---	F1	4
	1013	Reserved					
	to	↓	↓	↓	↓	↓	↓
	1017	Reserved					
RS485 COM1 SERIAL PORT	1018	Serial Communication Address	1 to 255	1	---	F1	1
	1019	Modbus Baud Rate for RS485 COM1	0 to 4	1	---	F12	3 = 9600
	101A	Parity for RS485 COM1	0 to 2	1	---	F13	0 = NONE
	101B	Reserved					
	to	↓	↓	↓	↓	↓	↓
	101F	Reserved					
RS485 COM2 SERIAL PORT	1020	Modbus Baud Rate for RS485 COM2	0 to 4	1	---	F12	3 = 9600
	1021	Parity for RS485 COM2	0 to 2	1	---	F13	0 = NONE
	1022	Reserved					
	to	↓	↓	↓	↓	↓	↓
	1027	Reserved					
RS232 SERIAL PORT	1028	Modbus Baud Rate for RS232	0 to 4	1	---	F12	3 = 9600
	1029	Parity for RS232	0 to 2	1	---	F13	0 = NONE
	102A	Reserved					
	to	↓	↓	↓	↓	↓	↓
	102F	Reserved					
CALCU-LATION PARAMETERS	1030	Current Demand Calculation Type	0 to 2	1	---	F28	0 = Block Interval
	1031	Current Demand Time Interval	5 to 180	1	minutes	F1	30 min
	1032	Power Demand Calculation Type	0 to 2	1	---	F28	0 = Block Interval
	1033	Power Demand Time Interval	5 to 180	1	minutes	F1	30 min
	1034	Energy Cost Per kWh	1 to 50000	1	¢ x 0.01	F1	10.00 ¢
	1035	Extract Fundamental	0 to 1	1	---	F11	0=DISABLE
	1036	Reserved					
	1037	Reserved					
CLEAR DATA	1038	Clear Energy Values	0 to 1	1	---	F31	0 = NO
	1039	Clear Max Demand Values	0 to 1	1	---	F31	0 = NO
	103A	Clear Min/Max Current Values	0 to 1	1	---	F31	0 = NO
	103B	Clear Min/Max Voltage Values	0 to 1	1	---	F31	0 = NO
	103C	Clear Min/Max Power Values	0 to 1	1	---	F31	0 = NO

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents "OFF". **** Minimum Setpoint value represents "OFF".
***** Maximum Setpoint value represents "UNLIMITED".

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Table 7–10: PQM MEMORY MAP (Sheet 28 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
CLEAR DATA continued	103D	Clear Max THD Values	0 to 1	1	---	F31	0 = NO
	103E	Clear Pulse Input Values	0 to 1	1	---	F31	0 = NO
	103F	Clear Event Record	0 to 1	1	---	F31	0 = NO
	1040	Clear All Demand Values	0 to 1	1	---	F31	0 = NO
	1041	Clear Frequency Values	0 to 1	1	---	F31	0 = NO
	1042	Reserved					
	1043	Reserved					
DNP	1044	DNP Port	0 to 3	1	---	F47	0 = NONE
	1045	DNP Slave Address	0 to 255	1	---	F1	0
	1046	DNP Turnaround Time	0 to 100	10	ms	F1	10 ms
TARIFF	1047	Tariff Period 1 Start Time	0 to 1439	1	minutes	F1	0 min.
	1048	Tariff Period 1 Cost per MWh	1 to 50000	1	¢ × 0.01	F1	10.00 ¢
	1049	Tariff Period 2 Start Time	0 to 1439	1	minutes	F1	0 min.
	104A	Tariff Period 2 Cost per MWh	1 to 50000	1	¢ × 0.01	F1	10.00 ¢
	104B	Tariff Period 3 Start Time	0 to 1439	1	minutes	F1	0 min.
	104C	Tariff Period 3 Cost per MWh	1 to 50000	1	¢ × 0.01	F1	10.00 ¢
	104D	Reserved					
	104E	Reserved					
	104F	Reserved					
CURRENT /VOLTAGE CONFIG.	1050	Phase CT Primary	0 to 12000****	5	A	F1	100 A
	1051	Neutral Current Sensing	0 to 2	1	---	F16	0 = OFF
	1052	Neutral CT Primary	5 to 6000	5	A	F1	100 A
	1053	VT Wiring	0 to 6	1	---	F15	0 = OFF
	1054	VT Ratio	10 to 35000	1	0.1 xratio	F1	1.0:1
	1055	VT Nominal Secondary Voltage	40 to 600	1	V	F1	120 V
	1056	Nominal Direct Input Voltage	40 to 600	1	V	F1	600 V
	1057	Nominal Frequency	50 to 60	10	Hz	F1	60 Hz
	1058	CT Wiring	0 to 3	1	---	F44	0 = A,B AND C
	1059	Reserved					
	to	↓	↓	↓	↓	↓	↓
	105F	Reserved					
ANALOG OUTPUT 1	1060	Analog Output 1 Main Type	0 to 59	1	---	F14	0 = NOT USED
	1061	Analog Output 1 Main Min Value	See Analog Output Range Table on page 7–63				0
	1062	Analog Output 1 Main Max Value	See Analog Output Range Table on page 7–63				0
	1063	Analog Output 1 Alternate Type	0 to 59	1	---	F14	0 = NOT USED
	1064	Analog Output 1 Alternate Min Value	See Analog Output Range Table on page 7–63				0
	1065	Analog Output 1 Alternate Max Value	See Analog Output Range Table on page 7–63				0
	1066	Reserved					
	1067	Analog Output 1 Serial Value		1	---	F2	0
ANALOG OUTPUT 2	1068	Analog Output 2 Main Type	0 to 59	1	---	F14	0 = NOT USED
	1069	Analog Output 2 Main Min Value	See Analog Output Range Table on page 7–63				0
	106A	Analog Output 2 Main Max Value	See Analog Output Range Table on page 7–63				0
	106B	Analog Output 2 Alternate Type	0 to 59	1	---	F14	0 = NOT USED
	106C	Analog Output 2 Alternate Min Value	See Analog Output Range Table on page 7–63				0

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
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Table 7–10: PQM MEMORY MAP (Sheet 29 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
ANALOG OUTPUT 2 continued	106D	Analog Output 2 Alternate Max Value	See Analog Output Range Table on page 7–63				0
	106E	Reserved					
	106F	Analog Output 2 Serial Value		1	---	F2	0
ANALOG OUTPUT 3	1070	Analog Output 3 Main Type	0 to 59	1	---	F14	0 = NOT USED
	1071	Analog Output 3 Main Min Value	See Analog Output Range Table on page 7–63				
	1072	Analog Output 3 Main Max Value	See Analog Output Range Table on page 7–63				
	1073	Analog Output 3 Alternate Type	0 to 59	1	---	F14	0 = NOT USED
	1074	Analog Output 3 Alternate Min Value	See Analog Output Range Table on page 7–63				
	1075	Analog Output 3 Alternate Max Value	See Analog Output Range Table on page 7–63				
	1076	Reserved					
	1077	Analog Output 3 Serial Value		1	---	F2	0
ANALOG OUTPUT 4	1078	Analog Output 4 Main Type	0 to 59	1	---	F14	0 = NOT USED
	1079	Analog Output 4 Main Min Value	See Analog Output Range Table on page 7–63				
	107A	Analog Output 4 Main Max Value	See Analog Output Range Table on page 7–63				
	107B	Analog Output 4 Alternate Type	0 to 59	1	---	F14	0 = NOT USED
	107C	Analog Output 4 Alternate Min Value	See Analog Output Range Table on page 7–63				
	107D	Analog Output 4 Alternate Max Value	See Analog Output Range Table on page 7–63				
	107E	Reserved					
	107F	Analog Output 4 Serial Value		1	---	F2	0
ANALOG INPUT	1080	Analog Input Main/Alt Select Relay	0 to 3	1	---	F19	0 = OFF
	1081	Analog In Main Name 1^{st} and 2^{nd} char.	---	---	ASCII	F10	““
	1082	Analog In Main Name 3^{rd} and 4^{th} char.	---	---	ASCII	F10	“MA”
	1083	Analog In Main Name 5^{th} and 6^{th} char.	---	---	ASCII	F10	“IN”
	1084	Analog In Main Name 7^{th} and 8^{th} char.	---	---	ASCII	F10	“ A”
	1085	Analog In Main Name 9^{th} and 10^{th} char.	--	--	ASCII	F10	“NA”
	1086	Analog In Main Name 11^{th} and 12^{th} char.	--	--	ASCII	F10	“LO”
	1087	Analog In Main Name 13^{th} and 14^{th} char.	---	---	ASCII	F10	“G “
	1088	Analog In Main Name 15^{h} and 16^{th} char.	----	----	ASCII	F10	“IN”
	1089	Analog In Main Name 17^{th} and 18^{th} char.	---	---	ASCII	F10	“PU”
	108A	Analog In Main Name 19^{th} and 20^{th} char.	---	---	ASCII	F10	“T “
	108B	Analog In Main Units 1^{st} and 2^{nd} char.	---	---	ASCII	F10	“ U”
	108C	Analog In Main Units 3^{rd} and 4^{th} char.	---	---	ASCII	F10	“ni”
	108D	Analog In Main Units 5^{th} and 6^{th} char.	---	---	ASCII	F10	“ts”
	108E	Analog In Main Units 7^{th} and 8^{th} char.	---	---	ASCII	F10	“”
	108F	Analog In Main Units 9^{th} and 10^{th} char.	---	---	ASCII	F10	““
	1090	Analog Input Main 4 mA Value	0 to 65000	1	---	F1	0
	1091	Analog Input Main 20 mA Value	0 to 65000	1	---	F1	0
	1092	Analog Input Main Relay	0 to 4	1	---	F29	0 = OFF
	1093	Analog Input Main Level	0 to 65000	1	---	F1	0
	1094	Analog Input Main Delay	5 to 6000	5	0.1 xs	F1	100 = 10.0 s
	1095	Reserved					
	1096	Reserved					
	1097	Reserved					
	1098	Analog In Alt Name 1^{st} and 2^{nd} char.	---	---	ASCII	F10	““

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 30 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
ANALOG INPUT continued	1099	Analog In Alt Name 3rd and 4th char.	---	---	ASCII	F10	"AL"
	109A	Analog In Alt Name 5th and 6th char.	---	---	ASCII	F10	"T "
	109B	Analog In Alt Name 7th and 8th char.	---	---	ASCII	F10	" A"
	109C	Analog In Alt Name 9th and 10th char.	--	--	ASCII	F10	"NA"
	109D	Analog In Alt Name 11th and 12th char.	--	--	ASCII	F10	"LO"
	109E	Analog In Alt Name 13th and 14th char.	---	---	ASCII	F10	"G "
	109F	Analog In Alt Name 15h and 16th char.	----	----	ASCII	F10	"IN"
	10A0	Analog In Alt Name 17th and 18th char.	---	---	ASCII	F10	"PU"
	10A1	Analog In Alt Name 19th and 20th char.	---	---	ASCII	F10	"T "
	10A2	Analog In Alt Units 1st and 2nd char.	---	---	ASCII	F10	" U"
	10A3	Analog In Alt Units 3rd and 4th char.	---	---	ASCII	F10	"ni"
	10A4	Analog In Alt Units 5th and 6th char.	---	---	ASCII	F10	"ts"
	10A5	Analog In Alt Units 7th and 8th char.	---	---	ASCII	F10	""
	10A6	Analog In Alt Units 9th and 10th char.	---	---	ASCII	F10	""
	10A7	Analog Input Alt 4 mA Value	0 to 65000	1	---	F1	0
	10A8	Analog Input Alt 20 mA Value	0 to 65000	1	---	F1	0
	10A9	Analog Input Alt Relay	0-4	1	---	F29	0=OFF
	10AA	Analog Input Alt Level	0 to 65000	1	---	F1	0
	10AB	Analog Input Alt Delay	5 to 6000	5	0.1 xs	F1	100=10.0 s
	10AC	Reserved					
	10AD	Reserved					
	10AE	Reserved					
	10AF	Reserved					
SWITCH A	10B0	Switch A Name characters 1 and 2	---	---	ASCII	F10	""
	10B1	Switch A Name characters 3 and 4	---	---	ASCII	F10	" S"
	10B2	Switch A Name characters 5 and 6	---	---	ASCII	F10	"WI"
	10B3	Switch A Name characters 7 and 8	---	---	ASCII	F10	"TC"
	10B4	Switch A Name characters 9 and 10	---	---	ASCII	F10	"H "
	10B5	Switch A Name characters 11 and 12	---	---	ASCII	F10	"IN"
	10B6	Switch A Name characters 13 and 14	---	---	ASCII	F10	"PU"
	10B7	Switch A Name characters 15 and 16	---	---	ASCII	F10	"T "
	10B8	Switch A Name characters 17 and 18	---	---	ASCII	F10	"A "
	10B9	Switch A Name characters 19 and 20	---	---	ASCII	F10	""
	10BA	Switch A Function	0 to 14	1	---	F20	0=NOT USED
	10BB	Switch A Activation	0 to 1	1	---	F27	1=CLOSED
	10BC	Switch A Time Delay	0 to 6000	1	0.1 xs	F1	0.0 s
	10BD	Reserved					
	10BE	Reserved					
	10BF	Reserved					

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents "OFF". **** Minimum Setpoint value represents "OFF".
***** Maximum Setpoint value represents "UNLIMITED".

Table 7–10: PQM MEMORY MAP (Sheet 31 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
SWITCH B	10C0	Switch B Name characters 1 and 2	---	---	ASCII	F10	““
	10C1	Switch B Name characters 3 and 4	---	---	ASCII	F10	“ S”
	10C2	Switch B Name characters 5 and 6	---	---	ASCII	F10	“WI”
	10C3	Switch B Name characters 7 and 8	---	---	ASCII	F10	“TC”
	10C4	Switch B Name characters 9 and 10	---	---	ASCII	F10	“H “
	10C5	Switch B Name characters 11 and 12	---	---	ASCII	F10	“IN“
	10C6	Switch B Name characters 13 and 14	---	---	ASCII	F10	“PU”
	10C7	Switch B Name characters 15 and 16	---	---	ASCII	F10	“T ”
	10C8	Switch B Name characters 17 and 18	---	---	ASCII	F10	“B “
	10C9	Switch B Name characters 19 and 20	---	---	ASCII	F10	““
	10CA	Switch B Function	0 to 14	1	---	F20	0 = NOT USED
	10CB	Switch B Activation	0 to 1	1	---	F27	1 = CLOSED
	10CC	Switch B Time Delay	0 to 6000	1	0.1 x s	F1	0.0 s
	10CD	Reserved					
	10CE	Reserved					
	10CF	Reserved					
SWITCH C	10D0	Switch C Name characters 1 and 2	---	---	ASCII	F10	““
	10D1	Switch C Name characters 3 and 4	---	---	ASCII	F10	“ S”
	10D2	Switch C Name characters 5 and 6	---	---	ASCII	F10	“WI”
	10D3	Switch C Name characters 7 and 8	---	---	ASCII	F10	“TC”
	10D4	Switch C Name characters 9 and 10	---	---	ASCII	F10	“H “
	10D5	Switch C Name characters 11 and 12	---	---	ASCII	F10	“IN“
	10D6	Switch C Name characters 13 and 14	---	---	ASCII	F10	“PU”
	10D7	Switch C Name characters 15 and 16	---	---	ASCII	F10	“T ”
	10D8	Switch C Name characters 17 and 18	---	---	ASCII	F10	“C “
	10D9	Switch C Name characters 19 and 20	---	---	ASCII	F10	““
	10DA	Switch C Function	0 to 14	1	---	F20	0 = NOT USED
	10DB	Switch C Activation	0 to 1	1	---	F27	1 = CLOSED
	10DC	Switch C Time Delay	0 to 6000	1	0.1 x s	F1	0.0 s
	10DD	Reserved					
	10DE	Reserved					
	10DF	Reserved					
SWITCH D	10E0	Switch D Name characters 1 and 2	---	---	ASCII	F10	““
	10E1	Switch D Name characters 3 and 4	---	---	ASCII	F10	“ S”
	10E2	Switch D Name characters 5 and 6	---	---	ASCII	F10	“WI”
	10E3	Switch D Name characters 7 and 8	---	---	ASCII	F10	“TC”
	10E4	Switch D Name characters 9 and 10	---	---	ASCII	F10	“H “
	10E5	Switch D Name characters 11 and 12	---	---	ASCII	F10	“IN“
	10E6	Switch D Name characters 13 and 14	---	---	ASCII	F10	“PU”
	10E7	Switch D Name characters 15 and 16	---	---	ASCII	F10	“T ”
	10E8	Switch D Name characters 17 and 18	---	---	ASCII	F10	“D “
	10E9	Switch D Name characters 19 and 20	---	---	ASCII	F10	““
	10EA	Switch D Function	0 to 14	1	---	F20	0 = NOT USED
	10EB	Switch D Activation	0 to 1	1	---	F27	1 = CLOSED

Notes: * Data type depends on the Command Operation Code.
** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”.
**** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 32 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
SWITCH D continued	10EC	Switch D Time Delay	0 to 6000	1	0.1 x s	F1	0.0 s
	10ED	Reserved					
	10EE	Reserved					
	10EF	Reserved					
PULSE OUTPUT	10F0	Positive kWh Pulse Output Relay	0 to 4	1	---	F29	0=OFF
	10F1	Positive kWh Pulse Output Interval	1 to 65000	1	kWh	F1	100 kWh
	10F2	Negative kWh Pulse Output Relay	0 to 4	1	---	F29	0=OFF
	10F3	Negative kWh Pulse Output Interval	1 to 65000	1	kWh	F1	100 kWh
	10F4	Positive kvarh Pulse Output Relay	0 to 3	1	---	F29	0=OFF
	10F5	Positive kvarh Pulse Output Interval	1 to 65000	1	kvarh	F1	100 kvarh
	10F6	Negative kvarh Pulse Output Relay	0 to 3	1	---	F29	0=OFF
	10F7	Negative kvarh Pulse Output Interval	1 to 65000	1	kvarh	F1	100 kvarh
	10F8	kVAh Pulse Output Relay	0 to 3	1	---	F19	0=OFF
	10F9	kVAh Pulse Output Interval	1 to 65000	1	kVAh	F1	100 kVAh
	10FA	Pulse Output Width	100 to 2000	10	ms	F1	100 ms
	10FB	Serial Pulse Relay Interval	100 to 10000	100	ms	F1	100 ms
	10FC	Reserved					
PULSE INPUT	10FD	Pulse Input Units 1st and 2nd char.	---	---	ASCII	F10	" U"
	10FE	Pulse Input Units 3rd and 4th char.	---	---	ASCII	F10	"ni"
	10FF	Pulse Input Units 5th and 6th char.	---	---	ASCII	F10	"ts"
	1100	Pulse Input Units 7th and 8th char.	---	---	ASCII	F10	""
	1101	Pulse Input Units 9th and 10th char.	---	---	ASCII	F10	""
	1102	Pulse Input 1 Value	0 to 65000	1	Units	F1	1
	1103	Pulse Input 2 Value	0 to 65000	1	Units	F1	1
	1104	Pulse Input 3 Value	0 to 65000	1	Units	F1	1
	1105	Pulse Input 4 Value	0 to 65000	1	Units	F1	1
	1106	Pulse Input Total	0 to 10	1	---	F43	9 = 1+2+3+4
	1107	Reserved					
ALARM RELAY	1108	Alarm Relay Operation	0 to 1	1	---	F17	0 = NON-FAILSAFE
	1109	Alarm Relay Activation	0 to 1	1	---	F18	0 = UNLATCHED
	110A	Reserved					
	to	↓	↓	↓	↓	↓	↓
	110F	Reserved					
AUXILIARY RELAY 1	1110	Auxiliary Relay 1 Operation	0 to 1	1	---	F17	0 = NON-FAILSAFE
	1111	Auxiliary Relay 1 Activation	0 to 1	1	---	F18	0 = UNLATCHED
	1112	Reserved					
	to	↓	↓	↓	↓	↓	↓
	1117	Reserved					
AUXILIARY RELAY 2	1118	Auxiliary Relay 2 Operation	0 to 1	1	---	F17	0 = NON-FAILSAFE
	1119	Auxiliary Relay 2 Activation	0 to 1	1	---	F18	0 = UNLATCHED
	111A	Reserved					
	to	↓	↓	↓	↓	↓	↓
	111F	Reserved					

Notes: * Data type depends on the Command Operation Code.
*** Maximum Setpoint value represents "OFF".
***** Maximum Setpoint value represents "UNLIMITED".
** Any valid Actual Values or Setpoints address.
**** Minimum Setpoint value represents "OFF".

Table 7–10: PQM MEMORY MAP (Sheet 33 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
AUXILIARY RELAY 3	1120	Auxiliary Relay 3 Operation	0 to 1	1	---	F17	0 = NON-FAILSAFE
	1121	Auxiliary Relay 3 Activation	0 to 1	1	---	F18	0 = UNLATCHED
	1122	Reserved					
	1123	Reserved					
	1124	Reserved					
	1125	Reserved					
CURRENT/ VOLTAGE ALARMS	1126	Phase Overcurrent Activation	0 to 1	1	---	F115	0 = AVERAGE
	1127	Detect I/V Alarms Using Percentage	0 to 1	1	---	F31	0 = NO
	1128	Phase Undercurrent Relay	0 to 4	1	---	F29	0 = OFF
	1129	Phase Undercurrent Level in Amps	1 to 7500	1	A	F1	100 A
	112A	Phase Undercurrent Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	112B	Phase Overcurrent Relay	0 to 4	1	---	F29	0 = OFF
	112C	Phase Overcurrent Level in Amps	1 to 7500	1	A	F1	100 A
	112D	Phase Overcurrent Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	112E	Neutral Overcurrent Relay	0 to 4	1	---	F29	0 = OFF
	112F	Neutral Overcurrent Level in Amps	1 to 7500	1	A	F1	100 A
	1130	Neutral Overcurrent Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	1131	Undervoltage Relay	0 to 4	1	---	F29	0 = OFF
	1132	Undervoltage Level in Volts	20 to 65000	1	V	F1	100 V
	1133	Undervoltage Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	1134	Phases Req'd for Operation of U/V	0 to 2	1	---	F30	0 = ANY ONE
	1135	Detect U/V Below 20V	0 to 1	1	---	F11	0 = DISABLE
	1136	Overvoltage Relay	0 to 4	1	---	F29	0 = OFF
	1137	Overvoltage Level in Volts	1 to 65000	1	V	F1	100 V
	1138	Overvoltage Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	1139	Phases Req'd for Operation of O/V	0 to 2	1	---	F30	0 = ANY ONE
	113A	Phase Current Unbalance Relay	0 to 4	1	---	F29	0 = OFF
	113B	Phase Current Unbalance Level	1 to 100	1	%	F1	10%
	113C	Phase Current Unbalance Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	113D	Voltage Unbalance Relay	0 to 4	1	---	F29	0 = OFF
	113E	Voltage Unbalance Level	1 to 100	1	%	F1	10%
	113F	Voltage Unbalance Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	1140	Voltage Phase Reversal Relay	0 to 4	1	---	F29	0 = OFF
	1141	Voltage Phase Reversal Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	1142	Detect Undercurrent When 0A	0 to 1	1	---	F31	0 = NO
	1143	Phase Undercurrent Level in % of CT	1 to 100	1	%	F1	100%
	1144	Phase Overcurrent Level in % of CT	1 to 150	1	%	F1	100%
	1145	Neutral Overcurrent Level in % of CT	1 to 150	1	%	F1	100%
	1146	Undervoltage Level in % of VT	20 to 100	1	%	F1	100%
	1147	Overvoltage Level in % of VT	20 to 100	1	%	F1	100%
TOTAL HARMONIC DISTORTION ALARMS	1148	Average Current THD Relay	0 to 4	1	---	F29	0 = OFF
	1149	Average Current THD Level	5 to 1000	5	0.1 x %	F1	100 = 10.0%
	114A	Average Current THD Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	114B	Average Voltage THD Relay	0 to 4	1	---	F29	0 = OFF

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 34 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
THD ALARMS continued	114C	Average Voltage THD Level	5 to 1000	5	0.1 x %	F1	100 = 10.0%
	114D	Average Voltage THD Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	114E	Reserved					
	to	↓	↓	↓	↓	↓	↓
	1157	Reserved					
FREQUENCY ALARMS	1158	Underfrequency Relay	0 to 4	1	---	F29	0 = OFF
	1059	Underfrequency Level	2000 to 7000	1	0.01 x Hz	F1	40.00 Hz
	115A	Underfrequency Delay	1 to 100	1	0.1 x s	F1	100 = 10.0 s
	115B	Zero Frequency Detect	0 to 1	1	---	F11	0 = DISABLE
	115C	Overfrequency Relay	0 to 4	1	---	F29	0 = OFF
	115D	Overfrequency Level	2000 to 12500	1	0.01 x Hz	F1	70.00 Hz
	115E	Overfrequency Delay	1 to 100	1	0.1 x s	F1	100 = 10.0 s
	115F	Reserved					
	to	↓	↓	↓	↓	↓	↓
	1166	Reserved					
POWER ALARMS	1167	Power Alarms Level Base Units	0 to 1	1	---	F114	0 = kW/kVAR
	1168	Positive Real Power Relay	0 to 4	1	---	F29	0 = OFF
	1169	Positive Real Power Level in kW	1 to 65000	1	kW	F1	1000 kW
	116A	Positive Real Power Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	116B	Negative Real Power Relay	0 to 4	1	---	F29	0 = OFF
	116C	Negative Real Power Level in kW	1 to 65000	1	kW	F1	1000 kW
	116D	Negative Real Power Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	116E	Positive Reactive Power Relay	0 to 4	1	---	F29	0 = OFF
	116F	Positive Reactive Power Level in kVAR	1 to 65000	1	kVAR	F1	1000 kVAR
	1170	Positive Reactive Power Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	1171	Negative Reactive Power Relay	0 to 4	1	---	F29	0 = OFF
	1172	Negative Reactive Power Level in kVAR	1 to 65000	1	kVAR	F1	1000 kVAR
	1173	Negative Reactive Power Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	1174	Positive Real Power Level in MW	1 to 65000	1	0.01 MW	F1	10.00MW
	1175	Negative Real Power Level in MW	1 to 65000	1	0.01 MW	F1	10.00MW
	1176	Positive Reactive Power Level in MVAR	1 to 65000	1	0.01 MVAR	F1	10.00MVAR
	1177	Negative Reactive Power Level in MVAR	1 to 65000	1	0.01 MVAR	F1	10.00MVAR
POWER FACTOR ALARMS	1178	Power Factor Lead 1 Relay	0 to 4	1	---	F29	0 = OFF
	1179	Power Factor Lead 1 Pickup Level	0 to 100	1	0.01 x PF	F1	1.00
	117A	Power Factor Lead 1 Dropout Level	0 to 100	1	0.01 x PF	F1	1.00
	117B	Power Factor Lead 1 Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	117C	Power Factor Lag 1 Relay	0 to 4	1	---	F29	0 = OFF
	117D	Power Factor Lag 1 Pickup Level	0 to 100	1	0.01 x PF	F1	1.00
	117E	Power Factor Lag 1 Dropout Level	0 to 100	1	0.01 x PF	F1	1.00
	117F	Power Factor Lag 1 Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	1180	Power Factor Lead 2 Relay	0 to 4	1	---	F29	0 = OFF
	1181	Power Factor Lead 2 Pickup Level	0 to 100	1	0.01 x PF	F1	1.00
	1182	Power Factor Lead 2 Dropout Level	0 to 100	1	0.01 x PF	F1	1.00
	1183	Power Factor Lead 2 Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 35 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
POWER FACTOR ALARMS continued	1184	Power Factor Lag 2 Relay	0 to 4	1	---	F29	0 = OFF
	1185	Power Factor Lag 2 Pickup Level	0 to 100	1	0.01 x PF	F1	1.00
	1186	Power Factor Lag 2 Dropout Level	0 to 100	1	0.01 x PF	F1	1.00
	1187	Power Factor Lag 2 Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	1188	Reserved					
	to	↓	↓	↓	↓	↓	↓
	118F	Reserved					
DEMAND ALARMS	1190	Phase A Current Demand Relay	0 to 4	1	---	F29	0 = OFF
	1191	Phase A Current Demand Level	10 to 7500	1	A	F1	100 A
	1192	Phase B Current Demand Relay	0 to 4	1	---	F29	0 = OFF
	1193	Phase B Current Demand Level	10 to 7500	1	A	F1	100 A
	1194	Phase C Current Demand Relay	0 to 4	1	---	F29	0 = OFF
	1195	Phase C Current Demand Level	10 to 7500	1	A	F1	100 A
	1196	Neutral Current Demand Relay	0 to 4	1	---	F29	0 = OFF
	1197	Neutral Current Demand Level	10 to 7500	1	A	F1	100 A
	1198	Positive Real Power Demand Relay	0 to 4	1	---	F29	0 = OFF
	1199	Positive Real Power Demand Level	1 to 65000	1	kW	F1	1000 kW
	119A	Positive Reactive Power Demand Relay	0 to 4	1	---	F29	0 = OFF
	119B	Positive Reactive Power Demand Level	1 to 65000	1	kvar	F1	1000 kvar
	119C	Apparent Power Demand Relay	0 to 4	1	---	F29	0 = OFF
	119D	Apparent Power Demand Level	1 to 65000	1	kVA	F1	1000 kVA
	119E	Negative Real Power Demand Relay	0 to 4	1	---	F29	0 = OFF
	119F	Negative Real Power Demand Level	1 to 65000	1	kW	F1	1000 kW
	11A0	Negative Reactive Power Demand Relay	0 to 4	1	---	F29	0 = OFF
	11A1	Negative Reactive Power Demand Level	1 to 65000	1	kvar	F1	1000 kvar
	11A2	Reserved					
	to	↓	↓	↓	↓	↓	↓
	11A7	Reserved					
PULSE INPUT ALARMS	11A8	Pulse Input 1 Relay	0 to 4	1	---	F29	0 = OFF
	11A9	Pulse Input 1 Level	1 to 65000	1	---	F1	100
	11AA	Pulse Input 1 Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	11AB	Reserved					
	to	↓	↓	↓	↓	↓	↓
	11AF	Reserved					
MISC. ALARMS	11B0	Serial COM1 Failure Alarm Delay	5 to 61***	1	s	F1	61 = OFF
	11B1	Serial COM2 Failure Alarm Delay	5 to 61***	1	s	F1	61 = OFF
	11B2	Clock Not Set Alarm	0 to 1	1	---	F11	1 = ENABLE
	11B3	Data Log 1 Percentage Full Alarm Level	50 to 101***	1	s	F1	101 = OFF
	11B4	Data Log 2 Percentage Full Alarm Level	50 to 101***	1	s	F1	101 = OFF
	11B5	Reserved					
	11B6	Reserved					
	11B7	Reserved					

Notes: * Data type depends on the Command Operation Code.
** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”.
**** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 36 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
PULSE INPUT ALARMS	11B8	Pulse Input 2 Relay	0 to 4	1	---	F29	0 = OFF
	11B9	Pulse Input 2 Level	1 to 65000	1	---	F1	100
	11BA	Pulse Input 2 Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	11BB	Pulse Input 3 Relay	0 to 4	1	---	F29	0 = OFF
	11BC	Pulse Input 3 Level	1 to 65000	1	---	F1	100
	11BD	Pulse Input 3 Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	11BE	Pulse Input 4 Relay	0 to 4	1	---	F29	0 = OFF
	11BF	Pulse Input 4 Level	1 to 65000	1	---	F1	100
	11C0	Pulse Input 4 Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	11C1	Totalized Pulse Input Relay	0 to 4	1	---	F29	0 = OFF
	11C2	Totalized Pulse Input Level	1 to 65000	1	---	F1	100
	11C3	Totalized Pulse Input Delay	5 to 6000	5	0.1 x s	F1	100 = 10.0 s
	11C4	Reserved					
	to	↓	↓	↓	↓	↓	↓
	11C7	Reserved					
SIMULATION	11C8	Current/Voltage Simulation	0 to 1	1	---	F11	0 = OFF
	11C9	Current/Voltage Simulation Time	5 to 305	5	min	F1*****	15 min
	11CA	Phase A Current	0 to 10000	1	A	F1	0 A
	11CB	Phase B Current	0 to 10000	1	A	F1	0 A
	11CC	Phase C Current	0 to 10000	1	A	F1	0 A
	11CD	Neutral Current	0 to 10000	1	A	F1	0 A
	11CE	Vax Voltage	0 to 65000	1	V	F1	0 V
	11CF	Vbx Voltage	0 to 65000	1	V	F1	0 V
	11D0	Vcx Voltage	0 to 65000	1	V	F1	0 V
	11D1	Phase Angle	0 to 359	1	degrees	F1	0 degrees
	11D2	Analog Output Simulation	0 to 1	1	---	F11	0 = OFF
	11D3	Analog Output Simulation Time	5 to 305	5	min	F1*****	15 min
	11D4	Analog Output 1	0 to 1201***	1	0.1 x %	F1	1201 = OFF
	11D5	Analog Output 2	0 to 1201***	1	0.1 x %	F1	1201 = OFF
	11D6	Analog Output 3	0 to 1201***	1	0.1 x %	F1	1201 = OFF
	11D7	Analog Output 4	0 to 1201***	1	0.1 x %	F1	1201 = OFF
	11D8	Analog Input Simulation	0 to 1	1	---	F11	0 = OFF
	11D9	Analog Input Simulation Time	5 to 305	5	min	F1*****	15 min
	11DA	Analog Input	40 to 201	1	0.1 x mA	F1	201 = OFF
	11DB	Switch Input Simulation	0 to 1	1	---	F11	0 = OFF
	11DC	Switch Input Simulation Time	5 to 305	5	min	F1*****	15 min
	11DD	Switch Input A	0 to 1	1	---	F27	0 = OPEN
	11DE	Switch Input B	0 to 1	1	---	F27	0 = OPEN
	11DF	Switch Input C	0 to 1	1	---	F27	0 = OPEN
	11E0	Switch Input D	0 to 1	1	---	F27	0 = OPEN
	11E1	Reserved					
	11E2	Reserved					
	11E3	Reserved					

Notes: * Data type depends on the Command Operation Code.
*** Maximum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.
** Any valid Actual Values or Setpoints address.
**** Minimum Setpoint value represents “OFF”.

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Table 7–10: PQM MEMORY MAP (Sheet 37 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
TIME ALARM	11E4	Time Relay	0 to 4	1	---	F29	0 = OFF
	11E5	Pickup Time Hours/Minutes	0 to 65535	1	hr/min	F22	12:00
	11E6	Pickup Time Seconds	0 to 59000	1000	ms	F1	0
	11E7	Dropout Time Hours/Minutes	0 to 65535	1	hr/min	F22	12:00
	11E8	Dropout Time Seconds	0 to 59000	1000	ms	F1	0
	11E9	Reserved					
	to	↓	↓	↓	↓	↓	↓
	11EF	Reserved					
PROGRAM-MABLE MESSAGE	11F0	Programmable message chars 1 & 2	32 to 127	1	ASCII	F10	"Ph"
	11F1	Programmable message chars 3 & 4	32 to 127	1	ASCII	F10	"on"
	11F2	Programmable message chars 5 & 6	32 to 127	1	ASCII	F10	"e:"
	11F3	Programmable message chars 7 & 8	32 to 127	1	ASCII	F10	" 9"
	11F4	Programmable message chars 9 & 10	32 to 127	1	ASCII	F10	"05"
	11F5	Programmable message chars 11 & 12	32 to 127	1	ASCII	F10	"-2"
	11F6	Programmable message chars 13 & 14	32 to 127	1	ASCII	F10	"94"
	11F7	Programmable message chars 15 & 16	32 to 127	1	ASCII	F10	"-6"
	11F8	Programmable message chars 17 & 18	32 to 127	1	ASCII	F10	"22"
	11F9	Programmable message chars 19 & 20	32 to 127	1	ASCII	F10	"2 "
	11FA	Programmable message chars 21 & 22	32 to 127	1	ASCII	F10	"GE"
	11FB	Programmable message chars 23 & 24	32 to 127	1	ASCII	F10	"in"
	11FC	Programmable message chars 25 & 26	32 to 127	1	ASCII	F10	"du"
	11FD	Programmable message chars 27 & 28	32 to 127	1	ASCII	F10	"st"
	11FE	Programmable message chars 29 & 30	32 to 127	1	ASCII	F10	"ri"
	11FF	Programmable message chars 31 & 32	32 to 127	1	ASCII	F10	"al"
	1200	Programmable message chars 33 & 34	32 to 127	1	ASCII	F10	".c"
	1201	Programmable message chars 35 & 36	32 to 127	1	ASCII	F10	"om"
	1202	Programmable message chars 37 & 38	32 to 127	1	ASCII	F10	"/p"
	1203	Programmable message chars 39 & 40	32 to 127	1	ASCII	F10	"m "
	1204	Reserved					
	to	↓	↓	↓	↓	↓	↓
	120F	Reserved					
FLASH MESSAGE	1210	Flash message characters 1 and 2	32 to 127	1	ASCII	F10	""
	1211	Flash message characters 3 and 4	32 to 127	1	ASCII	F10	""
	1212	Flash message characters 5 and 6	32 to 127	1	ASCII	F10	""
	1213	Flash message characters 7 and 8	32 to 127	1	ASCII	F10	""
	1214	Flash message characters 9 and 10	32 to 127	1	ASCII	F10	""
	1215	Flash message characters 11 and 12	32 to 127	1	ASCII	F10	""
	1216	Flash message characters 13 and 14	32 to 127	1	ASCII	F10	""
	1217	Flash message characters 15 and 16	32 to 127	1	ASCII	F10	""
	1218	Flash message characters 17 and 18	32 to 127	1	ASCII	F10	""
	1219	Flash message characters 19 and 20	32 to 127	1	ASCII	F10	""
	121A	Flash message characters 21 and 22	32 to 127	1	ASCII	F10	""
	121B	Flash message characters 23 and 24	32 to 127	1	ASCII	F10	""
	121C	Flash message characters 25 and 26	32 to 127	1	ASCII	F10	""

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

Table 7–10: PQM MEMORY MAP (Sheet 38 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
FLASH MESSAGE continued	121D	Flash message characters 27 and 28	32 to 127	1	ASCII	F10	""
	121E	Flash message characters 29 and 30	32 to 127	1	ASCII	F10	""
	121F	Flash message characters 31 and 32	32 to 127	1	ASCII	F10	""
	1220	Flash message characters 33 and 34	32 to 127	1	ASCII	F10	""
	1221	Flash message characters 35 and 36	32 to 127	1	ASCII	F10	""
	1222	Flash message characters 37 and 38	32 to 127	1	ASCII	F10	""
	1223	Flash message characters 39 and 40	32 to 127	1	ASCII	F10	""
	1224	Reserved					
	to	↓	↓	↓	↓	↓	↓
	125F	Reserved					
DATA LOGGER	1260	Log 1 Interval (high)	1 to 86400	1	s	F3	3600
	1261	Log 1 Interval (low)	1 to 86400	1	s	F3	3600
	1262	Log 2 Interval (high)	1 to 86400	1	s	F3	3600
	1263	Log 2 Interval (low)	1 to 86400	1	s	F3	3600
	1264	Log 1 Mode	0 to 1	1	---	F32	0 = RUN TO FILL
	1265	Log 2 Mode	0 to 1	1	---	F32	0 = RUN TO FILL
	1266	Log Size Determination	0 to 1	1	---	F33	0 = AUTOMATIC
	1267	Log 1 Size	0 to 100	1	%	F1	0%
	1268	Data Log Memory Access Block Number	0 to 511	1	---	F1	0
	1269	Stop Data Log 1	0 to 1	1	---	F31	0=NO
	126A	Stop Data Log 2	0 to 1	1	---	F31	0=NO
	126B	Reserved					
	to	↓	↓	↓	↓	↓	↓
	126F	Reserved					
	1270	Ia Log Assignment	0 to 3	1	---	F34	0 = NONE
	1271	Ib Log Assignment	0 to 3	1	---	F34	0 = NONE
	1272	Ic Log Assignment	0 to 3	1	---	F34	0 = NONE
	1273	Iavg Log Assignment	0 to 3	1	---	F34	0 = NONE
	1274	In Log Assignment	0 to 3	1	---	F34	0 = NONE
	1275	I Unbalance Log Assignment	0 to 3	1	---	F34	0 = NONE
	1276	Van Log Assignment	0 to 3	1	---	F34	0 = NONE
	1277	Vbn Log Assignment	0 to 3	1	---	F34	0 = NONE
	1278	Vcn Log Assignment	0 to 3	1	---	F34	0 = NONE
	1279	Vpavg Log Assignment	0 to 3	1	---	F34	0 = NONE
	127A	Vab Log Assignment	0 to 3	1	---	F34	0 = NONE
	127B	Vbc Log Assignment	0 to 3	1	---	F34	0 = NONE
	127C	Vca Log Assignment	0 to 3	1	---	F34	0 = NONE
	127D	Vlavg Log Assignment	0 to 3	1	---	F34	0 = NONE
	127E	V Unbalance Log Assignment	0 to 3	1	---	F34	0 = NONE
	127F	Pa Log Assignment	0 to 3	1	---	F34	0 = NONE
	1280	Qa Log Assignment	0 to 3	1	---	F34	0 = NONE
	1281	Sa Log Assignment	0 to 3	1	---	F34	0 = NONE
	1282	PFa Log Assignment	0 to 3	1	---	F34	0 = NONE
	1283	Pb Log Assignment	0 to 3	1	---	F34	0 = NONE

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 39 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
DATA LOGGER continued	1284	Qb Log Assignment	0 to 3	1	---	F34	0 = NONE
	1285	Sb Log Assignment	0 to 3	1	---	F34	0 = NONE
	1286	PFb Log Assignment	0 to 3	1	---	F34	0 = NONE
	1287	Pc Log Assignment	0 to 3	1	---	F34	0 = NONE
	1288	Qc Log Assignment	0 to 3	1	---	F34	0 = NONE
	1289	Sc Log Assignment	0 to 3	1	---	F34	0 = NONE
	128A	PFc Log Assignment	0 to 3	1	---	F34	0 = NONE
	128B	P3 Log Assignment	0 to 3	1	---	F34	0 = NONE
	128C	Q3 Log Assignment	0 to 3	1	---	F34	0 = NONE
	128D	S3 Log Assignment	0 to 3	1	---	F34	0 = NONE
	128E	PF3 Log Assignment	0 to 3	1	---	F34	0 = NONE
	128F	Frequency Log Assignment	0 to 3	1	---	F34	0 = NONE
	1290	Positive kWh Log Assignment	0 to 3	1	---	F34	0 = NONE
	1291	Negative kWh Log Assignment	0 to 3	1	---	F34	0 = NONE
	1292	Positive kvarh Log Assignment	0 to 3	1	---	F34	0 = NONE
	1293	Negative kvarh Log Assignment	0 to 3	1	---	F34	0 = NONE
	1294	kVAh Log Assignment	0 to 3	1	---	F34	0 = NONE
	1295	Ia Demand Log Assignment	0 to 3	1	---	F34	0 = NONE
	1296	Ib Demand Log Assignment	0 to 3	1	---	F34	0 = NONE
	1297	Ic Demand Log Assignment	0 to 3	1	---	F34	0 = NONE
	1298	In Demand Log Assignment	0 to 3	1	---	F34	0 = NONE
	1299	P3 Demand Log Assignment	0 to 3	1	---	F34	0 = NONE
	129A	Q3 Demand Log Assignment	0 to 3	1	---	F34	0 = NONE
	129B	S3 Demand Log Assignment	0 to 3	1	---	F34	0 = NONE
	129C	Ia THD Log Assignment	0 to 3	1	---	F34	0 = NONE
	129D	Ib THD Log Assignment	0 to 3	1	---	F34	0 = NONE
	129E	Ic THD Log Assignment	0 to 3	1	---	F34	0 = NONE
	129F	In THD Log Assignment	0 to 3	1	---	F34	0 = NONE
	12A0	Van THD Log Assignment	0 to 3	1	---	F34	0 = NONE
	12A1	Vbn THD Log Assignment	0 to 3	1	---	F34	0 = NONE
	12A2	Vcn THD Log Assignment	0 to 3	1	---	F34	0 = NONE
	12A3	Vab THD Log Assignment	0 to 3	1	---	F34	0 = NONE
	12A4	Vbc THD Log Assignment	0 to 3	1	---	F34	0 = NONE
	12A5	Analog Input Log Assignment	0 to 3	1	---	F34	0 = NONE
	12A6	Reserved					
	to	↓	↓	↓	↓	↓	↓
	12BF	Reserved					
	12C0	Event Recorder Memory Access Event Number	0 to 65535	1	---	F1	0
	12C1	Event Recorder Operation	0 to 1	1	---	F11	0 = DISABLE
	12C2	Event Recorder Event Enable Flags 1	0 to 65535	1	---	F105	65535
	12C3	Event Recorder Event Enable Flags 2	0 to 65535	1	---	F106	65535
	12C4	Event Recorder Event Enable Flags 3	0 to 65535	1	---	F107	65535
	12C5	Event Recorder Event Enable Flags 4	0 to 65535	1	---	F112	65535
	12C6	Reserved					

Notes: * Data type depends on the Command Operation Code. ** Any valid Actual Values or Setpoints address.
*** Maximum Setpoint value represents “OFF”. **** Minimum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.

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Table 7–10: PQM MEMORY MAP (Sheet 40 of 40)

GROUP	ADDR (HEX)	DESCRIPTION	RANGE	STEP VALUE	UNITS and SCALE	FORMAT	FACTORY DEFAULT
	to	↓	↓	↓	↓	↓	↓
	12CF	Reserved					
TRACE MEMORY	12D0	Trace Memory Usage	0 to 2	1	---	F37	0 = 1x36 cycles
	12D1	Trace Memory Trigger Mode	0 to 1	1	---	F38	0 = ONE SHOT
	12D2	Ia Overcurrent Trigger Level	1 to 151***	1	% CT	F1	151 = OFF
	12D3	Ib Overcurrent Trigger Level	1 to 151***	1	% CT	F1	151 = OFF
	12D4	Ic Overcurrent Trigger Level	1 to 151***	1	% CT	F1	151 = OFF
	12D5	In Overcurrent Trigger Level	1 to 151***		% CT	F1	151 = OFF
	12D6	Va Overvoltage Trigger Level	20 to 151***	1	% VT	F1	151 = OFF
	12D7	Vb Overvoltage Trigger Level	20 to 151***	1	% VT	F1	151 = OFF
	12D8	Vc Overvoltage Trigger Level	20 to 151***	1	% VT	F1	151 = OFF
	12D9	Va Undervoltage Trigger Level	20 to 151***	1	% VT	F1	151 = OFF
	12DA	Vb Undervoltage Trigger Level	20 to 151***	1	% VT	F1	151 = OFF
	12DB	Vc Undervoltage Trigger Level	20 to 151***	1	% VT	F1	151 = OFF
	12DC	Switch Input A Trigger	0 to 2	1	---	F39	0 = OFF
	12DD	Switch Input B Trigger	0 to 2	1	---	F39	0 = OFF
	12DE	Switch Input C Trigger	0 to 2	1	---	F39	0 = OFF
	12DF	Switch Input D Trigger	0 to 2	1	---	F39	0 = OFF
	12E0	Trace Memory Trigger Delay	0 to 30	1	cycles	F1	0 cycles
	12E1	Trace Memory Waveform Selection	0 to 6	1	---	F40	0 = Ia
	12E2	Trace Memory Trigger Relay	0 to 4	1	---	F29	0 = OFF
	12E3	Reserved					
	to	↓	↓	↓	↓	↓	↓
	12EF	Reserved					
PRODUCT OPTIONS	12F0	Product Options Upgrade	0 to 23	1	---	F116	0
	12F1	Product Modifications Upgrade MOD1	0 to 999	1	---	F1	0
	12F2	Product Modifications Upgrade MOD2	0 to 999	1	---	F1	0
	12F3	Product Modifications Upgrade MOD3	0 to 999	1	---	F1	0
	12F4	Product Modifications Upgrade MOD4	0 to 999	1	---	F1	0
	12F5	Product Modifications Upgrade MOD5	0 to 999	1	---	F1	0
	12F6	Passcode Input 1	32 to 127	1	---	F10	32
	12F7	Passcode Input 2	32 to 127	1	---	F10	32
	12F8	Passcode Input 3	32 to 127	1	---	F10	32
	12F9	Passcode Input 4	32 to 127	1	---	F10	32
	12FA	Passcode Input 5	32 to 127	1	---	F10	32
	12FB	Passcode Input 6	32 to 127	1	---	F10	32
	12FC	Passcode Input 7	32 to 127	1	---	F10	32
	12FD	Passcode Input 8	32 to 127	1	---	F10	32
	12FE	Passcode Input 9	32 to 127	1	---	F10	32
	12FF	Passcode Input 10	32 to 127	1	---	F10	32
	1300	Reserved					
	to	↓	↓	↓	↓	↓	↓
	131F	Reserved					

Notes: * Data type depends on the Command Operation Code.
*** Maximum Setpoint value represents “OFF”.
***** Maximum Setpoint value represents “UNLIMITED”.
** Any valid Actual Values or Setpoints address.
**** Minimum Setpoint value represents “OFF”.

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7.3.4 MEMORY MAP DATA FORMATS

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 1 of 16)

CODE	DESCRIPTION	BITMASK
F1	UNSIGNED INTEGER - NUMERICAL DATA	FFFF
F2	SIGNED INTEGER - NUMERICAL DATA	FFFF
F3	UNSIGNED LONG INTEGER - NUMERICAL DATA	FFFFFFFF
F4	SIGNED LONG INTEGER - NUMERICAL DATA	FFFFFFFF
F5	HARDWARE VERSION CODE	FFFF
	1 = A	---
	2 = B	---
	↓	ø
	26 = Z	---
F6	UNSIGNED INTEGER - CURRENT KEY PRESS	FFFF
	0000 = no key	---
	FE01 = STORE	---
	FE02 = SETPOINT	---
	FE04 = MESSAGE RIGHT	---
	FE08 = VALUE UP	---
	FD01 = RESET	---
	FD02 = MESSAGE LEFT	---
	FD04 = MESSAGE UP	---
	FD08 = VALUE DOWN	---
	FB01 = ACTUAL	---
	FB02 = MESSAGE DOWN	---
F7	UNSIGNED INTEGER - COMMAND	FFFF
	1 = Reset	---
	2 = Alarm Relay On	---
	3 = Alarm Relay Off	---
	4 = Auxiliary Relay 1 On	---
	5 = Auxiliary Relay 1 Off	---
	6 = Auxiliary Relay 2 On	---
	7 = Auxiliary Relay 2 Off	---
	8 = Auxiliary Relay 3 On	---
	9 = Auxiliary Relay 3 Off	---
	10 = Set Clock Time	---
	11 = Set Clock Date	---
	12 = Display 40 character Flash Message for 5 s	---
	13 = Simulate Keypress	---
	14 = Clear Energy Values	---
	15 = Clear Max. Demand Values	---
	16 = Clear Min./Max. Current Values	---
	17 = Clear Min./Max. Voltage Values	---
	18 = Clear Min./Max. Power Values	---
	19 = Clear Max. THD Values	---
	20 = Clear Switch Input Pulse Count	---
	21 = High Speed Sampling Trigger	---
	22 = Upload Mode Entry 2	---
	23 = Upload Mode Entry 1	---

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 2 of 16)

CODE	DESCRIPTION	BITMASK
F7 con't	24 = Factory Setpoints Reload 2	---
	25 = Factory Setpoints Reload 1	---
	26 = Test Relays and LEDs	---
	27 = Waveform Capture Trigger	---
	28 = Start Data Log(s)	---
	29 = Stop Data Log(s)	---
	30 = Resize Data Logs (valid only if both logs are stopped)	---
	31 = Clear Event Record	---
	32 = Trigger Trace Memory	---
	33 = Re-arm Trace Memory	---
	34 = Clear All Demand	---
	35 = Clear Min./Max. Frequency	---
F8	UNSIGNED INTEGER - KEYPRESS SIMULATION	FFFF
	49 = '1' = SETPOINT	---
	50 = '2' = ACTUAL	---
	51 = '3' = RESET	---
	52 = '4' = STORE	---
	53 = '5' = MESSAGE UP	---
	54 = '6' = MESSAGE DOWN	---
	55 = '7' = MESSAGE LEFT	---
	56 = '8' = MESSAGE RIGHT	---
	57 = '9' = VALUE UP	---
	97 = 'a' = VALUE DOWN	---
F9	UNSIGNED INTEGER - RELAY/LED TEST DATA	FFFF
	Alarm Relay	0001
	Auxiliary Relay 1	0002
	Auxiliary Relay 2	0004
	Auxiliary Relay 3	0008
	'ALARM' LED	0010
	'PROGRAM' LED	0020
	'SIMULATION' LED	0040
	'SELF TEST' LED	0080
	'ALARM' Relay LED	0100
	'AUX 1' Relay LED	0200
	'AUX 2' Relay LED	0400
	'AUX 3' Relay LED	0800
F10	TWO ASCII CHARACTERS	FFFF
	32-127 = ASCII Character	7F00
	32-127 = ASCII Character	007F
F11	UNSIGNED INTEGER - ENABLE/DISABLE	FFFF
	0 = Disable/OFF	---
	1 = Enable/ON	---

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 3 of 16)

CODE	DESCRIPTION	BITMASK
F12	UNSIGNED INTEGER - MODBUS BAUD RATE	FFFF
	0 = 1200	---
	1 = 2400	---
	2 = 4800	---
	3 = 9600	---
	4 = 19200	---
F13	UNSIGNED INTEGER - PARITY TYPE	FFFF
	0 = None	---
	1 = Even	---
	2 = Odd	---
F14	UNSIGNED INTEGER - ANALOG OUTPUT TYPE	FFFF
	0 = Not Used	---
	1 = Phase A Current	---
	2 = Phase B Current	---
	3 = Phase C Current	---
	4 = Neutral Current	---
	5 = Average Phase Current	---
	6 = Current Unbalance	---
	7 = Voltage Van	---
	8 = Voltage Vbn	---
	9 = Voltage Vcn	---
	10 = Voltage Vab	---
	11 = Voltage Vbc	---
	12 = Voltage Vca	---
	13 = Average Phase Voltage	---
	14 = Average Line Voltage	---
	15 = Voltage Unbalance	---
	16 = Frequency	---
	17 = 3 Phase Power Factor	---
	18 = 3 Phase Real Power (kW)	---
	19 = 3 Phase Reactive Power (kvar)	---
	20 = 3 Phase Apparent Power (kVA)	---
	21 = 3 Phase Real Power (MW)	---
	22 = 3 Phase Reactive Power (Mvar)	---
	23 = 3 Phase Apparent Power (MVA)	---
	24 = Phase A Power Factor	---
	25 = Phase A Real Power	---
	26 = Phase A Reactive Power	---
	27 = Phase A Apparent Power	---
	28 = Phase B Power Factor	---
	29 = Phase B Real Power	---
	30 = Phase B Reactive Power	---
	31 = Phase B Apparent Power	---
	32 = Phase C Power Factor	---
	33 = Phase C Real Power	---
	34 = Phase C Reactive Power	---
	35 = Phase C Apparent Power	---

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 4 of 16)

CODE	DESCRIPTION	BITMASK
F14 con't	36 = 3 Phase Positive Real Energy Used	---
	37 = 3 Phase Positive Reactive Energy Used	---
	38 = 3 Phase Negative Real Energy Used	---
	39 = 3 Phase Negative Reactive Energy Used	---
	40 = 3 Phase Apparent Energy Used	---
	41 = Phase A Current Demand	---
	42 = Phase B Current Demand	---
	43 = Phase C Current Demand	---
	44 = Neutral Current Demand	---
	45 = 3 Phase Real Power Demand	---
	46 = 3 Phase Reactive Power Demand	---
	47 = 3 Phase Apparent Power Demand	---
	48 = Three Phase Current THD	---
	49 = Three Phase Voltage THD	---
	50 = Phase A Current THD	---
	51 = Phase B Current THD	---
	52 = Phase C Current THD	---
	53 = Voltage Van THD	---
	54 = Voltage Vbn THD	---
	55 = Voltage Vcn THD	---
	56 = Voltage Vab THD	---
	57 = Voltage Vbc THD	---
	58 = Neutral Current THD	---
	59 = Serial Control	---
F15	UNSIGNED INTEGER - VT WIRING	FFFF
	0 = Off	---
	1 = 4 Wire Wye / 3 VTs	---
	2 = 4 Wire Wye Direct	---
	3 = 4 Wire Wye / 2 VTs	---
	4 = 3 Wire Delta / 2 VTs	---
	5 = 3 Wire Direct	---
	6 = Single Phase Direct	---
F16	UNSIGNED INTEGER NEUTRAL CURRENT SENSING	FFFF
	0 = Off	---
	1 = Separate CT	---
	2 = Calculated	---
F17	UNSIGNED INTEGER -FAILSAFE/NON-FAILSAFE	FFFF
	0 =Non-failsafe	---
	1 = Failsafe	---
F18	UNSIGNED INTEGER - UNLATCHED / LATCHED	FFFF
	0 = Unlatched	---
	1 = Latched	---
F19	UNSIGNED INTEGER - AUX RELAY FUNCTION	FFFF
	0 = Off	---
	1 = Aux1 Relay	---
	2 = Aux2 Relay	---
	3 = Aux3 Relay	---

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 5 of 16)

CODE	DESCRIPTION	BITMASK
F20	UNSIGNED INTEGER - SWITCH FUNCTION	FFFF
	0 = Not Used	---
	1 = Alarm Relay	---
	2 = Auxiliary Relay 1	---
	3 = Auxiliary Relay 2	---
	4 = Auxiliary Relay 3	---
	5 = Pulse Input 1	---
	6 = New Demand Period	---
	7 = Setpoint Access	---
	8 = Select Main/Alt Analog Output	---
	9 = Select Main/Alt Analog Input	---
	10 = Pulse Input 2	---
	11 = Pulse Input 3	---
	12 = Pulse Input 4	---
	13 = Clear Energy	---
	14 = Clear Demand	---
F22	TIME HOURS/MINUTES	FFFF
	Hours: 0 = 12 am, 1 = 1 am, ..., 23 = 11 pm	FF00
	Minutes: 0-59 in steps of 1	00FF
F23	UNSIGNED INTEGER - TIME SECONDS	FFFF
	Seconds: 0 = 0.000s,...,59999 = 59.999s	---
F24	DATE MONTH/DAY	FFFF
	Month: 1=January, ..., 12=December	FF00
	Day: 1-31 in steps of 1	00FF
F25	UNSIGNED INTEGER - DATE YEAR	FFFF
	Year: 1995, 1996, 1997, ...	---
F26	UNSIGNED INTEGER HARMONIC SPECTRUM PARAMETER	FFFF
	0 = None	---
	1 = Phase A Current	---
	2 = Phase B Current	---
	3 = Phase C Current	---
	4 = Neutral Current	---
	5 = Voltage Vax	---
	6 = Voltage Vbx	---
	7 = Voltage Vcx	---
F27	UNSIGNED INTEGER - SWITCH ACTIVATION	FFFF
	0 = Open	---
	1 = Closed	---
F28	UNSIGNED INTEGER DEMAND CALCULATION TYPE	FFFF
	0 = Thermal Exponential	---
	1 = Block Interval	---
	2 = Rolling Interval	---

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 6 of 16)

CODE	DESCRIPTION	BITMASK
F29	UNSIGNED INTEGER ALARM/CONTROL RELAY SELECTION	FFFF
	0 = Off	---
	1 = Alarm Relay	---
	2 = Auxiliary Relay 1	---
	3 = Auxiliary Relay 2	---
	4 = Auxiliary Relay 3	---
F30	UNSIGNED INTEGER PHASES REQ'D FOR OPERATION	FFFF
	0 = Any One	---
	1 = Any Two	---
	2 = All Three	---
F31	UNSIGNED INTEGER - YES/NO	FFFF
	0 = No	---
	1 = Yes	---
F32	UNSIGNED INTEGER - DATA LOG MODE	FFFF
	0 = Run to Fill	---
	1 = Circulate	---
F33	UNSIGNED INTEGER DATA LOG SIZE DETERMINATION	FFFF
	0 = Automatic	---
	1 = From Setpoint	---
F34	UNSIGNED INTEGER - DATA LOG SELECTION	FFFF
	0 = None	---
	1 = Log 1	---
	2 = Log 2	---
	3 = Log 1 and Log 2	---
F35	UNSIGNED INTEGER - DATA LOG STATUS	FFFF
	0 = Stopped	---
	1 = Running	---
F36	UNSIGNED INTEGER - CAUSE OF EVENT	FFFF
	0 = No Event	---
	1 = Clear Event Record	---
	2 = Power On	---
	3 = Power Off	---
	4 = Reset	---
	5 = Setpoint Access Enabled	---
	6 = Switch A Alarm	---
	7 = Switch B Alarm	---
	8 = Switch C Alarm	---
	9 = Switch D Alarm	---
	10 = COM1 Fail Alarm	---
	11 = COM2 Fail Alarm	---
	12 = Self Test Alarm	---
	13 = Clock Not Set Alarm	---
	14 = Parameters Not Set Alarm	---
	15 = Underfrequency Alarm	---
	16 = Overfrequency Alarm	---

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Table 7–11: MEMORY MAP DATA FORMATS (Sheet 7 of 16)

CODE	DESCRIPTION	BITMASK
	17 = Undercurrent Alarm	---
	18 = Overcurrent Alarm	---
	19 = Neutral Overcurrent Alarm	---
	20 = Undervoltage Alarm	---
	21 = Overvoltage Alarm	---
	22 = Current Unbalance Alarm	---
	23 = Voltage Unbalance Alarm	---
	24 = Phase Reversal Alarm	---
	25 = Power Factor Lead 1 Alarm	---
	26 = Power Factor Lead 2 Alarm	---
	27 = Power Factor Lag 1 Alarm	---
	28 = Power Factor Lag 2 Alarm	---
	29 = Positive kW Alarm	---
	30 = Negative kW Alarm	---
	31 = Positive kvar Alarm	---
	32 = Negative kvar Alarm	---
	33 = Positive kW Demand Alarm	---
	34 = Positive kvar Demand Alarm	---
	35 = Negative kW Demand Alarm	---
	36 = Negative kvar Demand Alarm	---
	37 = kVA Demand Alarm	---
	38 = Phase A Current Demand Alarm	---
	39 = Phase B Current Demand Alarm	---
	40 = Phase C Current Demand Alarm	---
	41 = Neutral Current Demand Alarm	---
	42 = Pulse Input 1 Alarm	---
	43 = Current THD Alarm	---
	44 = Voltage THD Alarm	---
	45 = Analog Input Main Alarm	---
	46 = Analog Input Alternate Alarm	---
	47 = Data Log 1 Alarm	---
	48 = Data Log 2 Alarm	---
	49 = Switch A Alarm Clear	---
	50 = Switch B Alarm Clear	---
	51 = Switch C Alarm Clear	---
	52 = Switch D Alarm Clear	---
	53 = COM1 Fail Alarm Clear	---
	54 = COM2 Fail Alarm Clear	---
	55 = Self Test Alarm Clear	---
	56 = Clock Not Set Alarm Clear	---
	57 = Parameters Not Set Alarm Clear	---
	58 = Underfrequency Alarm Clear	---
	59 = Overfrequency Alarm Clear	---
	60 = Undercurrent Alarm Clear	---
	61 = Overcurrent Alarm Clear	---
	62 = Neutral Overcurrent Alarm Clear	---
	63 = Undervoltage Alarm Clear	---

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 8 of 16)

CODE	DESCRIPTION	BITMASK
	64 = Overvoltage Alarm Clear	---
	65 = Current Unbalance Alarm Clear	---
	66 = Voltage Unbalance Alarm Clear	---
	67 = Phase Reversal Alarm Clear	---
	68 = Power Factor Lead 1 Alarm Clear	---
	69 = Power Factor Lead 2 Alarm Clear	---
	70 = Power Factor Lag 1 Alarm Clear	---
	71 = Power Factor Lag 2 Alarm Clear	---
	72 = Positive kW Alarm Clear	---
	73 = Negative kW Alarm Clear	---
	74 = Positive kvar Alarm Clear	---
	75 = Negative kvar Alarm Clear	---
	76 = Positive kW Demand Alarm Clear	---
	77 = Positive kvar Demand Alarm Clear	---
	78 = Negative kW Demand Alarm Clear	---
	79 = Negative kvar Demand Alarm Clear	---
	80 = kVA Demand Alarm Clear	---
	81 = Phase A Current Demand Alarm Clear	---
	82 = Phase B Current Demand Alarm Clear	---
	83 = Phase C Current Demand Alarm Clear	---
	84 = Neutral Current Demand Alarm Clear	---
	85 = Pulse Input 1 Alarm Clear	---
	86 = Current THD Alarm Clear	---
	87 = Voltage THD Alarm Clear	---
	88 = Analog Input Main Alarm Clear	---
	89 = Analog Input Alternate Alarm Clear	---
	90 = Data Log 1 Alarm Clear	---
	91 = Data Log 2 Alarm Clear	---
	92 = Pulse Input 2 Alarm	---
	93 = Pulse Input 3 Alarm	---
	94 = Pulse Input 4 Alarm	---
	95 = Pulse Count Total Alarm	---
	96 = Pulse Input 2 Alarm Clear	---
	97 = Pulse Input 3 Alarm Clear	---
	98 = Pulse Input 4 Alarm Clear	---
	99 = Pulse Input Total Alarm Clear	---
	100 = Time Alarm	---
	101 = Time Alarm Clear	---
	102 = Trace Memory Trigger	---
F37	TRACE MEMORY USAGE	FFFF
	0 = 1 x 36 cycles	---
	1 = 2 x 18 cycles	---
	2 = 3 x 12 cycles	---
F38	TRACE MEMORY TRIGGER MODE	FFFF
	0 = ONE SHOT	---
	1 = RETRIGGER	---

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 9 of 16)

CODE	DESCRIPTION	BITMASK
F39	TRACE MEMORY USAGE	FFFF
	0 = OFF	---
	1 = OPEN-TO-CLOSED	---
	2 = CLOSED-TO-OPEN	---
F40	TRACE MEMORY USAGE	FFFF
	0 = Ia	---
	1 = Ib	---
	2 = Ic	---
	3 = In	---
	4 = Va	---
	5 = Vb	---
	6 = Vc	---
F41	TRACE MEMORY TRIGGERS	FFFF
	0 = Trace Memory Not Triggered	---
	1 = Ia Overcurrent	---
	2 = Ib Overcurrent	---
	3 = Ic Overcurrent	---
	4 = In Overcurrent	---
	5 = Va Overvoltage	---
	6 = Vb Overvoltage	---
	7 = Vc Overvoltage	---
	8 = Va Undervoltage	---
	9 = Vb Undervoltage	---
	10 = Vc Undervoltage	---
	11 = Switch Input A	---
	12 = Switch Input B	---
	13 = Switch Input C	---
	14 = Switch Input D	---
	15 = Serial Communication	---
F43	**PULSE INPUT TOTALIZATION**	**FFFF**
	0 = 1+2	---
	1 = 1+3	---
	2 = 1+4	---
	3 = 2+3	---
	4 = 2+4	---
	5 = 3+4	---
	6 = 1+2+3	---
	7 = 1+3+4	---
	8 = 2+3+4	---
	9 = 1+2+3+4	---
	10 = 1+2+4	---
F44	**PHASE CT WIRING**	**FFFF**
	0 = Phase A, B and C	---
	1 = Phase A and B only	---
	2 = Phase A and C only	---
	3 = Phase A only	---

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 10 of 16)

CODE	DESCRIPTION	BITMASK
F47	DNP PORT	FFFF
	0 = NONE	---
	1 = RS232	---
	2 = COM1	---
	3 = COM2	---
F100	**PQM OPTIONS**	**FFFF**
	No Options Installed (Chassis Mount)	0000
	PQM (Display Version)	0001
	T20 (4-20mA Transducer) Option	0002
	T1 (0-1mA Transducer) Option	0004
	C (Control) Option	0008
	A (Power Analysis) Option	0010
	Not Used	0020
	Not Used	0040
	Not Used	0080
	Not Used	0100
	Not Used	0200
	Not Used	0400
	Not Used	0800
	Not Used	1000
	Not Used	2000
	Not Used	4000
	Not Used	8000
F101	**SWITCH INPUT STATUS (0 = OPEN, 1 = CLOSED)**	**FFFF**
	Not Used	0001
	Not Used	0002
	Not Used	0004
	Not Used	0008
	Not Used	0010
	Not Used	0020
	Not Used	0040
	Not Used	0080
	Switch A	0100
	Switch B	0200
	Switch C	0400
	Switch D	0800
	Not Used	1000
	Not Used	2000
	Not Used	4000
	Not Used	8000

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 11 of 16)

CODE	DESCRIPTION	BITMASK
F102	**LED STATUS FLAGS: (0 = INACTIVE, 1 = ACTIVE)**	**FFFF**
	AUX 1 Relay	0001
	AUX 2 Relay	0002
	AUX 3 Relay	0004
	ALARM	0008
	PROGRAM	0010
	SIMULATION	0020
	ALARM Relay	0040
	SELF TEST	0080
	Not Used	0100
	Not Used	0200
	Not Used	0400
	Not Used	0800
	Not Used	1000
	Not Used	2000
	Not Used	4000
	Not Used	8000
F103	**LED ATTRIBUTE FLAGS (0 = FLASHING, 1 = SOLID; ACTIVE)**	**FFFF**
	AUX 1 Relay	0001
	AUX 2 Relay	0002
	AUX 3 Relay	0004
	ALARM	0008
	PROGRAM	0010
	SIMULATION	0020
	ALARM Relay	0040
	SELF TEST	0080
	Not Used	0100
	Not Used	0200
	Not Used	0400
	Not Used	0800
	Not Used	1000
	Not Used	2000
	Not Used	4000
	Not Used	8000
F104	**OUTPUT RELAY FLAG (0=DE-ENERGIZED,1=ENERGIZED)**	**FFFF**
	Alarm Relay	0001
	Auxiliary Relay 1	0002
	Auxiliary Relay 2	0004
	Auxiliary Relay 3	0008
	Not Used	0010
	Not Used	0020
	Not Used	0040
	Not Used	0080
	Not Used	0100
	Not Used	0200

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 12 of 16)

CODE	DESCRIPTION	BITMASK
F104 con't	Not Used	0400
	Not Used	0800
	Not Used	1000
	Not Used	2000
	Not Used	4000
	Not Used	8000
F105	**ALARM STATUS FLAGS 1:**	**FFFF**
	Phase Undercurrent Alarm	0001
	Phase Overcurrent Alarm	0002
	Neutral Overcurrent Alarm	0004
	Undervoltage Alarm	0008
	Overvoltage Alarm	0010
	Current Unbalance Alarm	0020
	Voltage Unbalance Alarm	0040
	Voltage Phase Reversal	0080
	Power Factor Lead Alarm 1	0100
	Power Factor Lead Alarm 2	0200
	Power Factor Lag Alarm 1	0400
	Power Factor Lag Alarm 2	0800
	Positive Real Power Alarm	1000
	Negative Real Power Alarm	2000
	Positive Reactive Power Alarm	4000
	Negative Reactive Power Alarm	8000
F106	**ALARM STATUS FLAGS 2:**	**FFFF**
	Underfrequency Alarm	0001
	Overfrequency Alarm	0002
	Positive Real Power Demand alarm	0004
	Positive Reactive Power Demand Alarm	0008
	Apparent Power Demand Alarm	0010
	Phase A Current Demand Alarm	0020
	Phase B Current Demand Alarm	0040
	Phase C Current Demand Alarm	0080
	Neutral Current Demand Alarm	0100
	Switch A Alarm	0200
	Switch B Alarm	0400
	Switch C Alarm	0800
	Switch D Alarm	1000
	Internal Fault Alarm	2000
	Serial COM1 Failure Alarm	4000
	Serial COM2 Failure Alarm	8000
F107	**ALARM STATUS FLAGS 3:**	**FFFF**
	Clock Not Set Alarm	0001
	Parameters Not Set Alarm	0002
	Pulse Input 1 Alarm	0004
	Current THD Alarm	0008
	Voltage THD Alarm	0010
	Analog Input Main Alarm	0020

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 13 of 16)

CODE	DESCRIPTION	BITMASK
F107 con't	Analog Input Alt Alarm	0040
	Data Log 1	0080
	Data Log 2	0100
	Negative Real Power Demand alarm	0200
	Negative Reactive Power Demand Alarm	0400
	Pulse Input 2 Alarm	0800
	Pulse Input 3 Alarm	1000
	Pulse Input 4 Alarm	2000
	Totalized Pulse Input Alarm	4000
	Time Alarm	8000
F108	**INTERNAL FAULT ERROR CODE**	**FFFF**
	ADC Reference Out of Range	0001
	HC705 Processor Not Responding	0002
	Switch Input Circuit Fault	0004
	HC705 MOR Byte is Not Programmed	0008
	Not Used	0010
	Not Used	0020
	Not Used	0040
	Not Used	0080
	Not Used	0100
	Not Used	0200
	Not Used	0400
	Not Used	0800
	Not Used	1000
	Not Used	2000
	Not Used	4000
	Not Used	8000
F109	**GENERAL STATUS**	**FFFF**
	Alarm Present	0001
	Clock Not Set	0002
	Clock Drifting	0004
	Data Log 1 Running	0008
	Data Log 2 Running	0010
	Not Used	0020
	Not Used	0040
	Not Used	0080
	Not Used	0100
	Not Used	0200
	Not Used	0400
	Not Used	0800
	Not Used	1000
	Not Used	2000
	Not Used	4000
	Not Used	8000
F110	**DATA LOGGER NUMBERS**	**FFFF**
	Log 1	0001
	Log 2	0002

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 14 of 16)

CODE	DESCRIPTION	BITMASK
F110 con't	Not Used	0004
	Not Used	0008
	Not Used	0010
	Not Used	0020
	Not Used	0040
	Not Used	0080
	Not Used	0100
	Not Used	0200
	Not Used	0400
	Not Used	0800
	Not Used	1000
	Not Used	2000
	Not Used	4000
	Not Used	8000
F111	**EVENT RECORD SWITCHES AND RELAY STATUS**	**FFFF**
	Alarm Relay	0001
	Auxiliary Relay 1	0002
	Auxiliary Relay 2	0004
	Auxiliary Relay 3	0008
	Not Used	0010
	Not Used	0020
	Not Used	0040
	Not Used	0080
	Switch A	0100
	Switch B	0200
	Switch C	0400
	Switch D	0800
	Not Used	1000
	Not Used	2000
	Not Used	4000
	Not Used	8000
F112	**EVENT RECORDER EVENT ENABLE FLAGS 4**	**FFFF**
	Power On	0001
	Power Off	0002
	Alarm / Control Reset	0004
	Setpoint Access Enable	0008
	Not Used	0010
	Not Used	0020
	Not Used	0040
	Not Used	0080
	Not Used	0100
	Not Used	0200
	Not Used	0400
	Not Used	0800
	Not Used	1000
	Not Used	2000
	Not Used	4000

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 15 of 16)

CODE	DESCRIPTION	BITMASK
	Not Used	8000
F113	**TRACE MEMORY TRIGGERED FLAG STATUS**	**FFFF**
	0 = Trace Memory Not Triggered	---
	1 = Trace Memory Triggered	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
F114	**POWER ALARMS LEVEL BASE UNITS**	**FFFF**
	0 = kW/kVAR	---
	1 = MW/MVAR	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
F115	**PHASE OVERCURRENT ACTIVATION**	**FFFF**
	0 = Average	---
	1 = Maximum	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---

Table 7–11: MEMORY MAP DATA FORMATS (Sheet 16 of 16)

CODE	DESCRIPTION	BITMASK
F115 con't	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
F116	**PRODUCT OPTIONS UPGRADE**	**FFFF**
	0 = PQM/ND	---
	1 = PQM	---
	2 = PQM/ND-T20	---
	3 = PQM-T20	---
	4 = PQM/ND-T1	---
	5 = PQM-T1	---
	6 = PQM/ND-C	---
	7 = PQM-C	---
	8 = PQM/ND-T20-C	---
	9 = PQM-T20-C	---
	10 = PQM/ND-T1-C	---
	11 = PQM-T1-C	---
	12 = PQM/ND-A	---
	13 = PQM-A	---
	14 = PQM/ND-T20-A	---
	15 = PQM-T20-A	---
	16 = PQM/ND-T1-A	---
	17 = PQM-T1-A	---
	18 = PQM/ND-C-A	---
	19 = PQM-C-A	---
	20 = PQM/ND-T20-C-A	---
	21 = PQM-T20-C-A	---
	22 = PQM/ND-T1-C-A	---
	23 = PQM-T1-C-A	---
F117	**Invalid Serial Number Flag**	**FFFF**
	0 = Serial Number Valid	---
	1 = Serial Number Invalid	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---
	Not Used	---

7.3.5 ANALOG OUTPUT PARAMETER RANGE

Table 7–12: ANALOG OUTPUT PARAMETER RANGE FOR SERIAL PORTS (Sheet 1 of 2)

NO.	ANALOG OUT PARAMETER	RANGE	STEP	UNITS/ SCALE	DEFAULT
0	Not Used	0	0	---	0
1	Phase A Current	0 to 150	1	%	0
2	Phase B Current	0 to 150	1	%	0
3	Phase C Current	0 to 150	1	%	0
4	Neutral Current	0 to 150	1	%	0
5	Average Phase Current	0 to 150	1	%	0
6	Current Unbalance	0 to 1000	1	0.1 x%	0
7	Voltage Van	0 to 200	1	%	0
8	Voltage Vbn	0 to 200	1	%	0
9	Voltage Vcn	0 to 200	1	%	0
10	Voltage Vab	0 to 200	1	%	0
11	Voltage Vbc	0 to 200	1	%	0
12	Voltage Vca	0 to 200	1	%	0
13	Average Phase Voltage	0 to 200	1	%	0
14	Average Line Voltage	0 to 200	1	%	0
15	Voltage Unbalance	0 to 1000	1	0.1 x%	0
16	Frequency	0 to 7500	1	0.01 xHz	0
17	*3 Phase PF	–99 to +99	1	0.01 xPF	0
18	3 Phase kW	–32500 to +32500	1	kW	0
19	3 Phase kvar	–32500 to +32500	1	kvar	0
20	3 Phase kVA	0 to 65400	1	kVA	0
21	3 Phase MW	–32500 to +32500	1	0.1 xMW	0
22	3 Phase Mvar	–32500 to +32500	1	0.1 xMvar	0
23	3 Phase MVA	0 to 65400	1	0.1 xMVA	0
24	*Phase A PF	–99 to +99	1	0.01 xPF	0
25	Phase A kW	–32500 to +32500	1	kW	0
26	Phase A kvar	–32500 to +32500	1	kvar	0
27	Phase A kVA	0 to 65400	1	kVA	0
28	*Phase B PF	–99 to +99	1	0.01 xPF	0
29	Phase B kW	–32500 to +32500	1	kW	0
30	Phase B kvar	–32500 to +32500	1	kvar	0
31	Phase B kVA	0 to 65400	1	kVA	0
32	*Phase C PF	–99 to +99	1	0.01 xPF	0
33	Phase C kW	–32500 to +32500	1	kW	0
34	Phase C kvar	–32500 to +32500	1	kvar	0
35	Phase C kVA	0 to 65400	1	kVA	0
36	3 Phase +kWh Used	0 to 65400	1	kWh	0
37	3 Phase +kvarh Used	0 to 65400	1	kvarh	0

* Due to the fact that –0 and +0 both exist for power factor, the value stored in the PQM serial register is the opposite of the value shown on the display.
Example: If the range 0.23 lead (–0.23) to 0.35 lag (+0.35) is required, –77 (–100+23)and +65 (100–35) must be sent.

Table 7–12: ANALOG OUTPUT PARAMETER RANGE FOR SERIAL PORTS (Sheet 2 of 2)

NO.	ANALOG OUT PARAMETER	RANGE	STEP	UNITS/ SCALE	DEFAULT
38	3 Phase -kWh Used	0 to 65400	1	kWh	0
39	3 Phase -kvarh Used	0 to 65400	1	kvarh	0
40	3 Phase kVAh Used	0 to 65400	1	kVAh	0
41	Phase A Current Demand	0 to 7500	1	A	0
42	Phase B Current Demand	0 to 7500	1	A	0
43	Phase C Current Demand	0 to 7500	1	A	0
44	Neutral Current Demand	0 to 7500	1	A	0
45	3 Phase kW Demand	–32500 to +32500	1	kW	0
46	3 Phase kvar Demand	–32500 to +32500	1	kvar	0
47	3 Phase kVA Demand	0 to 65400	1	kVA	0
48	3 Phase Current THD	0 to 1000	1	0.1 × %	0
49	Three Phase Voltage THD	0 to 1000	1	0.1 × %	0
50	Phase A Current THD	0 to 1000	1	0.1 × %	0
51	Phase B Current THD	0 to 1000	1	0.1 × %	0
52	Phase C Current THD	0 to 1000	1	0.1 × %	0
53	Voltage Van THD	0 to 1000	1	0.1 × %	0
54	Voltage Vbn THD	0 to 1000	1	0.1 × %	0
55	Voltage Vcn THD	0 to 1000	1	0.1 × %	0
56	Voltage Vab THD	0 to 1000	1	0.1 × %	0
57	Voltage Vbc THD	0 to 1000	1	0.1 × %	0
58	Neutral Current THD	0 to 1000	1	0.1 × %	0
59	Serial Control	–32500 to +32500	1	---	0

* Due to the fact that –0 and +0 both exist for power factor, the value stored in the PQM serial register is the opposite of the value shown on the display.
Example: If the range 0.23 lead (–0.23) to 0.35 lag (+0.35) is required, –77 (–100+23)and +65 (100–35) must be sent.

8.1.1 DEVICE PROFILE DOCUMENT

The communications port configured as a DNP slave port must support the full set of features listed in the Level 2 DNP V3.00 Implementation (DNP-L2) described in Chapter 2 of the subset definitions.

DNP 3.0 DEVICE PROFILE DOCUMENT	
Vendor Name: General Electric Power Management Inc.	
Device Name: PQM Power Quality Meter	
Highest DNP Level Supported: For Requests: Level 2 For Responses: Level 2	Device Function: ☐ Master ☒ Slave
Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table): none	
Maximum Data Link Frame Size (octets): Transmitted: 249 Received: 292	Maximum Application Fragment Size (octets): Transmitted: 2048 Received: 2048
Maximum Data Link Re-tries: ☒ None ☐ Fixed ☐ Configurable	Maximum Application Layer Re-tries: ☒ None ☐ Configurable
Requires Data Link Layer Confirmation: ☒ Never ☐ Always ☐ Sometimes ☐ Configurable	
Requires Application Layer Confirmation: ☐ Never ☐ Always ☒ When reporting Event Data ☐ When sending multi-fragment responses ☐ Sometimes ☐ Configurable	
Timeouts while waiting for: Data Link Confirm ☒ None ☐ Fixed ☐ Variable ☐ Configurable Complete Appl. Fragment ☒ None ☐ Fixed ☐ Variable ☐ Configurable Application Confirm ☐ None ☒ Fixed ☐ Variable ☐ Configurable (fixed value is 5000 milliseconds) Complete Appl. Response ☒ None ☐ Fixed ☐ Variable ☐ Configurable Others: (None)	

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DNP 3.0
DEVICE PROFILE DOCUMENT (Continued)

Executes Control Operations:

WRITE Binary Outputs	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
SELECT/OPERATE	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE - NO ACK	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
Count > 1	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Pulse On	☐ Never	☐ Always	☒ Sometimes	☐ Configurable
Pulse Off	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Latch On	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Latch Off	☒ Never	☐ Always	☐ Sometimes	☐ Configurable

- No action is taken if Count is zero
- Queue, Clear, Trip, Close, On-Time, and Off-Time fields are ignored

Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable

Reports Binary Input Change Events when no specific variations requested:
- ☐ Never
- ☒ Only time-tagged
- ☐ Only non-time-tagged
- ☐ Configurable to send both, one or the other

Reports time-tagged Binary Input Change Events when no specific variation requested:
- ☐ Never
- ☒ Binary Input Change With Time
- ☐ Binary Input Change With Relative Time
- ☐ Configurable

Sends Unsolicited Responses:
- ☒ Never
- ☐ Configurable
- ☐ Only certain objects
- ☐ Sometimes
- ☒ ENABLE/DISABLE UNSOLICITED Function codes supported

Sends Static Data in Unsolicited Responses:
- ☒ Never
- ☐ When Device Restarts
- ☐ When Status Flags Change

Default Counter Object/Variation:
- ☐ No Counters Reported
- ☐ Configurable
- ☒ Default Object / Default Variation
- ☐ Point-by-point list attached

Counters Roll Over at:
- ☐ No Counters Reported
- ☐ Configurable
- ☒ 16 Bits
- ☒ 32 Bits
- ☐ Other Value
- ☐ Point-by-point list attached

Sends Multi-Fragment Responses: ☐ Yes ☒ No

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8.1.2 IMPLEMENTATION TABLE

The table below lists all objects recognized and returned by the PQM. Additional information provided on the following pages includes lists of the default variations and defined point numbers returned for each object.

DNP IMPLEMENTATION TABLE						
OBJECT			REQUEST		RESPONSE	
OBJ	VAR	DESCRIPTION	FUNC CODES	QUAL CODES (hex)	FUNC CODES	QUAL CODES (hex)
1	0	Binary Input - All Variations	1	06		
1	1	Binary Input	1	00, 01, 06	129	00, 01
1	2	Binary Input With Status (Note 6)	1	00, 01, 06	129	00, 01
2	0	Binary Input Change - All Variations	1	06, 07, 08		
2	1	Binary Input Change Without Time	1	06, 07, 08	129	17, 28
2	2	Binary Input Change With Time	1	06, 07, 08	129	17, 28
10	0	Binary Output - All Variations	1	06		
10	2	Binary Output Status	1	00, 01, 06	129	00, 01
12	1	Control Relay Output Block	3, 4, 5, 6	17, 28	129	17, 28
20	0	Binary Counter - All Variations	1, 7, 8, 9,10	06, 07, 08	129	00. 01
20	5	32-Bit Binary Counter Without Flag	1, 7, 8, 9, 10	06, 07, 08	129	00. 01
20	6	16-Bit Binary Counter Without Flag	1, 7, 8, 9, 10	06, 07, 08	129	00. 01
21	0	Frozen Counter - All Variations	1	06, 07, 08	129	00. 01
21	9	32-Bit Frozen Counter Without Flag	1	06, 07, 08	129	00. 01
21	10	16-Bit Frozen Counter Without Flag	1	06, 07, 08	129	00. 01
30	0	Analog Input - All Variations	1	06		
30	1	32-Bit Analog Input With Flag	1	00, 01, 06	129	00, 01
30	2	16-Bit Analog Input With Flag	1	00, 01, 06	129	00, 01
30	3	32-Bit Analog Input Without Flag	1	00, 01, 06	129	00, 01
30	4	16-Bit Analog Input Without Flag	1	00, 01, 06	129	00, 01
32	0	Analog Input Change - All Variations	1	06, 07, 08		
32	1	32-Bit Analog Input Change without Time	1	06, 07, 08	129	17, 28
32	2	16-Bit Analog Input Change without Time	1	06, 07, 08	129	17, 28
32	3	32-Bit Analog Input Change with Time	1	06, 07, 08	129	17, 28
32	4	16-Bit Analog Input Change with Time	1	06, 07, 08	129	17, 28
50	1	Time and Date	1, 2	07 (Note 1)	129	07
60	1	Class 0 Data (Note 2)	1	06	129	
60	2	Class 1 Data (Note 3)	1	06, 07, 08	129	
60	3	Class 2 Data (Note 3)	1	06, 07, 08	129	
60	4	Class 3 Data (Note 3)	1	06, 07, 08	129	
80	1	Internal Indications	2	00 (Note 4)	129	
		No object - Cold Start	13			
		No object - Warm Start (Note 5)	14			
		No object - enable unsolicited (parsed only)	20			
		No object - disable unsolicited (parsed only)	21			
		No object - Delay Measurement	23			

1, 2, 3, 4, 5, 6: see the IMPLEMENATION TABLE NOTES on the following page.

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Implementation Table Notes:

1. For this object, the quantity specified in the request must be exactly 1 as there is only one instance of this object defined in the relay.
2. All static input data known to the relay is returned in response to a request for Class 0. This includes all objects of type 1 (Binary Input) and type 30 (Analog Input).
3. The point tables for Binary Input and Analog Input objects contain a field which defines which event class the corresponding static data has been assigned to.
4. For this object, the qualifier code must specify an index of 7 only.
5. Warm Restart (function code 14) is supported although it is not required by the DNP level 2 specification.
6. Object 1 Variation 1 always indicates ON LINE for all points.

8.1.3 DEFAULT VARIATIONS

The following table specifies the default variation for all objects returned by the relay. These are the variations that will be returned for the object in a response when no specific variation is specified in a request.

DEFAULT VARIATIONS		
Object	**Description**	**Default Variation**
1	Binary Input - Single Bit	1
2	Binary Input Change With Time	2
10	Binary Output Status	2
12	Control Relay Output Block	1
20	16-Bit Binary Counter Without Flag	6
21	16-Bit Frozen Counter Without Flag	10
30	16-Bit Analog Input Without Flag	4
32	16-Bit Analog Input Change Without Time	2

8.1.4 INTERNAL INDICATION BITS

The following internal indication bits are supported:

CHARACTER POSITION	BIT POSITION	DESCRIPTION
0	7	Device Restart -- set when PQM powers up, cleared by writing zero to object 80
0	4	Need Time -- set whenever the PQM has a “CLOCK NOT SET” alarm, cleared by setting the clock
0	1	Class 1 -- indicates that class 1 events are available
0	2	Class 2 -- indicates that class 2 events are available
0	3	Class 3 -- indicates that class 2 events are available
1	3	Buffer Overflow -- generally indicates that the host has not picked up the event data often enough

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8.1.5 BINARY INPUT / BINARY INPUT CHANGE POINT LIST

POINT LIST FOR: BINARY INPUT (OBJECT 01) / BINARY INPUT CHANGE (OBJECT 02)			
INDEX	**DESCRIPTION**	**EVENT CLASS ASSIGNED TO**	**NOTES**
0	Alarm condition(s) active	Class 1	
1	Clock not set	Class 1	Note 1
2	Clock drifting	Class 1	
3	Internal error: ADC reference out of range	Class 1	
4	Internal error: HC705 processor not responding	Class 1	
5	Internal error: switch input circuit fault	Class 1	
6	PQM (display) option installed	Class 1	
7	T20 (4-20 mA transducer) option installed	Class 1	
8	T1 (0-1 mA transducer) option installed	Class 1	
9	C (control) option installed	Class 1	
10	A (power analysis) option installed	Class 1	
11	Switch A closed	Class 1	
12	Switch B closed	Class 1	
13	Switch C closed	Class 1	
14	Switch D closed	Class 1	
15	Alarm relay energized	Class 1	
16	Auxiliary relay 1 energized	Class 1	
17	Auxiliary relay 2 energized	Class 1	
18	Auxiliary relay 3 energized	Class 1	
19	Aux 1 relay LED active	Class 1	
20	Aux 2 relay LED active	Class 1	
21	Aux 3 relay LED active	Class 1	
22	Alarm LED active	Class 1	
23	Program LED active	Class 1	
24	Simulation LED active	Class 1	
25	Alarm relay LED active	Class 1	
26	Self test LED active	Class 1	
27	Aux 1 relay LED solid (not flashing)	Class 1	
28	Aux 2 relay LED solid (not flashing)	Class 1	
29	Aux 3 relay LED solid (not flashing)	Class 1	
30	Alarm LED solid (not flashing)	Class 1	
31	Program LED solid (not flashing)	Class 1	
32	Simulation LED solid (not flashing)	Class 1	
33	Alarm relay LED solid (not flashing)	Class 1	
34	Self test LED solid (not flashing)	Class 1	
35	Alarm active: phase undercurrent	Class 1	
36	Alarm active: phase overcurrent	Class 1	
37	Alarm active: neutral overcurrent	Class 1	
38	Alarm active: undervoltage	Class 1	
39	Alarm active: overvoltage	Class 1	
40	Alarm active: current unbalance	Class 1	

Note 1: This point is also reflected in the corresponding internal indication (IIN) bit in each response header.

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POINT LIST FOR: BINARY INPUT (OBJECT 01) / BINARY INPUT CHANGE (OBJECT 02) (Continued)			
INDEX	**DESCRIPTION**	**EVENT CLASS ASSIGNED TO**	**NOTES**
41	Alarm active: voltage unbalance	Class 1	
42	Alarm active: voltage phase reversal	Class 1	
43	Alarm active: power factor lead alarm 1	Class 1	
44	Alarm active: power factor lead alarm 2	Class 1	
45	Alarm active: power factor lag alarm 1	Class 1	
46	Alarm active: power factor lag alarm 2	Class 1	
47	Alarm active: positive real power	Class 1	
48	Alarm active: negative real power	Class 1	
49	Alarm active: positive reactive power	Class 1	
50	Alarm active: negative reactive power	Class 1	
51	Alarm active: underfrequency	Class 1	
52	Alarm active: overfrequency	Class 1	
53	Alarm active: real power demand	Class 1	
54	Alarm active: reactive power demand	Class 1	
55	Alarm active: apparent power demand	Class 1	
56	Alarm active: phase A current demand	Class 1	
57	Alarm active: phase B current demand	Class 1	
58	Alarm active: phase C current demand	Class 1	
59	Alarm active: Neutral demand	Class 1	
60	Alarm active: switch A	Class 1	
61	Alarm active: switch B	Class 1	
62	Alarm active: switch C	Class 1	
63	Alarm active: switch D	Class 1	
64	Alarm active: internal fault	Class 1	
65	Alarm active: serial COM1 failure	Class 1	
66	Alarm active: serial COM2 failure	Class 1	
67	Alarm active: clock not set	Class 1	
68	Alarm active: parameters not set	Class 1	
69	Alarm active: Pulse input 1	Class 1	
70	Alarm active: current THD	Class 1	
71	Alarm active: voltage THD	Class 1	
72	Alarm active: analog input main	Class 1	
73	Alarm active: analog input alt	Class 1	
74	Alarm active: data log 1	Class 1	
75	Alarm active: data log 2	Class 1	
76	Alarm active: Negative real demand	Class 1	
77	Alarm active: Negative reactive demand	Class 1	
78	Alarm active: Pulse input 2	Class 1	
79	Alarm active: Pulse input 3	Class 1	
80	Alarm active: Pulse input 4	Class 1	
81	Alarm active: Pulse input total	Class 1	
82	Alarm active: Time	Class 1	

Note 1: This point is also reflected in the corresponding internal indication (IIN) bit in each response header.

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8.1.6 BINARY OUTPUT / CONTROL RELAY OUTPUT POINT LIST

POINT LIST FOR: BINARY OUTPUT (OBJECT 10) CONTROL RELAY OUTPUT BLOCK (OBJECT 12)	
INDEX	**DESCRIPTION**
0	Reset
1	Alarm relay on
2	Alarm relay off
3	Auxiliary relay 1 on
4	Auxiliary relay 1 off
5	Auxiliary relay 2 on
6	Auxiliary relay 2 off
7	Auxiliary relay 3 on
8	Auxiliary relay 3 off
9	Display 40 character flash message for 5 seconds (next to useless at the moment, since you have to set up the display message using Modbus)
10	Clear energy values
11	Clear max. demand values
12	Clear min./max current values
13	Clear min./max voltage values
14	Clear min./max power values
15	Clear max. THD values
16	Clear switch input pulse count
17	Clear event record
18	Simulate “SETPOINT” keypress
19	Simulate “ACTUAL” keypress
20	Simulate “RESET” keypress
21	Simulate “STORE” keypress
22	Simulate “MESSAGE UP” keypress
23	Simulate “MESSAGE DOWN” keypress
24	Simulate “MESSAGE LEFT” keypress
25	Simulate “MESSAGE RIGHT” keypress
26	Simulate “VALUE UP” keypress
27	Simulate “VALUE DOWN” keypress

The following restrictions should be observed when using object 12 to control the points listed in the following table.

1. The **Count** field is checked first. If it is zero, the command will be accepted but no action will be taken. If this field is non-zero, the command will be executed exactly once regardless of its value.
2. The **Control Code** field of object 12 is then inspected:

- A NUL Code will cause the command to be accepted without any action being taken.
- A Code of “Pulse On” (1) is valid for all points. This is used to activate the function (e.g., Reset) associated with the point.
- All other Codes are invalid and will be rejected.
- The Queue, Clear, and Trip/Close sub-fields are ignored.

3. The **On Time** and **Off Time** fields are ignored. A ”Pulse On” Code takes effect immediately when received. Thus, the timing is irrelevant.
4. The **Status** field in the response will reflect the success or failure of the control attempt thus:

- A Status of “Request Accepted” (0) will be returned if the command was accepted.
- A Status of “Request not Accepted due to Formatting Errors” (3) will be returned if the **Control Code** field was incorrectly formatted or an invalid Code was present in the command.
- A Status of “Control Operation not Supported for this Point” (4) will be returned in response to a “Latch On” or “Latch Off” command

5. An operate of the Reset, alarm relay on/off or Aux Relay 1-3 on/off points may fail (even if the command is accepted) due to other inputs or conditions (e.g., alarm conditions) existing at the time. To verify the success or failure of an operate of these points it is necessary that the associated Binary Input(s) be examined after the control attempt is performed.
6. When using object 10 to read the status of a Binary Output, a read will always return zero.

8.1.7 POINT LIST FOR ANALOG INPUT/OUTPUT CHANGE

In the following table, the entry in the "Format" column indicates that the format of the associated data point can be determined by looking up the entry in Table 7–11: MEMORY MAP DATA FORMATS on page 7–55. For example, an "F1" format is described in that table as a (16-bit) unsigned value without any decimal places. Therefore, the value read should be interpreted in this manner

Table 8–1: POINT LIST FOR ANALOG INPUT/OUTPUT CHANGE (Sheet 1 of 5)

POINT	MOBUS REG	DESCRIPTION	UNIT / VALUE	DEADBAND	FORMAT CODE	EVENT CLASS ASSIGNED TO
1	1050	Phase CT Primary setpoint [1]	amps	1 unit	F1	3
2	1052	Neutral CT Primary setpoint [1]	amps	1 unit	F1	3
3	1054	VT Ratio setpoint [2]	0.1 x ratio	1 unit	F1	3
4	1055	VT Nominal Secondary Voltage setpoint	volts	1 unit	F1	3
5	-	VT Nominal Phase-to-Phase Voltage [3] (VT Ratio x Nominal Sec. adjusted for wye or delta)	32-bit volts	1 unit	F3	3
6	-	VT Nominal Phase-to-Neutral Voltage (VT Ratio x Nominal Sec. adjusted for wye or delta)	32-bit volts	1 unit	F3	3
7	-	Nominal Single-Phase VA[4] (VT Nominal Pri. x Phase CT Pri.)	32-bit VA	1 unit	F3	3
8	-	Nominal Three-Phase VA (VT Nominal Pri. x Phase CT Pri. x 3)	32-bit VA	1 unit	F3	3
9	0240	Phase A Current	1000ths of nominal A	20 units	F1	1
10	0241	Phase B Current	1000ths of nominal	20 units	F1	1
11	0242	Phase C Current	1000ths of nominal	20 units	F1	1
12	0243	Average Current	1000ths of nominal	20 units	F1	1
13	0244	Neutral Current	1000ths of nominal	20 units	F1	1
14	0245	Current Unbalance	tenths of 1 percent	10 units	F1	2
15	0280	Voltage Van	1000ths of nominal V	20 units	F3	1
16	0282	Voltage Vbn	1000ths of nominal V	20 units	F3	1
17	0284	Voltage Vcn	1000ths of nominal V	20 units	F3	1
18	0286	Average Phase Voltage	1000ths of nominal V	20 units	F3	1
19	0288	Voltage Vab	1000ths of nominal V	20 units	F3	1
20	028A	Voltage Vbc	1000ths of nominal V	20 units	F3	1
21	028C	Voltage Vca	1000ths of nominal V	20 units	F3	1
22	028E	Average Line Voltage	1000ths of nominal	20 units	F3	1
23	0290	Voltage Unbalance	0.1 x %	10 units	F1	2
24	02F0	3 Phase Real Power	1000ths of nominal VA	20 units	F4	2
25	02F2	3 Phase Reactive Power	1000ths of nominal VA	20 units	F4	2
26	02F4	3 Phase Apparent Power	1000ths of nominal VA	20 units	F3	2

see footnote explanations at the end of the table

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Table 8–1: POINT LIST FOR ANALOG INPUT/OUTPUT CHANGE (Sheet 2 of 5)

POINT	MOBUS REG	DESCRIPTION	UNIT / VALUE	DEADBAND	FORMAT CODE	EVENT CLASS ASSIGNED TO
27	02F6	3 Phase Power Factor	%	5 units	F2	2
28	02F7	Phase A Real Power	1000ths of nominal	20 units	F4	3
29	02F9	Phase A Reactive Power	1000ths of nominal	20 units	F4	3
30	02FB	Phase A Apparent Power	1000ths of nominal	20 units	F3	3
31	02FD	Phase A Power Factor	%	5 units	F2	3
32	02FE	Phase B Real Power	1000ths of nominal	20 units	F4	3
33	0300	Phase B Reactive Power	1000ths of nominal	20 units	F4	3
34	0302	Phase B Apparent Power	1000ths of nominal	20 units	F3	3
35	0304	Phase B Power Factor	%	5 units	F2	3
36	0305	Phase C Real Power	1000ths of nominal	20 units	F4	3
37	0307	Phase C Reactive Power	1000ths of nominal	20 units	F4	3
38	0309	Phase C Apparent Power	1000ths of nominal	20 units	F3	3
39	030B	Phase C Power Factor	%	5 units	F2	3
40	0400	Phase A Current Demand	1000ths of nominal	20 units	F1	3
41	0401	Phase B Current Demand	1000ths of nominal	20 units	F1	3
42	0402	Phase C Current Demand	1000ths of nominal	20 units	F1	3
43	0403	Neutral Current Demand	1000ths of nominal	20 units	F1	3
44	0404	3 Phase Real Power Demand	1000ths of nominal	20 units	F4	3
45	0406	3 Phase React Power Demand	1000ths of nominal	20 units	F4	3
46	0408	3 Phase Apparent Power Demand	1000ths of nominal	20 units	F3	3
47	0440	Frequency	0.01x Hz	.05 Hz	F1	1
48	0458	Main/Alternate Analog Input	Unit varies -- 32 bits	10	F3	2
49	0470	Ia Crest Factor	0.001 x CF	-	F1	-
50	0471	Ib Crest Factor	0.001 x CF	-	F1	-
51	0472	Ic Crest Factor	0.001 x CF	-	F1	-
52	0473	Ia Transformer Harmonic Derating Factor	0.01 x THDF	-	F1	-
53	0474	Ib Transformer Harmonic Derating Factor	0.01 x THDF	-	F1	-
54	0475	Ic Transformer Harmonic Derating Factor	0.01 x THDF	-	F1	-
55	0478	Phase A Current THD	0.1 x %	5.0%	F1	3
56	0479	Phase B Current THD	0.1 x %	5.0%	F1	3
57	047A	Phase C Current THD	0.1 x %	5.0%	F1	3
58	047B	Neutral Current THD	0.1 x %	5.0%	F1	3
59	047C	Voltage Van THD	0.1 x %	5.0%	F1	3
60	047D	Voltage Vbn THD	0.1 x %	5.0%	F1	3
61	047E	Voltage Vcn THD	0.1 x %	5.0%	F1	3
62	047F	Voltage Vab THD	0.1 x %	5.0%	F1	3

see footnote explanations at the end of the table

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Table 8–1: POINT LIST FOR ANALOG INPUT/OUTPUT CHANGE (Sheet 3 of 5)

POINT	MOBUS REG	DESCRIPTION	UNIT / VALUE	DEADBAND	FORMAT CODE	EVENT CLASS ASSIGNED TO
63	0480	Voltage Vbc THD	0.1 x %	5.0%	F1	3
64	0481	Voltage Vca THD	0.1 x %	5.0%	F1	3
65	04B4	Average Current THD	0.1 x %	5.0%	F1	3
66	04B5	Average Voltage THD	0.1 x %	5.0%	F1	3
67	0246	Phase A Current - Minimum	1000ths of nominal A	1 unit	F1	3
68	0247	Phase B Current - Minimum	1000ths of nominal A	1 unit	F1	3
69	0248	Phase C Current - Minimum	1000ths of nominal A	1 unit	F1	3
70	0249	Neutral Current - Minimum	1000ths of nominal A	1 unit	F1	3
71	024A	Current Unbalance - Minimum	tenths of 1 percent	1 unit	F1	3
72	024B	Phase A Current - Maximum	1000ths of nominal A	1 unit	F1	3
73	024C	Phase B Current - Maximum	1000ths of nominal A	1 unit	F1	3
74	024D	Phase C Current - Maximum	1000ths of nominal A	1 unit	F1	3
75	024E	Neutral Current - Maximum	1000ths of nominal A	1 unit	F1	3
76	024F	Current Unbalance - Maximum	tenths of 1 percent	1 unit	F1	3
77	0291	Voltage Van - Minimum	1000ths of nominal V	1 unit	F3	3
78	0293	Voltage Vbn - Minimum	1000ths of nominal V	1 unit	F3	3
79	0295	Voltage Vcn - Minimum	1000ths of nominal V	1 unit	F3	3
80	0297	Voltage Vab - Minimum	1000ths of nominal V	1 unit	F3	3
81	0299	Voltage Vbc - Minimum	1000ths of nominal V	1 unit	F3	3
82	029B	Voltage Vca - Minimum	1000ths of nominal V	1 unit	F3	3
83	029D	Voltage Unbalance - Minimum	0.1 x %	1 unit	F1	3
84	029E	Voltage Van - Maximum	1000ths of nominal V	1 unit	F3	3
85	02A0	Voltage Vbn - Maximum	1000ths of nominal V	1 unit	F3	3
86	02A2	Voltage Vcn - Maximum	1000ths of nominal V	1 unit	F3	3
87	02A4	Voltage Vab - Maximum	1000ths of nominal V	1 unit	F3	3
88	02A6	Voltage Vbc - Maximum	1000ths of nominal V	1 unit	F3	3
89	02A8	Voltage Vca - Maximum	1000ths of nominal V	1 unit	F3	3
90	02AA	Voltage Unbalance - Maximum	0.1 x %	1 unit	F1	3
91	030C	3 Phase Real Power - Minimum	1000ths of nominal W	1 unit	F4	3
92	030E	3 Phase Reactive Power Minimum	1000ths of nominal kvar	1 unit	F4	3
93	0310	3 Phase Apparent Power Minimum	1000ths of nominal VA	1 unit	F3	3
94	0312	3 Phase Power Factor - Minimum	%	1 unit	F2	3
95	0313	3 Phase Real Power - Maximum	1000ths of nominal	1 unit	F4	3
96	0315	3 Phase Reactive Power Maximum	1000ths of nominal	1 unit	F4	3
97	0317	3 Phase Apparent Power Maximum	1000ths of nominal	1 unit	F3	3
98	0319	3 Phase Power Factor - Maximum	%	1 unit	F2	3
99	031A	Phase A Real Power - Minimum	1000ths of nominal	1 unit	F4	3

see footnote explanations at the end of the table

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Table 8–1: POINT LIST FOR ANALOG INPUT/OUTPUT CHANGE (Sheet 4 of 5)

POINT	MOBUS REG	DESCRIPTION	UNIT / VALUE	DEADBAND	FORMAT CODE	EVENT CLASS ASSIGNED TO
100	031C	Phase A Reactive Power Minimum	1000ths of nominal	1 unit	F4	3
101	031E	Phase A Apparent Power Minimum	1000ths of nominal	1 unit	F3	3
102	0220	Phase A Power Factor - Minimum	%	1 unit	F2	3
103	0321	Phase A Real Power - Maximum	1000ths of nominal	1 unit	F4	3
104	0323	Phase A Reactive Power Maximum	1000ths of nominal	1 unit	F4	3
105	0325	Phase A Apparent Power Maximum	1000ths of nominal	1 unit	F3	3
106	0327	Phase A Power Factor Maximum	%	1 unit	F2	3
107	0328	Phase B Real Power Minimum	1000ths of nominal	1 unit	F4	3
108	032A	Phase B Reactive Power Minimum	1000ths of nominal	1 unit	F4	3
109	032C	Phase B Apparent Power Minimum	1000ths of nominal	1 unit	F3	3
110	032E	Phase B Power Factor Minimum	%	1 unit	F2	3
111	032F	Phase B Real Power Maximum	1000ths of nominal	1 unit	F4	3
112	0331	Phase B Reactive Power Maximum	1000ths of nominal	1 unit	F4	3
113	0333	Phase B Apparent Power Maximum	1000ths of nominal	1 unit	F3	3
114	0335	Phase B Power Factor Maximum	%	1 unit	F2	3
115	0336	Phase C Real Power Minimum	1000ths of nominal	1 unit	F4	3
116	0338	Phase C Reactive Power Minimum	1000ths of nominal	1 unit	F4	3
117	033A	Phase C Apparent Power - Minimum	1000ths of nominal	1 unit	F3	3
118	033C	Phase C Power Factor Minimum	%	1 unit	F2	3
119	033D	Phase C Real Power Maximum	1000ths of nominal	1 unit	F4	3
120	033F	Phase C Reactive Power Maximum	1000ths of nominal	1 unit	F4	3
121	0341	Phase C Apparent Power Maximum	1000ths of nominal	1 unit	F3	3
122	0343	Phase C Power Factor Maximum	%	1 unit	F2	3
123	040A	Phase A Current Demand Maximum	1000ths of nominal	1 unit	F1	3
124	040B	Phase B Current Demand Maximum	1000ths of nominal	1 unit	F1	3
125	040C	Phase C Current Demand Maximum	1000ths of nominal	1 unit	F1	3
126	040D	Neutral Current Demand Maximum	1000ths of nominal	1 unit	F1	3
127	040E	3 Phase Real Power Dmd Max	1000ths of nominal	1 unit	F4	3
128	0410	3 Phase React Power Dmd Max	1000ths of nominal	1 unit	F4	3
129	0412	3 Phase Apparent Power Dmd Max	1000ths of nominal	1 unit	F3	3
130	0441	Frequency Minimum	0.01x Hz	.01 Hz	F1	3
131	0442	Frequency Maximum	0.01x Hz	.01 Hz	F1	3
132	0482	Phase A Current THD - Maximum	0.1 x %	1 unit	F1	3
133	0483	Phase B Current THD - Maximum	0.1 x %	1 unit	F1	3
134	0484	Phase C Current THD - Maximum	0.1 x %	1 unit	F1	3
135	0485	Neutral Current THD - Maximum	0.1 x %	1 unit	F1	3
136	0486	Voltage Van THD - Maximum	0.1 x %	1 unit	F1	3

see footnote explanations at the end of the table

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Table 8–1: POINT LIST FOR ANALOG INPUT/OUTPUT CHANGE (Sheet 5 of 5)

POINT	MOBUS REG	DESCRIPTION	UNIT / VALUE	DEADBAND	FORMAT CODE	EVENT CLASS ASSIGNED TO
137	0487	Voltage Vbn THD - Maximum	0.1 x %	1 unit	F1	3
138	0488	Voltage Vcn THD - Maximum	0.1 x %	1 unit	F1	3
139	0489	Voltage Vab THD - Maximum	0.1 x %	1 unit	F1	3
140	048A	Voltage Vbc THD - Maximum	0.1 x %	1 unit	F1	3
141	048B	Voltage Vca THD - Maximum	0.1 x %	1 unit	F1	3
142	04C8	ADC Reference	-	20 units	F1	2
143	04C9	Power Loss Fine Time	10 ms	1 unit	F1	2
144	04CA	Power Loss Coarse Time	0.1 min.	1 unit	F1	2
145	04CB	Current Key Press	-	1 unit	F8[5]	2
146	04CC	Internal Fault Error Code	-	1 unit	F108	2
147	0000	Multilin Product Device Code	always 65	-	F1	-
148	0001	Hardware Version Code	-	-	F5	-
149	0002	Main Software Version Code	-	-	F1	-
150	0003	Modification File Number 1	-	-	F1	-
151	0004	Boot Software Version Code	-	-	F1	-
152	0005	Supervisor Processor Version Code	-	-	F1	-
153	0007	Modification File Number 2	-	-	F1	-
154	0008	Modification File Number 3	-	-	F1	-
155	0009	Modification File Number 4	-	-	F1	-
156	000A	Modification File Number 5	-	-	F1	-
157	0020	Serial Number Character 1 and 2	-	-	F10	-
158	0021	Serial Number Character 3 and 4	-	-	F10	-
159	0022	Serial Number Character 5 and 6	-	-	F10	-
160	0023	Serial Number Character 7 and 8	-	-	F10	-
161	0030	Manufacture Month/Day	-	-	F24	-
162	0031	Manufacture Year	-	-	F25	-
163	0032	Calibration Month/Day	-	-	F24	-
164	0033	Calibration Year	-	-	F25	-
see footnote explanations at the end of the table						

1. This point is used to reconstruct neutral current values from the 1,000ths per-unit quantities given in the other points. Multiply the particular point by this one, and divide by 1000 to get amps.
2. The VT Ratio setpoint is always reported, but is not used if a direct (i.e., without VTs) voltage wiring scheme is configured. In this case the VT Ratio setpoint is ignored, and a ratio of 1.0:1 is used in the PQM.
3. This point is used to reconstruct voltage values from the 1,000ths per-unit quantities given in the other points. Multiply the particular point by this one, and divide by 1000 to get volts. Since some SCADA systems don't read 32 bit values, you can also multiply the VT ratio and nominal secondary (both of which are 16 bit) in the master in cases where the nominal primary may exceed 32767 volts.
4. This point is used to reconstruct power values from the 1,000ths per-unit quantities given in the other points. Multiply the particular point by this one, and divide by 1000 to get VA, kW or kvar.
5. In Modbus, the current keypress is reported with format code F6. In order to fit the value into a sixteen-bit signed value, F8 is used in DNP, with ASCII zero (49 decimal) returned when no key is pressed.

8.1.8 POINT LIST FOR COUNTERS

Point list for: Binary Counters (object 20)
Frozen Counters (object 21)
Counter Change Event (object 22)
Frozen Counter Events (object 23)

Point Num	Modbus Register	Description	Unit	Deadband	Format code	Event class point assigned to
0	0450	Pulse Input 1	-	-	F3	-
1	0452	Pulse Input 2	-	-	F3	-
2	0454	Pulse Input 3	-	-	F3	-
3	0456	Pulse Input 4	-	-	F3	-
4	0460	Totalized Pulse Input	-	-	F3	-
5	03D0	3 Phase Positive Real Energy Used	kWh	-	F3	-
6	03D2	3 Phase Negative Real Energy Used	kWh	-	F3	-
7	03D4	3 Phase Positive React. Energy Used	kvarh	-	F3	-
8	03D6	3 Phase Negative React. Energy Used	kvarh	-	F3	-
9	03D8	3 Phase Apparent Energy Used	kVAh	-	F3	-
10	03DA	3 Phase Energy Used in Last 24 h	kWh	-	F3	-
11	03DC	3 Phase Energy Cost Since Reset	cents	-	F3	-
12	03DE	3 Phase Energy Cost Per Day	cents	-	F3	-

NOTE

Only counter points 0 to 4 can be cleared using function codes 9 and 10, and doing so disturbs the totals presented on the display and via Modbus communications. In general, the binary output points which clear data should be used if it is necessary to clear any of these counters.

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Table 9–1: PQM SETPOINTS (Sheet 1 of 11)

S1 PQM SETUP	
PREFERENCES	
DEFAULT MESSAGE TIME	min.
DEFAULT MESSAGE BRIGHTNESS	%
DISPLAY FILTER CONSTANT	
SETPOINT ACCESS	
SETPOINT ACCESS	
ENTER SETPOINT ACCESS CODE	
SETPOINT ACCESS ON FOR	min.
CHANGE ACCESS CODE	
ENTER NEW ACCESS CODE	
RE-ENTER NEW ACCESS CODE	
ENCRYPTED ACCESS CODE	
COM 1 RS485 PORT	
MODBUS COMM ADDRESS	
COM 1 BAUD RATE	baud
COM 1 PARITY	
COM 2 RS485 PORT	
COM 2 BAUD RATE	baud
COM 2 PARITY	
FRONT PANEL RS232 PORT	
RS232 BAUD RATE	baud
RS232 PARITY	
DNP 3.0 CONFIGURATION	
DNP PORT	
DNP SLAVE ADDRESS	
DNP TURNAROUND TIME	ms
CLOCK	
SET TIME hh:mm:ss	
SET TIME mm:dd:yyyy	
CALCULATION PARAMETERS	
EXTRACT FUNDAMENTAL	
CURRENT DEMAND TYPE	
CURRENT DEMAND TIME INTERVAL	min.
POWER DEMAND TYPE	
POWER DEMAND TIME INTERVAL	min.

Table 9–1: PQM SETPOINTS (Sheet 2 of 11)

S1 PQM SETUP continued	
ENERGY COST PER kWh	cents
TARIFF PERIOD 1 START TIME	min.
TARIFF PERIOD 1 COST PER kWh	cents
TARIFF PERIOD 2 START TIME	min.
TARIFF PERIOD 2 COST PER kWh	cents
TARIFF PERIOD 3 START TIME	min.
TARIFF PERIOD 3 COST PER kWh	cents
EVENT RECORDER	
EVENT RECORDER OPERATION	
TRACE MEMORY	
TRACE MEMORY USAGE	cycles
TRACE MEMORY TRIGGER MODE	
Ia OVERCURRENT TRIG LEVEL	% CT
Ib OVERCURRENT TRIG LEVEL	% CT
Ic OVERCURRENT TRIG LEVEL	% CT
In OVERCURRENT TRIG LEVEL	% CT
Va OVERVOLTAGE TRIG LEVEL	% nominal
Vb OVERVOLTAGE TRIG LEVEL	% nominal
Vc OVERVOLTAGE TRIG LEVEL	% nominal
Va UNDERVOLTAGE TRIG LEVEL	% nominal
Vb UNDERVOLTAGE TRIG LEVEL	% nominal
Vc UNDERVOLTAGE TRIG LEVEL	% nominal
SWITCH INPUT A TRIG	
SWITCH INPUT B TRIG	
SWITCH INPUT C TRIG	
SWITCH INPUT D TRIG	
TRACE MEMORY TRIGGER DELAY	cycles
TRACE MEMORY TRIGGER RELAY	
PROGRAMMABLE MESSAGE	
PROGRAMMABLE MESSAGE NAME	

Table 9–1: PQM SETPOINTS (Sheet 3 of 11)

S2 SYSTEM SETUP	
CURRENT/VOLTS CONFIGURATION	
PHASE CT WIRING	
PHASE CT PRIMARY	A
NEUTRAL CURRENT SENSING	
NEUTRAL CT PRIMARY	A
VT WIRING	
VT RATIO	
VT NOMINAL SEC VOLTAGE	V
NOMINAL DIRECT INPUT VOLTAGE	V
NOMINAL SYSTEM FREQUENCY	Hz
ANALOG OUTPUT 1	
ANALOG OUTPUT RANGE	mA
ANALOG OUT 1 MAIN	
MAIN 4 mA VALUE	
MAIN 20 mA VALUE	
ANALOG OUTPUT 1 ALT	
ALT 4 mA VALUE:	
ALT 20 mA VALUE	
ANALOG OUTPUT 2	
ANALOG OUT 2 MAIN	
MAIN 4 mA VALUE	
MAIN 20 mA VALUE	
ANALOG OUTPUT 2 ALT	
ALT 4 mA VALUE	
ALT 20 mA VALUE	
ANALOG OUTPUT 3	
ANALOG OUT 3 MAIN	
MAIN 4 mA VALUE	
MAIN 20 mA VALUE	
ANALOG OUTPUT 3 ALT	
ALT 4 mA VALUE	
ALT 20 mA VALUE	

Table 9–1: PQM SETPOINTS (Sheet 4 of 11)

S2 SYSTEM SETUP continued	
ANALOG OUTPUT 4	
ANALOG OUT 4 MAIN	
MAIN 4 mA VALUE	
MAIN 20 mA VALUE	
ANALOG OUTPUT 4 ALT	
ALT 4 mA VALUE	
ALT 20 mA VALUE	
ANALOG INPUT	
ANALOG IN MAIN/ALT SELECT RELAY	
ANALOG IN MAIN NAME	
ANALOG IN MAIN UNITS	
MAIN 4 mA VALUE	
MAIN 20 mA VALUE	
ANALOG IN MAIN RELAY	
ANALOG IN MAIN LEVEL	
ANALOG IN MAIN DELAY	sec.
ANALOG IN ALT NAME	
ANALOG IN ALT UNITS	
ALT 4 mA VALUE	
ALT 20 mA VALUE	
ANALOG IN ALT RELAY	
ANALOG IN ALT LEVEL	
ANALOG IN ALT DELAY	sec.
SWITCH INPUT A	
SWITCH A NAME	
SWITCH A FUNCTION	
SWITCH A ACTIVATION	
SWITCH A TIME DELAY	sec.
SWITCH INPUT B	
SWITCH B NAME	
SWITCH B FUNCTION	
SWITCH B ACTIVATION	
SWITCH B TIME DELAY	sec.

Table 9–1: PQM SETPOINTS (Sheet 5 of 11)

S2 SYSTEM SETUP continued	
SWITCH INPUT C	
SWITCH C NAME	
SWITCH C FUNCTION	
SWITCH C ACTIVATION	
SWITCH C TIME DELAY	sec.
SWITCH INPUT D	
SWITCH D NAME	
SWITCH D FUNCTION	
SWITCH D ACTIVATION	
SWITCH D TIME DELAY	sec.
PULSE OUTPUT	
POS kWh PULSE OUTPUT RELAY	
POS kWh PULSE OUTPUT INTERVAL	kWh
NEG kWh PULSE OUTPUT RELAY	
NEG kWh PULSE OUTPUT INTERVAL	kWh
POS kvarh PULSE OUTPUT RELAY	
POS kvarh PULSE OUTPUT INTERVAL	kvarh
NEG kvarh PULSE OUTPUT RELAY	
NEG kvarh PULSE OUTPUT INTERVAL	kvarh
kVAh PULSE OUTPUT RELAY	
kVAh PULSE OUTPUT INTERVAL	kVAh
PULSE WIDTH	
PULSE INPUT	
PULSE INPUT UNITS	
PULSE INPUT 1 VALUE	
PULSE INPUT 2 VALUE	
PULSE INPUT 3 VALUE	
PULSE INPUT 4 VALUE	
PULSE INPUT ADDITION	

Table 9–1: PQM SETPOINTS (Sheet 6 of 11)

S3 OUTPUT RELAYS	
ALARM RELAY	
ALARM OPERATION	
ALARM ACTIVATION	
AUXILIARY RELAY 1	
AUX1 OPERATION	
AUX1 ACTIVATION	
AUXILIARY RELAY 2	
AUX2 OPERATION	
AUX2 ACTIVATION	
AUXILIARY RELAY 3	
AUX3 OPERATION	
AUX3 ACTIVATION	

Table 9–1: PQM SETPOINTS (Sheet 7 of 11)

S4 ALARMS/CONTROL	
CURRENT/VOLTAGE	
DETECT I/V ALARMS USING PERCENT	
PHASE UNDERCURRENT RELAY	
PHASE UNDERCURRENT LEVEL	A
PHASE UNDERCURRENT DELAY	sec.
DETECT UNDERCURRENT WHEN 0 A	
PHASE OVERCURRENT RELAY	
PHASE OVERCURRENT LEVEL	A
PHASE OVERCURRENT DELAY	sec.
PHASE OVERCURRENT ACTIVATION	
NEUTRAL OVERCURRENT RELAY	
NEUTRAL OVERCURRENT LEVEL	A
NEUTRAL OVERCURRENT DELAY	sec.
UNDERVOLTAGE RELAY	
UNDERVOLTAGE LEVEL	V
UNDERVOLTAGE DELAY	sec.
PHASES REQ'D FOR U/V OPERATION	
DETECT UNDERVOLTAGE BELOW 20 V	
OVERVOLTAGE RELAY	
OVERVOLTAGE LEVEL	V
OVERVOLTAGE DELAY	sec.
PHASES REQ'D FOR O/V OPERATION	
CURRENT UNBALANCE RELAY	
CURRENT UNBALANCE LEVEL	%
CURRENT UNBALANCE DELAY	sec.
VOLTAGE UNBALANCE RELAY	
VOLTAGE UNBALANCE LEVEL	%
VOLTAGE UNBALANCE DELAY	sec.
VOLTS PHASE REVERSAL RELAY	
VOLTS PHASE REVERSAL DELAY	sec.

Table 9–1: PQM SETPOINTS (Sheet 8 of 11)

S4 ALARMS/CONTROL continued	
TOTAL HARMONIC DISTORTION	
AVERAGE CURRENT THD RELAY	
AVERAGE CURRENT THD LEVEL	%
AVERAGE CURRENT THD DELAY	sec.
AVERAGE VOLTAGE THD RELAY	
AVERAGE VOLTAGE THD LEVEL	%
AVERAGE VOLTAGE THD DELAY	sec.
FREQUENCY	
UNDERFREQUENCY RELAY	
UNDERFREQUENCY LEVEL	Hz
UNDERFREQUENCY DELAY	sec.
OVERFREQUENCY RELAY	
OVERFREQUENCY LEVEL	Hz
OVERFREQUENCY DELAY	sec.
POWER	
POWER ALARMS LEVEL BASE UNITS	
POSITIVE REAL POWER RELAY	
POSITIVE REAL POWER LEVEL	kW
POSITIVE REAL POWER DELAY	sec.
NEGATIVE REAL POWER RELAY	
NEGATIVE REAL POWER LEVEL	kW
NEGATIVE REAL POWER DELAY	sec.
POSITIVE REACT POWER RELAY	
POSITIVE REACT POWER LEVEL	kvar
POSITIVE REACT POWER DELAY	sec.
NEGATIVE REACT POWER RELAY	
NEGATIVE REACT POWER LEVEL	kvar
NEGATIVE REACT POWER DELAY	sec.

Table 9–1: PQM SETPOINTS (Sheet 9 of 11)

S4 ALARMS/CONTROL continued	
POWER FACTOR	
POWER FACTOR LEAD 1 RELAY	
POWER FACTOR LEAD 1 PICKUP	
POWER FACTOR LEAD 1 DROPOUT	
POWER FACTOR LEAD 1 DELAY	sec.
POWER FACTOR LAG 1 RELAY	
POWER FACTOR LAG 1 PICKUP	
POWER FACTOR LAG 1 DROPOUT	
POWER FACTOR LAG 1 DELAY	sec.
POWER FACTOR LEAD 2 RELAY	
POWER FACTOR LEAD 2 PICKUP	
POWER FACTOR LEAD 2 DROPOUT	
POWER FACTOR LEAD 2 DELAY	sec.
POWER FACTOR LAG 2 RELAY	
POWER FACTOR LAG 2 PICKUP	
POWER FACTOR LAG 2 DROPOUT	
POWER FACTOR LAG 2 DELAY	sec.
DEMAND	
PHASE A CURRENT DMD RELAY	
PHASE A CURRENT DMD LEVEL	A
PHASE B CURRENT DMD RELAY	
PHASE B CURRENT DMD LEVEL	A
PHASE C CURRENT DMD RELAY	
PHASE C CURRENT DMD LEVEL	A
NEUTRAL CURRENT DMD RELAY	
NEUTRAL CURRENT DMD LEVEL	A
3Φ POS REAL POWER DMD RELAY	
3Φ POS REAL POWER DMD LEVEL	kW
3Φ POS REACT POWER DMD RELAY	
3Φ POS REACT POWER DMD LEVEL	kvar
3Φ NEG REAL POWER DMD RELAY	
3Φ NEG REAL POWER DMD LEVEL	kW
3Φ NEG REACT POWER DMD RELAY	
3Φ NEG REACT POWER DMD LEVEL	kvar
3Φ APPARENT POWER DMD RELAY	
3Φ APPARENT POWER DMD LEVEL	kVA

Table 9–1: PQM SETPOINTS (Sheet 10 of 11)

S4 ALARMS/CONTROL continued	
PULSE INPUT	
PULSE INPUT 1 RELAY	
PULSE INPUT 1 LEVEL	units
PULSE INPUT 1 DELAY	sec.
PULSE INPUT 2 RELAY	
PULSE INPUT 2 LEVEL	units
PULSE INPUT 2 DELAY	sec.
PULSE INPUT 3 RELAY	
PULSE INPUT 3 LEVEL	units
PULSE INPUT 3 DELAY	sec.
PULSE INPUT 4 RELAY	
PULSE INPUT 4 LEVEL	units
PULSE INPUT 4 DELAY	sec.
TOTALIZED PULSES RELAY	
TOTALIZED PULSES LEVEL	units
TOTALIZED PULSES DELAY	sec.
TIME	
TIME RELAY	
PICKUP TIME	
DROPOUT TIME	
MISCELLANEOUS	
SERIAL COM1 FAILURE ALARM DELAY	sec.
SERIAL COM2 FAILURE ALARM DELAY	sec.
CLOCK NOT SET ALARM	
DATA LOG 1 MEMORY FULL LEVEL	sec.
DATA LOG 2 MEMORY FULL LEVEL	sec.

Table 9–1: PQM SETPOINTS (Sheet 11 of 11)

S5 TESTING	
TEST RELAYS AND LEDS	
OPERATION TEST	
CURRENT/VOLTAGE SIMULATION	
SIMULATION	
SIMULATION ENABLED FOR	min.
PHASE A CURRENT	A
PHASE B CURRENT	A
PHASE C CURRENT	A
NEUTRAL CURRENT	A
Vax VOLTAGE	V
Vbx VOLTAGE	V
Vcx VOLTAGE	V
PHASE ANGLE	°
ANALOG OUTPUTS SIMULATION	
SIMULATION	
SIMULATION ENABLED FOR	min.
ANALOG OUTPUT 1	%
ANALOG OUTPUT 2	%
ANALOG OUTPUT 3	%
ANALOG OUTPUT 4	%
ANALOG INPUT SIMULATION	
SIMULATION	
SIMULATION ENABLED FOR	min.
ANALOG INPUT	mA
SWITCH INPUTS SIMULATION	
SIMULATION	
SIMULATION ENABLED FOR	min.
SWITCH INPUT A	
SWITCH INPUT B	
SWITCH INPUT C	
SWITCH INPUT D	

APPLICATION NOTE PQMAN01: EVENT RECORDER APPLICATION

The Event Recorder stores all online data in a section of non-volatile memory when triggered by an event. The PQM defines any of the following situations as an event:

- Analog Input Alternate Alarm
- Analog Input Alternate Alarm Clear
- Analog Input Main Alarm
- Analog Input Main Alarm Clear
- Clear Event Record
- Clock Not Set Alarm
- Clock Not Set Alarm Clear
- COM1 Fail Alarm
- COM1 Fail Alarm Clear
- COM2 Fail Alarm
- COM2 Fail Alarm Clear
- Current THD Alarm
- Current THD Alarm Clear
- Current Unbalance Alarm
- Current Unbalance Alarm Clear
- Data Log 1 Alarm
- Data Log 1 Alarm Clear
- Data Log 2 Alarm
- Data Log 2 Alarm Clear
- kVA Demand Alarm
- kVA Demand Alarm Clear
- Negative kvar Alarm
- Negative kvar Alarm Clear
- Negative kvar Demand Alarm
- Negative kvar Demand Alarm Clear
- Negative kW Alarm
- Negative kW Alarm Clear
- Negative kW Demand Alarm
- Negative kW Demand Alarm Clear
- Neutral Current Demand Alarm
- Neutral Current Demand Alarm Clear
- Neutral Overcurrent Alarm
- Neutral Overcurrent Alarm Clear
- Overcurrent Alarm
- Overcurrent Alarm Clear
- Overfrequency Alarm
- Overfrequency Alarm Clear
- Overvoltage Alarm
- Overvoltage Alarm Clear
- Parameters Not Set Alarm
- Parameters Not Set Alarm Clear
- Phase A Current Demand Alarm
- Phase A Current Demand Alarm Clear
- Phase B Current Demand Alarm
- Phase B Current Demand Alarm Clear
- Phase C Current Demand Alarm
- Phase C Current Demand Alarm Clear
- Phase Reversal Alarm
- Phase Reversal Alarm Clear
- Positive kvar Alarm
- Positive kvar Alarm Clear
- Positive kvar Demand Alarm
- Positive kvar Demand Alarm Clear
- Positive kW Alarm
- Positive kW Alarm Clear
- Positive kW Demand Alarm
- Positive kW Demand Alarm Clear
- Power Factor Lag 1 Alarm
- Power Factor Lag 1 Alarm Clear
- Power Factor Lag 2 Alarm
- Power Factor Lag 2 Alarm Clear
- Power Factor Lead 1 Alarm
- Power Factor Lead 1 Alarm Clear
- Power Factor Lead 2 Alarm
- Power Factor Lead 2 Alarm Clear
- Power Off
- Power On
- Pulse Count Total Alarm
- Pulse Input 1 Alarm
- Pulse Input 1 Alarm Clear
- Pulse Input 2 Alarm
- Pulse Input 2 Alarm Clear
- Pulse Input 3 Alarm
- Pulse Input 3 Alarm Clear
- Pulse Input 4 Alarm
- Pulse Input 4 Alarm Clear
- Pulse Input Total Alarm Clear
- Reset
- Self Test Alarm
- Self Test Alarm Clear
- Setpoint Access Enabled
- Switch A Alarm
- Switch A Alarm Clear
- Switch B Alarm
- Switch B Alarm Clear
- Switch C Alarm
- Switch C Alarm Clear
- Switch D Alarm

A

- Switch D Alarm Clear
- Time Alarm
- Time Alarm Clear
- Trace Memory Trigger
- Undercurrent Alarm
- Undercurrent Alarm Clear
- Underfrequency Alarm

Up to 40 events can be stored in non-volatile memory for retrieval and review. The Event Recorder can be enabled, disabled, or cleared via the keypad or serial port. The following data is saved when an event occurs:

- Analog Input (high)
- Analog Input (low)
- Date - Month/Day
- Date - Year
- Event Cause
- Event Number
- Frequency
- I Unbalance
- Ia
- Ia Demand
- Ia THD
- Ib
- Ib Demand
- Ib THD
- Ic
- Ic Demand
- Ic THD
- In
- In Demand
- In THD
- kVAh (high)
- kVAh (low)
- Negative kvarh (high)
- Negative kvarh (low)
- Negative kWh (low)
- Negative kWh (high)
- P3 (high)
- P3 (low)
- P3 Demand (high)
- P3 Demand (low)
- Pa (high)
- Pa (low)
- Pb (high)
- Pb (low)
- Pc (high)
- Pc (low)
- PF3
- PFa
- PFb
- PFc
- Positive kvarh (high)
- Positive kvarh (low)
- Positive kWh (high)
- Positive kWh (low)
- Q3 (high)
- Q3 (low)
- Q3 Demand (high)
- Q3 Demand (low)
- Qa (high)
- Qa (low)
- Qb (high)
- Qb (low)
- Qc (high)
- Qc (low)
- S3 (high)
- S3 (low)
- S3 Demand (high)
- S3 Demand (low)
- Sa (low)
- Sa (high)
- Sb (high)
- Sb (low)
- Sc (high)
- Sc (low)
- Switches and Relays States
- Time - Hours/Minutes
- Time - Seconds
- V Unbalance
- Vab (high)
- Vab (low)
- Vab THD
- Van (high)
- Van (low)
- Van THD
- Vbc (high)
- Vbc (low)
- Vbc THD
- Vbn (high)
- Vbn (low)
- Vbn THD
- Vca (high)
- Vca (low)
- Vcn (high)
- Vcn (low)
- Vcn THD

a) ACCESS TO EVENT RECORDER INFORMATION:

There are two ways to access Event Recorder Information:

- Access only the Records and data you wish to view
- Access the entire Event Record.

The Event Recorder is indexed by Event Number (1 to 40). To access a specific Event, the Event Number must be written to the PQM memory map location 12C0h. The data specific to that Event can be read starting at memory map location 0AE0h. The specific Event Number must be known to read the Event Recorder in this fashion. However, this Event Number is usually not known and the entire Event Record must be read. The easiest way to do this is to read the PQM Memory Map location 0AD0h (Total Number of Events Since Last Clear) and loop through each Event Number indicated by the value from 0AD0h, reading the associated data pertaining to each Event. This require from 1 to 40 serial reads of 170 bytes each. Once this data is obtained, it can be interpreted based upon the format of each value as described in Section 7.3: MODBUS MEMORY MAP. It is important to note that some memory map parameters are 32 bits (4 bytes) long and require 2 registers to contain their value, one for the two high bytes and one for the two low bytes.

A.1.2 INTERFACING USING HYPERTERMINAL

APPLICATION NOTE PQMAN02: INTERFACING WITH THE PQM USING HYPERTERMINAL

When upgrading firmware, the PQM may appear to lockup if there is an interruption on the communication port during the upload process. If the PQM does not receive the necessary control signals for configuration during firmware upload, it could remain in a halted situation until reinitialized. The steps used by PQMPC to upload firmware to the PQM are as follows:

1. Prepare the PQM for firmware upgrade by saving setpoints to a file.
2. Erase the flash memory and verify it to be blank.
3. Upload the new firmware.
4. Verify the CRC when upload is complete.
5. Run the new code.

If the PQM is interrupted prior to erasing the flash memory, it could be halted in a mode where the display will read:

```
PQM FLASH LOADER
ENTER TEXT "LOAD"
```

If the computer being used to upload firmware has a screen saver enabled, and the screen saver operates during the upload process, the communication port will be interrupted during the launch of the screen saver. *It is recommended to disable any screen saver prior to firmware upload*.

There are two ways to alleviate this condition: one is to cycle power to the PQM; the second is to interface with the PQM using a terminal program, such as Hyperterminal, and perform the upload process manually.

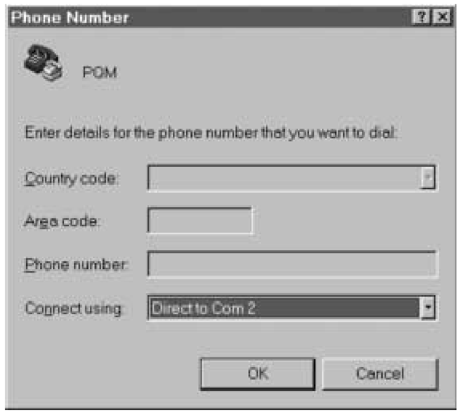
a) CYCLING POWER

Remove and then re-apply control power to the PQM. The PQM should then run the existing firmware in its flash memory. If the PQM does not run the firmware in flash memory, attempt the second method using Hyperterminal.

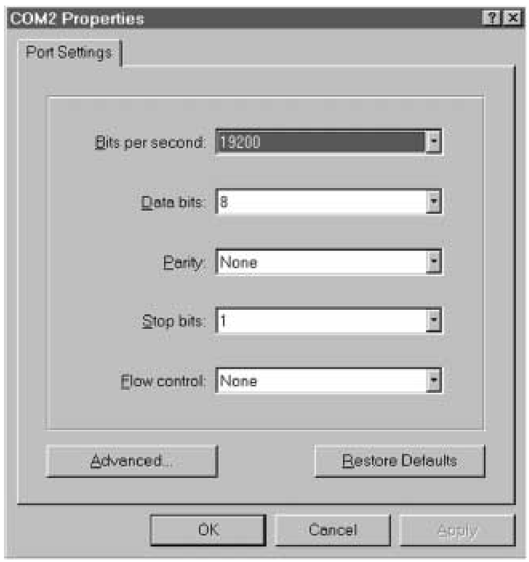
b) HYPERTERMINAL

1. Hyperterminal is a terminal interface program supplied with Microsoft Windows. Run the program “hypertrm.exe” which is usually located in the Accessories folder of your PC.
2. A Connection Description window will appear asking for a name, use a name such as PQM for the connection and click on OK.

3. The following window appears.



4. Select the communications port of your PC that is connected to the PQM and click on OK.
5. The following window appears next.



6. Change the settings in the Properties window to match those shown above, and click on OK. You should now have a link to the PQM. Enter the text LOAD in uppercase in the text window of Hyperterminal.

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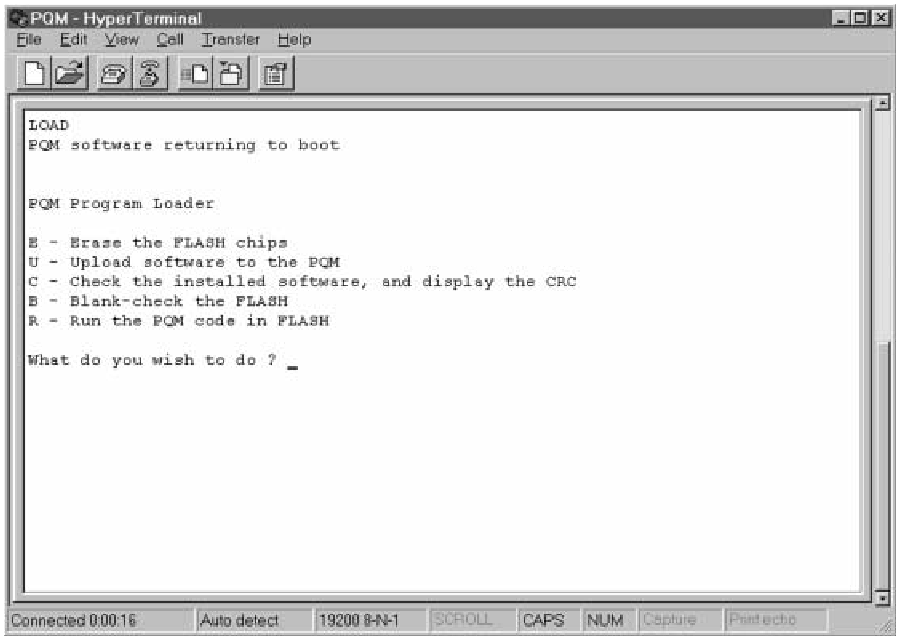
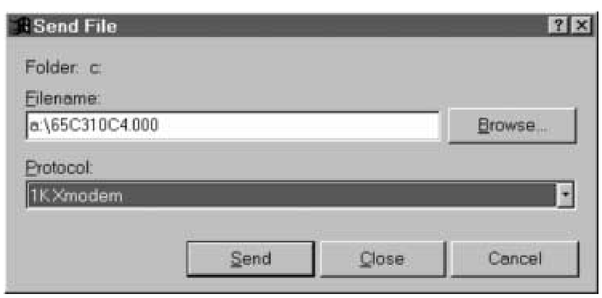
7. The PQM Boot Menu should appear in the text window.



8. Type “E” to Erase the PQM flash memory.
9. The PQM verify that you wish to erase the flash memory; enter “Y” for yes. The Boot Menu appears again when complete.
10. Now select “B” to blank check the flash memory; the PQM Boot Menu will appear again when complete.
11. Type “U” to upload software to the PQM. The PQM is now waiting for you to send a firmware file. Select “Transfer” and then “Send File” on the Hyperterminal task bar and the following window will appear.



12. Enter the location and the name of the firmware file you wish to send to the PQM, and ensure the Protocol is **1KXmodem**, and click on **Send**. The PQM will now proceed to receive the firmware file, this usually takes 3 to 4 minutes. When complete the Boot Menu will again appear.
13. Type “C” to check the installed firmware, and then type “R” to run the flash. If the CRC check is bad, erase the flash and re-install the firmware. If numerous bad CRC checks are encountered, it is likely that the file you are attempting to load is corrupted. Obtain a new file and try again. If attempts to use Hyperterminal are unsuccessful, consult the factory.

APPLICATION NOTE PQMAN03: PQM PHASORS IMPLEMENTATION

The purpose of the function Calc_Phasors within the PQM firmware is to take a digitally sampled periodic signal and generate the equivalent phasor representation of the signal. In the conventional sense, a phasor depicts a purely sinusoidal signal which is what we're interested in here; we wish to calculate the phasor for a given signal at the fundamental power system frequency. The following Discrete Fourier Series equations calculate the phasor in rectangular co-ordinates for an arbitrary digitally sampled signal. The justification for the equations is beyond the *scope* of this document but can be found in some form in any text on signal analysis.

$$\mathrm{Re}(g) = \frac{2}{n}\sum_{n=0}^{N-1} g_n \cdot \cos(\omega_0 nT)\ ;\quad \mathrm{Im}(g) = \frac{2}{n}\sum_{n=0}^{N-1} g_n \cdot \sin(\omega_0 nT)$$

where: $\mathrm{Re}(g)$ = Real component of phasor
$\mathrm{Im}(g)$ = Imaginary component of phasor
g = Set of N digital samples = $\{g_0, g_1,..., g_{N-1}\}$
g_n = nth sample from g
N = Number of samples
f_0 = Fundamental frequency in Hertz
$\omega_0 = 2\pi f_0$ = Angular frequency in radians
$T = 1/(f_0 N)$ = Time between samples

The PQM Trace Memory feature is employed to calculate the phasors. The Trace Memory feature samples 16 times per cycle for two cycles for all current and voltage inputs. Substituting $N = 16$ (samples/cycle) into the equations yields the following for the real and imaginary components of the phasor:

$$\mathrm{Re}(g) = \frac{1}{8}\left(g_0\cos 0 + g_1\cos\frac{\pi}{8} + g_2\cos\frac{2\pi}{8} + \ldots + g_{31}\cos\frac{31\pi}{8}\right)$$

$$\mathrm{Im}(g) = \frac{1}{8}\left(g_0\sin 0 + g_1\sin\frac{\pi}{8} + g_2\sin\frac{2\pi}{8} + \ldots + g_{31}\sin\frac{31\pi}{8}\right)$$

The number of multiples in the above equation can be reduced by using the symmetry inherent in the sine and cosine functions which is illustrated as follows:

$$\begin{aligned}
\cos\phi &= -\cos(\pi-\phi) = -\cos(\pi+\phi) = \cos(2\pi-\phi)\\
\sin\phi &= \sin(\pi-\phi) = -\sin(\pi+\phi) = -\sin(2\pi-\phi)\\
\cos\phi &= \sin\left(\frac{\pi}{2}-\phi\right)
\end{aligned}$$

Let $k_1 = \cos(\pi/8)$, $k_2 = \cos(\pi/4)$, $k_3 = \cos(3\pi/8)$; the equations for the real and imaginary components are reduced to:

$$\begin{aligned}
\mathrm{Re}(g) = \frac{1}{8}(&k_1(g_1 - g_7 - g_9 + g_{15} + g_{17} - g_{23} - g_{25} + g_{31}) + k_2(g_2 - g_6 - g_{10} + g_{14} + g_{18} - g_{22} - g_{26} + g_{30}) +\\
&k_3(g_3 - g_5 - g_{11} + g_{13} + g_{19} - g_{21} - g_{27} + g_{29}) + (g_0 - g_8 + g_{16} - g_{24}))
\end{aligned}$$

$$\begin{aligned}
\mathrm{Im}(g) = \frac{1}{8}(&k_1(g_3 + g_5 - g_{11} - g_{13} + g_{19} + g_{21} - g_{27} - g_{29}) + k_2(g_2 + g_6 - g_{10} - g_{14} + g_{18} + g_{22} - g_{26} - g_{30}) +\\
&k_3(g_1 + g_7 - g_9 - g_{15} + g_{17} + g_{23} - g_{25} - g_{31}) + (g_4 - g_{12} + g_{20} - g_{28}))
\end{aligned}$$

The number of subtractions can be reduced between the calculations of real and imaginary components by not repeating the same subtraction twice. The following subtractions are repeated:

$$\Delta_0 = g_0 - g_8 \qquad \Delta_1 = g_1 - g_9 \qquad \Delta_2 = g_2 - g_{10} \qquad \Delta_3 = g_3 - g_{11}$$

$$\Delta_4 = g_4 = g_{12} \qquad \Delta_5 = g_5 - g_{13} \qquad \Delta_6 = g_6 - g_{14} \qquad \Delta_7 = g_7 - g_{15}$$

$$\Delta_8 = g_{16} - g_{24} \qquad \Delta_9 = g_{17} - g_{25} \qquad \Delta_{10} = g_{18} - g_{26} \qquad \Delta_{11} = g_{19} - g_{27}$$

$$\Delta_{12} = g_{20} - g_{28} \qquad \Delta_{13} = g_{21} - g_{29} \qquad \Delta_{14} = g_{22} - g_{30} \qquad \Delta_{15} = g_{23} - g_{31}$$

Substituting in the above 'delta' values results in the form of the equations that will be used to calculate the phasors:

$$\mathrm{Re}(g) = \frac{1}{8}(\Delta_0 + \Delta_8 + k_1(\Delta_1 - \Delta_7 + \Delta_9 - \Delta_{15}) + k_3(\Delta_3 - \Delta_5 + \Delta_{11} - \Delta_{13}))$$

$$\mathrm{Im}(g) = \frac{1}{8}(\Delta_4 + \Delta_{12} + k_1(\Delta_3 + \Delta_5 + \Delta_{11} + \Delta_{13}) + k_2(\Delta_1 + \Delta_7 + \Delta_9 + \Delta_{15}))$$

APPLICATION NOTE PQMAN04: TRIGGERED TRACE MEMORY RESOLUTION

The Triggered Trace Memory can be used to detect and record system disturbances. The PQM uses a dedicated continuous sampling rate of 16 samples per cycle to record fluctuations in voltage or current as per user defined levels. The PQM calculates the true RMS value of one consecutive cycle, or 16 samples, and compares this value with the user-defined trigger levels to determine if it will record all sampled waveforms. The sampled waveforms include Ia, Ib, Ic, In, Va, Vb and Vc.

The PQM uses the following method to calculate the true RMS value of all sampled waveforms

$$\text{TrueRMS} = \sqrt{\frac{1}{n}\sum_{1 \to n} V_n^2}$$

where: n = the number of samples
V = the sampled waveform

To find the minimum disturbance that the PQM can detect, we first solve for the magnitude of any one sample. Deriving from the RMS calculation above, we have:

$$V_k = \sqrt{n \cdot \text{TrueRMS}^2 - \left(\sum_{1 \to k-1} V_{k-1}^2 + \sum_{1 \to k+1} V_{k+1}^2 \right)}$$

where: n = the number of samples
V = the sampled waveform
k = the sample to be extracted

The PQM Triggered Trace Memory has a minimum step value of 1% on the user defined level. Therefore, we find the minimum magnitude of any sample that can be detected. Using the individual sample equation above:

$$V_{k2} = \sqrt{n \cdot (0.99 \cdot \text{TrueRMS})^2 - \left(\sum_{1 \to k-1} V_{k-1}^2 + \sum_{1 \to k+1} V_{k+1}^2 \right)}$$

where: n = the number of samples
k = the sample number to be extracted
V_{k2} = the calculated value of the extracted sample that deflects the overall value of the RMS calculation by 1%

Knowing this, we can conclude that any individual sample that is equal to V_{k2} in the array of the 16 samples evaluated by the PQM is the minimum disturbance that can be detected by the Triggered Trace Memory. The PQM uses the fundamental RMS value based on the VT Secondary setpoint as the reference for the user-defined Trace Memory trigger levels.

The minimum duration of a disturbance is determined by the sample rate. At 16 samples per cycle, the time between samples is based upon the system frequency and is determined as follows:

$$t_s = \frac{1/f}{16}$$

where: t_s = the time between samples
f = the system frequency as determined by the PQM metering functions

The PQM can determine frequencies from 20 to 80 Hz. Therefore, the minimum duration of a detectable disturbance is 0.783 ms at 80 Hz. The minimum duration of a detectable disturbance is 3.125 ms at 20 Hz.

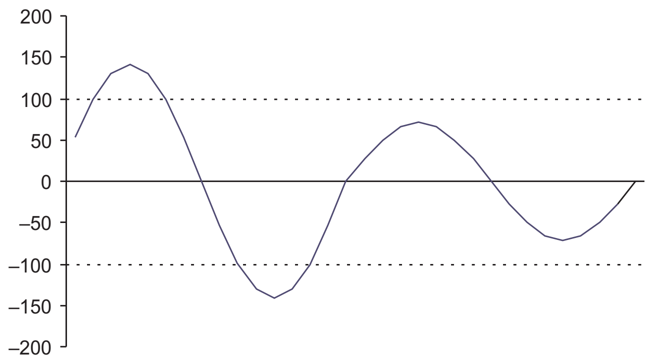
Any sample that deviates from its corresponding reference sample by the amount V_{k2} for a minimum duration as calculated above is detectable by the PQM.

EXAMPLE:

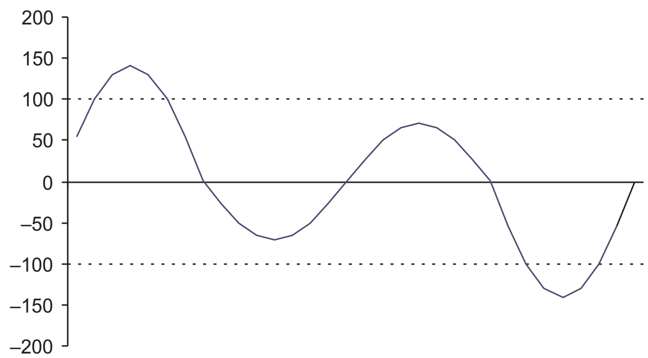
Consider a PQM with a nominal VT secondary voltage of 100 V into the VT inputs. The trace memory trigger for a Phase A undervoltage level of 90 V is enabled with the following setpoints:

S2 SYSTEM SETUP \ CURRENT/VOLTAGE CONFIGURATION \ VT NOMINAL SECONDARY VOLTAGE: 100 V
S1 PQM SETUP \ TRACE MEMORY \ VA UNDERVOLTAGE TRIG LEVEL: 90%

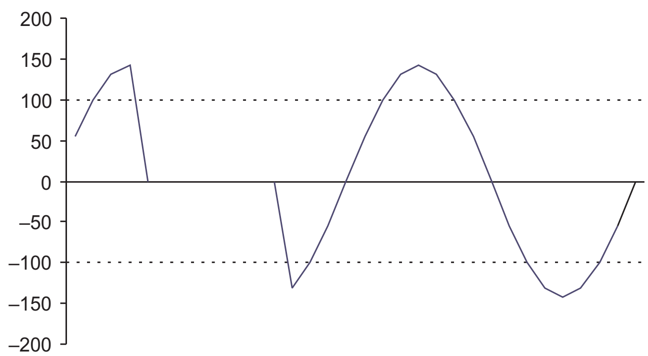
In the waveform below, an undervoltage fault occurs in the second cycle. The first cycle RMS voltage is 100 V; the second cycle RMS voltage is 50 V, triggering the trace memory feature for the settings above.



A centered one cycle undervoltage fault is shown below. In this case, the first cycle RMS voltage is 79.05 V and the second cycle RMS voltage is 79.05 V, triggering the trace memory feature for the settings above.



A half cycle undervoltage fault is shown below. In this case, the first cycle RMS voltage is 70.07 V and the second cycle RMS voltage is 100 V, triggering the trace memory feature for the settings above.



APPLICATION NOTE PQMAN05: PULSE OUTPUT APPLICATION

Up to 4 SPDT Form C output relays are configurable as Pulse Initiators based on energy quantities calculated by the PQM. Variables to consider when using the PQM as a Pulse Initiator are:

- PQM Pulse Output Parameter
- PQM Pulse Output Interval
- PQM Pulse Output Width
- PQM Output Relay Operation
- Pulse Acceptance Capability of the end receiver
- Type of Pulse Receiver
- Maximum Energy Consumed over a defined interval

1. **PQM Pulse Output Parameter**: The PQM activates the assigned output relay based upon the energy quantity used as the base unit for pulse initiation. These energy quantities include ±kWhr, ±kVARh, and kVAh.
2. **PQM Pulse Output Interval**: The PQM activates the assigned output relay at the accumulation of each Pulse Output Interval as defined by the user. This interval is based upon system parameters such that the PQM pulse output activates at a rate not exceeding the Pulse Acceptance Capability of the end receiver.
3. **PQM Pulse Output Width**: This user defined parameter defines the duration of the pulse initiated by the PQM when a quantity of energy equal to the Pulse Output Interval has accumulated. It is based upon system parameters such that the PQM pulse output will activate for a duration that is within the operating parameters of the end receiver.
4. **PQM Output Relay Operation**: This user defined parameter defines the normal state of the PQM output relay contacts, i.e. Fail-safe or Non-Failsafe.
5. **Pulse Acceptance Capability of the end Receiver**: This parameter is normally expressed as any one of the following: (a) Pulses per Demand Interval; (b) Pulses per second, minute or hour; (c) Minimum time between successive closures of the contacts.
6. **Type of Pulse Receiver**: There are 4 basic types of Pulse receivers: a) Three-wire, every pulse counting; b) Three-wire, every other pulse counting; c) Two-wire, Form A normally open, counts only each contact closure; d) Two-wire, counts every state change, i.e. recognizes both contact closure and contact opening.
7. **Maximum Energy Consumed over a defined interval**: This is based upon system parameters and defines the maximum amount of energy that may be accumulated over a specific time.

Application of the PQM Pulse Output Relays to an End Receiver Using KYZ Terminals:

Typical end receivers require a contact closure between KY or KZ based upon the type of receiver. The PQM Pulse Output feature can be used with either two- or three-wire connections. The PQM activates the designated Output Relay at each accumulation of the defined Pulse Output Interval for the defined Pulse Output Width. Therefore, each PQM contact operation represents one interval. For end receivers that count each closure and opening of the output contacts, the PQM Pulse Output Interval should be adjusted to match the registration of the end receiver. For example, if the end receiver counts each closure as 100 kWh and each opening as 100 kWh, the PQM Pulse Output Interval should be set to 50 kWh.

The PQM Output Relays can be configured as Failsafe or Non-Failsafe to match the normally open/closed configuration of the KY and KZ connections at the end receiver. The K connection is always made to the COM connection of the designated PQM output relay, and the Y and Z connections can be made to the N/O or N/C connections based upon the type of end receiver.

A.1.6 DATA LOGGER IMPLEMENTATION

APPLICATION NOTE PQMAN06: DATA LOGGER IMPLEMENTATION

The Data Logger allows various user defined parameters to be continually recorded at a user defined rate. The Data Logger uses 64 samples/cycle data. The PQM has allocated 65536 bytes of memory for Data Log storage. The memory structure is partitioned into 512 blocks containing 64 × 2 byte registers as shown below:

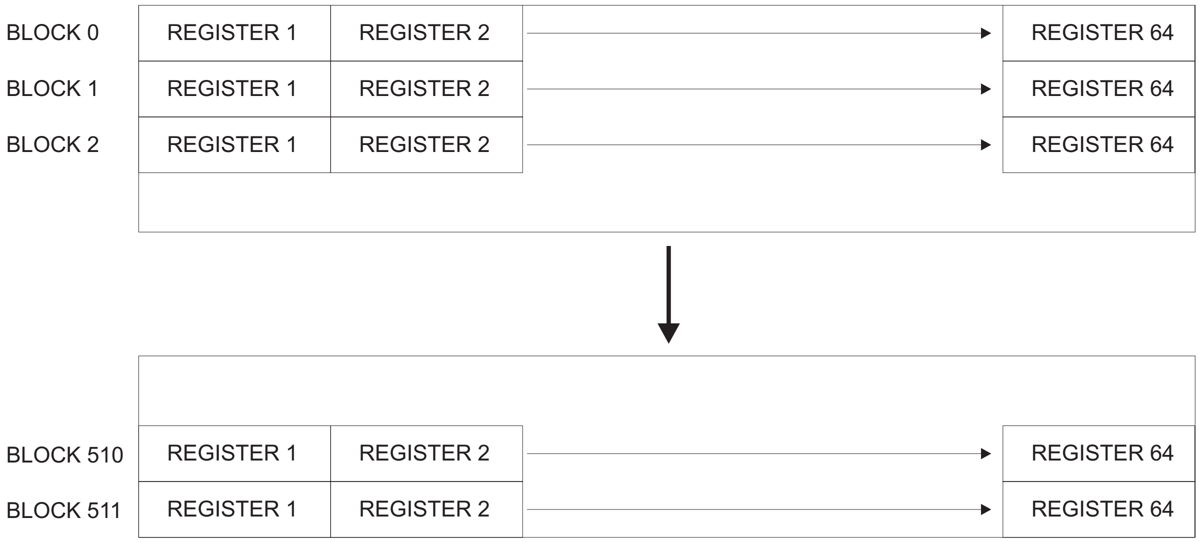


Figure A–1: DATA LOGGER MEMORY STRUCTURE

Each entry into the Data Log is called a Record. The Record can vary in size depending upon the parameters the user wishes to log. The memory structure can also be partitioned into 2 separate Data Logs. The 2 logs can be user defined in size, or can be optimized by PQMPC. The top of each Data Log contains what is called the Header. Each Data Log Header contains the following information…

- **Log Time Interval**: This is the user defined interval at which the data log will store entries
- **Present Log Time and Date**: This is the time and date of the most recent Record
- **Log Start Address**: This is the start address for the beginning of the logged data
- **Log Record Size**: This is the size of each Record entry into the Data Log based upon the user defined Data Log structure
- **Log Total Records**: This is the total number of records available based upon the user defined Data Log parameter structure
- **Log Pointer to First Item of First Record**: This is a pointer to the first record in the Data Log
- **Log Pointer to First Item of Record After Last**: This is a pointer to the next record to be written into the Data Log
- **Log Status**: This reports the current status of the Data Log; i.e.: Running or Stopped
- **Log Records Used**: This is the number of records that have been written into the Data Log
- **Log Time Remaining Until Next Reading**: This is a counter showing how much time remains until the next record is to be written into the Data Log

The Data Logger has 2 modes of operation, **Run to Fill** and **Circulate**. In the Run to Fill mode, the Data Log will stop writing records into the memory structure when there is not enough memory to add another record. Depending on the size of each record, the Data Log may not necessarily use the entire 65536 bytes of storage available. In the Circulate mode, the Data Log will continue to write new Records into the Log beyond the last available Record space. The Log will overwrite the first Record after the Header and continue to overwrite the Records to follow until the user wishes to stop logging data. The Log will act as a rolling window of data in time, going back in time as far as the amount of records times the Log Time Interval will allow in the total space of memory available.

a) ACCESSING THE DATA LOG INFORMATION

The Data Log can be accessed in two ways: using PQMPC via the serial port. Access via PQMPC is as described in Chapter 6: SOFTWARE. Access is manually via the serial port as follows:

- Set the Block of data you wish to access at 1268h in the PQM Memory Map
- Read the required amount of data from the 64 Registers in the Block

Accessing the Data Log in this manner assumes that the user knows which Block they wish to access, and knows the size of each Record based upon the parameters they have selected to log.

The easiest way to access the data in the Data Log is to read the entire log and export this data into a spreadsheet for analysis (this is the method incorporated by PQMPC). This requires defining the Block to be read, starting at Block 0, and reading all 128 bytes of data in each of the 64 Registers within the Block. You would then define Blocks 1,2,3 etc. and repeat the reading of the 64 Registers for each block, until Block 511. This requires 512 reads of 128 bytes each. The data can then be interpreted based upon the parameter configuration.

b) INTERPRETING THE DATA LOG INFORMATION

Using 2 Data Logs in the Run to Fill mode, the Data Log is configured as follows:

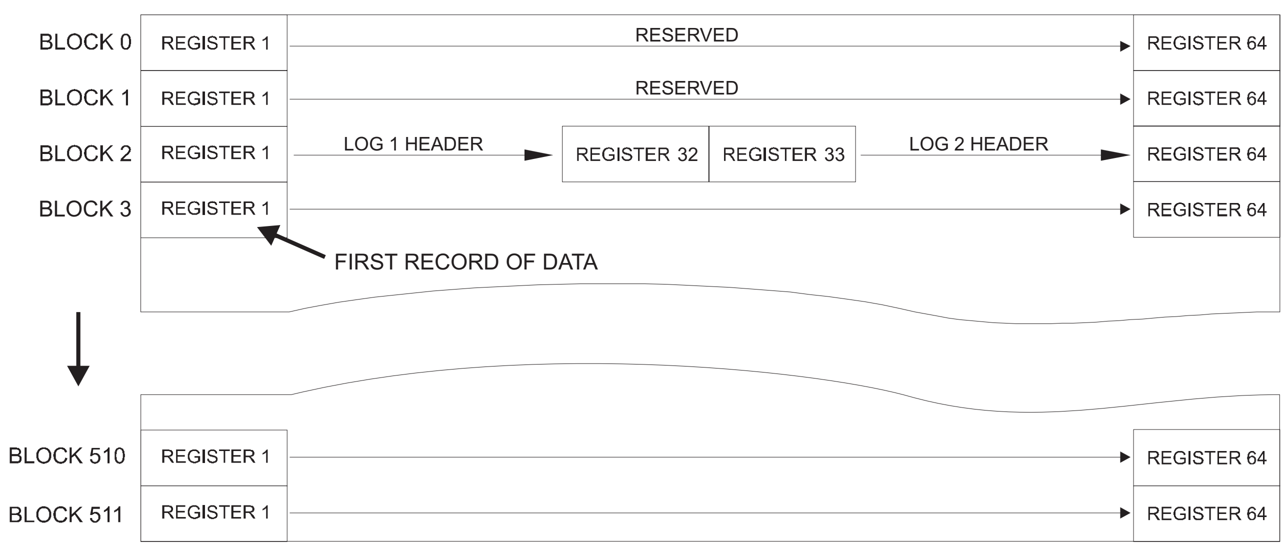


Figure A–2: DATA LOG CONFIGURATION

Blocks 0 and 1 are reserved for Data Logger Data Interval information. Block 2 contains the Header information for both Data Logs. The first 32 registers of Block 2 are reserved for Data Log 1 Header Information, and the remaining 32 registers of Block 2 are reserved for Data Log 2 Header Information. The first register of Data Log information resides at Register 1 of Block 3. This leaves 65152 bytes of storage for data.

The location of the first Record in Log 2 will depend upon the Log configuration. Its location is determined by reading the Log 2 Header value for Log Start Address at location 0AAEh in the memory map and performing a calculation. The Log Start Address is a value from 0 to 65535 representing the first byte of the first Record within the Data Log memory structure. Add 1 to this number and then divide this number by 64 (number of Records in a Block). Then divide this number by 2 (number of bytes in a record), and truncate the remainder of

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the division to determine the Block number. Multiplying the remainder of the division by 64 will determine the Register number. For example, if the Log Start Address was 34235, then the Block and Register numbers containing the first record of Log 2 are:

Block Number = (34235 + 1) / 64 / 2 = 267.46875

Therefore, Block Number 267 contains the starting record.

Record Number = 0.46875 × 64 = 30

Therefore, Register Number 30 contains the first byte of Log 2 data

This location will always be the starting address for Data Log 2 for the given configuration. Adding or deleting parameters to the configuration will change the Log 2 Starting Address.

The Data Logs will use the maximum amount of memory available, minus a 1 record buffer, based upon the user configuration. For Example, if the Record Size for a given configuration was 24 bytes, and there were 40 bytes of memory left in the memory structure, the Data Logger will not use that last 40 bytes, regardless of the mode of operation. The Data Logger uses the following formula to determine the total record space available…

Total Space = (65152 / Record Size) – 1

As in the example, the total space calculated would be 65152 / 24 – 1 = 2713.67. This equates to 2713 records with 40 bytes of unused memory at the end of Block 511. The total amount of space used in the structure can also be found in the Log Header in the Log Total Records field.

When the Data Log is configured for **Circulate** mode of operation, the memory structure is the same as for Run to Fill mode. To read the Log data, you must use the Log Starting Address, Log Record Size, and Log Total Records information from each of the Log Headers. The Log Starting Address for Log 2 can be determined as shown in the previous calculation for Run to Fill mode. The total space occupied in the memory structure by either log is determined by multiplying the Log Total Records by the Log Record Size and adding this value to the Log Starting Address. It is important to note that the Log Starting Address is always referenced to the first Register of Block 0, or the first byte of the Data Log memory structure.

Once you have separated the Data Log data from the Headers, you will then need to interpret the data into a structured format. Each Record is comprised of user-defined parameters. These parameters are implemented into the user-defined structure in a specific order based upon selection into either, or both, Data Log(s). Address 1270h in the PQM Memory Map is the Holding Register for the first available parameter for use by the Data Logs. The Data Logs will place the user-selected parameters into their respective Record structures based upon their respective order in the PQM Memory Map. For example, if Positive kWh, Frequency and Current Unbalance were selected to be measured parameters, they would be placed into the Record structure in the following order:

Unbalance	2 bytes	(16 bit value)
Frequency	2 bytes	(16 bit value)
Positive kWh	4 bytes	(32 bit value)

The DATA LOG PARAMETERS table on the following page illustrates the order of parameters and their size.

Therefore, the Record size would be 8 bytes. To put a time value associated with each Record, you must read the Log Time and Date from the Header. This is the time of the last Record in the Log. To time stamp the first Record used, multiply the Log Time Interval by the Log Records Used and subtract this number from the time associated with the last Record. To determine the time associated with any Record, add the Log Time Interval times the Record to be read to the time associated with the first Record in the Log.

For example:

Log Time Interval:	3600
Log Time - Hours/Minutes:	02 30
Log Time - Seconds:	30300

Log Date - Month:	06 15
Log Date - Year:	1997
Log Records Used:	1600

The last Record entry time is interpreted as 2:30 AM, 30.300 seconds, June 15, 1997. The Log Time Interval is 3600 seconds, or 1 hour. Taking the Log Records Used (1600) and multiplying this by the Log Time Interval(3600) gives 5760000 seconds. This translates into 66 days and 16 hours. Subtracting backwards on a calendar from the time for the last Record gives a time and date of 10:30:30.000AM, April 9, 1997. This is the time stamp for the first Record. Time stamping the remaining Records requires adding 3600 seconds for each Record starting from the time associated with the first Record. It is important to note that when in the Circulate mode, and the Data Log fills the available memory, the Log wraps around the first available Register of the memory structure and the Log Pointer to First Item of First Record will float along in time with each additional entry into the Log. For example, if the Data Log has wrapped around the available memory more than once, the Log Pointer to First Item of First Record will always be preceded in memory by the Log Pointer to First Item of Record After Last. As each new entry is written into the Log, these two pointers move down to the next record space in memory, overwriting the first entry into the log as of the Present Log Time and Date.

c) DATA LOG PARAMETERS

Listed below are the parameters available for capturing data via the Data Logger. Note that these parameters will be placed within the Record structure of the Data Log in the order and size that they appear in this table.

Table A–1: DATA LOG PARAMETERS

DATA LOG PARAMETER	SIZE (BYTES)
Ia	2
Ib	2
Ic	2
Iavg	2
In	2
I Unbalance	2
Van	4
Vbn	4
Vcn	4
Vpavg	4
Vab	4
Vbc	4
Vca	4
Vlavg	4
V Unbalance	2
Pa	4
Qa	4
Sa	4

DATA LOG PARAMETER	SIZE (BYTES)
PFa	2
Pb	4
Qb	4
Sb	4
PFb	2
Pc	4
Qc	4
Sc	4
PFc	2
P3	4
Q3	4
S3	4
PF3	2
Frequency	2
Positive kWh	4
Negative kWh	4
Positive kvarh	4
Negative kvarh	4

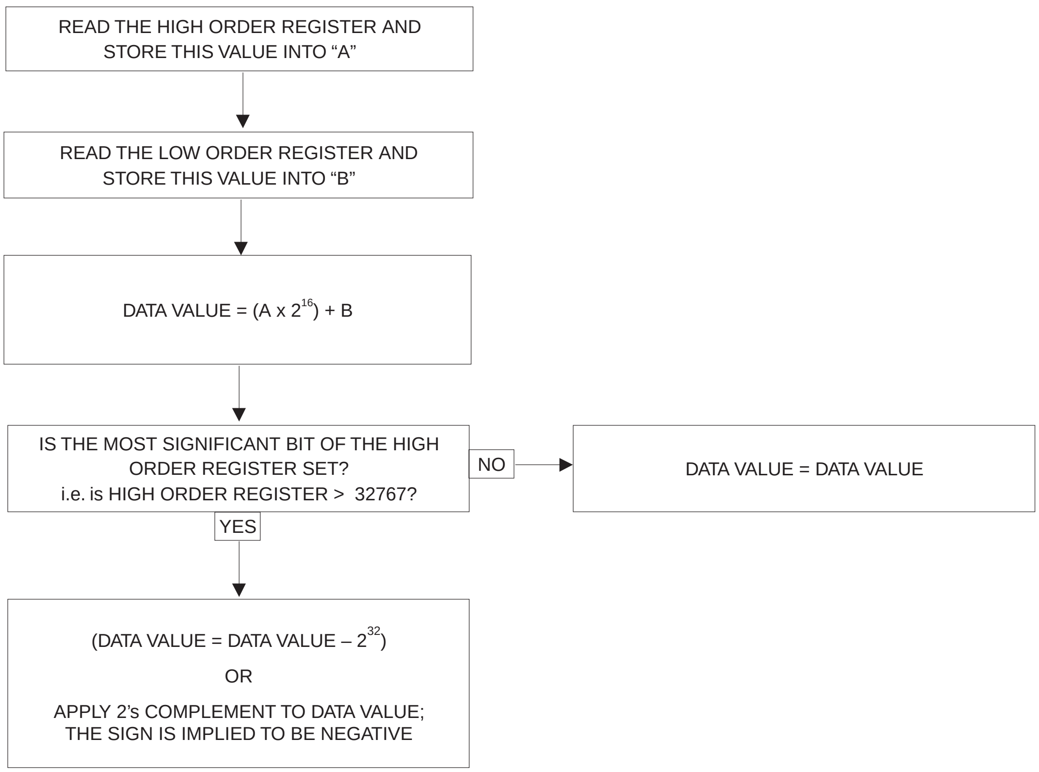
DATA LOG PARAMETER	SIZE (BYTES)
kVAh	4
Ia Demand	2
Ib Demand	2
Ic Demand	2
In Demand	2
P3 Demand	4
Q3 Demand	4
S3 Demand	4
Ia THD	2
Ib THD	2
Ic THD	2
In THD	2
Van THD	2
Vbn THD	2
Vcn THD	2
Vab THD	2
Vbc THD	2
Analog Input	4

where: I = current; V = Voltage; P = Real Power; Q = Reactive Power; S = Apparent Power; PF = Power Factor
THD = Total Harmonic Distortion

A.1.7 READING LONG INTEGERS FROM MEMORY MAP

APPLICATION NOTE PQMAN08: READING LONG INTEGER VALUES FROM THE MEMORY MAP

The PQM memory map contains some data which is formatted as a long integer type, or 32 bits. Because the Modbus Protocol maximum register size is 16 bits, the PQM stores long integers in 2 consecutive register locations, 2 high order bytes, and 2 low order bytes. The data can be retrieved by the following logic:



EXAMPLE:

1. Reading a positive 3 Phase Real Power actual value from the PQM:

REGISTER	ACTUAL VALUE (hex)	DESCRIPTION	UNITS & SCALE	FORMAT
02F0	004F	3 Phase Real Power (high)	0.01 x kW	F4
02F1	35D1	3 Phase Real Power (low)	0.01 x kW	F4

2. Following the method described above:

DATA VALUE = (004F $\times$ 2^{16}) + 35D1	hexadecimal
= 5177344 + 13777	converted to decimal
= 5191121	decimal

The most significant bit of the High Order register is not set, therefore the DATA VALUE is as calculated. Applying the Units & Scale parameters to the DATA VALUE, we multiply the DATA VALUE by 0.01 kW. Therefore the resultant value of 3 Phase Real Power as read from the memory map is 51911.21 kW.

3. Reading a negative 3 Phase Real Power actual value from the PQM:

REGISTER	ACTUAL VALUE (hex)	DESCRIPTION	UNITS & SCALE	FORMAT
02F0	FF3A	3 Phase Real Power (high)	0.01 x kW	F4
02F1	EA7B	3 Phase Real Power (low)	0.01 x kW	F4

4. Following the method described above:

   DATA VALUE = (FF3A $\times 2^{16}$) + EA7B — hexadecimal
   = (65338 $\times 2^{16}$) + 60027 — converted to decimal
   = 4282051195 — decimal

5. The most significant bit of the High Order register is set, therefore the DATA VALUE is calculated as:

   DATA VALUE = DATA VALUE – 2^{32}
   = 4282051195 – 4294967296
   = –12916101

Applying the Units & Scale parameters to the DATA VALUE, we multiply the DATA VALUE by 0.01 kW. Therefore the resultant value of 3 Phase Real Power as read from the memory map is –129161.01 kW.

A

A.1.8 PULSE INPUT APPLICATION

APPLICATION NOTE PQMAN09: PULSE INPUT APPLICATION

The PQM has up to 4 Logical Switch Inputs that can be configured as Pulse Input Counters. Variables to consider when using the PQM as a Pulse Input Counter are:

- PQM Switch Input A/B/C/D Function
- PQM Switch Input A/B/C/D Activation
- PQM Switch Input A/B/C/D Name
- PQM Pulse Input (Units)
- PQM Pulse Input A/B/C/D (Value)
- PQM Totalized Pulse Input

1. PQM Switch Input A/B/C/D Function: This parameter defines the functionality to be provided by the PQM Switch Input. For use as a Pulse Input Counter, the PQM Switch Input to be used must be assigned as either Pulse Input 1/2/3 or 4.
2. PQM Switch Input A/B/C/D Activation: This parameter is set to OPEN or CLOSED. The PQM will see the operation of the Switch Input in the state as defined by this parameter.
3. PQM Switch Input A/B/C/D Name: This parameter defines the name given to each of the Switch Inputs used. It is used as a label only and has no bearing on the operation of the Switch Input.
4. PQM Pulse Input (Units): This parameter is the name given to the base units that the PQM Pulse Input(s) will be counting. It is used as a label only and has no bearing on the operation of the Pulse Input.
5. PQM Pulse Input A/B/C/D Value: This is the value assigned to each counting operation as determined by the Switch Input.
6. PQM Totalized Pulse Input: This parameter creates a summing register of the various Pulse Inputs configured. It can be configured for any combination of the PQM Switch Inputs used as Pulse Inputs.

Application of the PQM Pulse Input(s) With a Pulse Initiator Using KYZ Terminals:

Typical end receivers require a contact closure between **KY** or **KZ** based upon the type of receiver. Because of the multi-functional parameters of the PQM Switch Inputs, the PQM Switch Inputs are not labeled with **KYZ** markings as a dedicated pulse input device. However, the PQM can still be used as a pulse counter. The PQM Switch Inputs require a signal from the PQM Switch Common terminal to be activated. The PQM configured as a Pulse Counter can be used with Two-Wire Pulse Initiators. The Pulse Initiator must provide a dry contact operation. The Switch Common terminal of the PQM is connected to the **K** terminal of the Pulse Initiator. The PQM Switch Input assigned to count pulses can be connected to the **Y** or the **Z** terminal of the Pulse Initiator, depending on the operation of the Pulse Initiator, i.e. OPEN or CLOSED. The PQM Pulse Input (Value) must be assigned to match the pulse value of the Pulse Initiator, i.e if the Pulse Initiator delivers a dry contact closure for every 100kWh, the PQM Pulse Input (Value) must also be set to 100.

Various operating parameters with regard to the PQM Switch Inputs must be taken into account. The PQM Switch Inputs require a minimum 100ms operation time to be detected. The duration of the contact operation can be indefinite. The internal Switch Input circuit of the PQM is itself switched on and off at the times when the PQM is reading the status of the Switch Inputs. Monitoring the input to one of the PQM Switch Inputs will reveal a pulsed 24VDC waveform, not a constant signal. Standard wiring practice should be adhered to when making connections to the PQM Switch Inputs, i.e. avoiding long runs of cable along current carrying conductors or any other source of EMI. An induced voltage on the Switch Input can cause malfunction of the Switch Input.

A.1.9 PULSE TOTALIZER APPLICATION

APPLICATION NOTE PQMAN10: PULSE INPUT APPLICATION FOR USE AS A PULSE TOTALIZER

The PQM has up to 4 Logical Switch Inputs that can be configured as Pulse Input Counters. One common application of these Pulse Inputs is their use as an energy totalizer for more than one circuit. One PQM can totalize input from up to 4 different sources and sum these results into a single register. Variables to consider when using the PQM as a Pulse Input Counter are:

- PQM Switch Input A/B/C/D Function
- PQM Switch Input A/B/C/D Activation
- PQM Switch Input A/B/C/D Name
- PQM Pulse Input (Units)
- PQM Pulse Input A/B/C/D (Value)
- PQM Totalized Pulse Input

1. PQM Switch Input A/B/C/D Function: This parameter defines the functionality to be provided by the PQM Switch Input. For use as a Pulse Input Counter, the PQM Switch Input to be used must be assigned as either Pulse Input 1/2/3 or 4.
2. PQM Switch Input A/B/C/D Activation: This parameter is set to OPEN or CLOSED. The PQM will see the operation of the Switch Input in the state as defined by this parameter.
3. PQM Switch Input A/B/C/D Name: This parameter defines the name given to each of the Switch Inputs used. It is used as a label only and has no bearing on the operation of the Switch Input.
4. PQM Pulse Input (Units): This parameter is the name given to the base units that the PQM Pulse Input(s) will be counting. It is used as a label only and has no bearing on the operation of the Pulse Input.
5. PQM Pulse Input A/B/C/D Value: This is the value assigned to each counting operation as determined by the Switch Input.
6. PQM Totalized Pulse Input: This parameter creates a summing register of the various Pulse Inputs configured. It can be configured for any combination of the PQM Switch Inputs used as Pulse Inputs.

Configuring the PQM to Totalize Energy From Multiple Metering Locations:

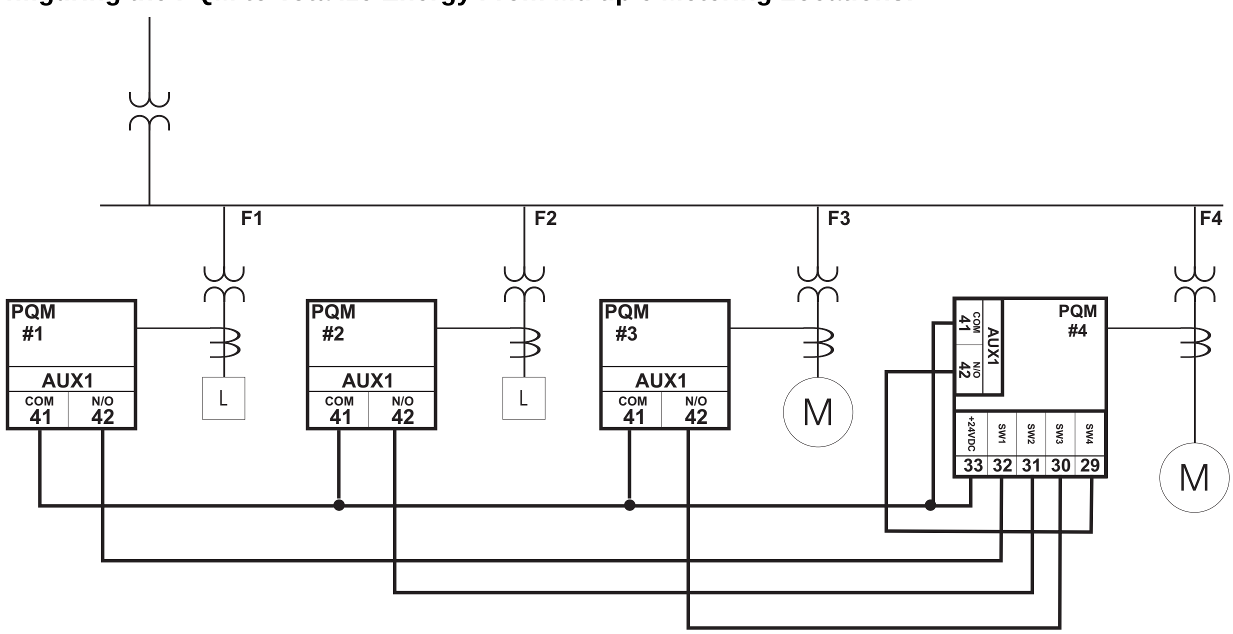


Figure A–3: MULTIPLE METERING LOCATIONS

The diagram above shows an example of a PQM being used to totalize the energy from 4 other PQMs. PQMs 1 through 4 have each of their respective AUX1 relays configured for Pulse Output functionality (refer to the Pulse Output PQM Application note for details, or the PQM manual). The Switch Common output from PQM#4 is fed to the common contact of the AUX1 relays on PQMs 1 through 4. The N/O contact of AUX1 for PQMs 1 through 4 will operate based upon the setup as described in the Pulse Output functionality section of the PQM manual. The Totalized Pulse Input register of PQM#4 can be set to sum the counts from Switch Inputs 1 through 4, thus giving a total energy representation for the 4 metering locations. The count value for each Pulse Input on PQM#4 can be set to match the Pulse Output Interval as programmed on each PQM. For example, if PQM#1 had a Pulse Output Interval = 100 kWhr, and PQM#2 had a Pulse Output Interval = 10 kWhr, then Pulse Input 1 on PQM#4 would have the Pulse Input Value set for 100 and Pulse Input 2 on PQM#4 would have the Pulse Input Value set for 10.

Various operating parameters with regard to the PQM Switch Inputs must be taken into account. The PQM Switch Inputs require a minimum 100 ms operation time to be detected. Therefore the Pulse Output Width should be equal to or greater than 100 ms. The duration of the contact operation can be indefinite. The internal Switch Input circuit of the PQM is itself switched on and off at the times when the PQM is reading the status of the Switch Inputs. Monitoring the input to one of the PQM Switch Inputs will reveal a pulsed 24 V DC waveform, not a constant signal. Standard wiring practice should be adhered to when making connections to the PQM Switch Inputs, i.e. avoiding long runs of cable along current carrying conductors or any other source of EMI. An induced voltage on the Switch Input can cause malfunction of the Switch Input.

B.1.1 LIST OF TABLES

B.1.2 LIST OF FIGURES

B

GE POWER MANAGEMENT RELAY WARRANTY

General Electric Power Management (GE Power Management) warrants each relay it manufactures to be free from defects in material and workmanship under normal use and service for a period of 24 months from date of shipment from factory.

In the event of a failure covered by warranty, GE Power Management will undertake to repair or replace the relay providing the warrantor determined that it is defective and it is returned with all transportation charges prepaid to an authorized service centre or the factory. Repairs or replacement under warranty will be made without charge.

Warranty shall not apply to any relay which has been subject to misuse, negligence, accident, incorrect installation or use not in accordance with instructions nor any unit that has been altered outside a GE Power Management authorized factory outlet.

GE Power Management is not liable for special, indirect or consequential damages or for loss of profit or for expenses sustained as a result of a relay malfunction, incorrect application or adjustment.

For complete text of Warranty (including limitations and disclaimers), refer to GE Power Management Standard Conditions of Sale.

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GE POWER MANAGEMENT WEBSITE

The latest product information for the PQM relay is available on the Internet via the GE Power Management home page:

h t t p : / / w w w . G E i n d u s t r i a l . c o m / p m

This site provides access to the following customer services:

- Digital Products Directory
  A brief description of products can be viewed online.
- Product Catalog
  Individual product brochures can be downloaded and printed
- Product Selector Guide
  A graphical tool for finding the product you are interested in
- Sales Offices
  A complete listing of world-wide sales offices
- Technical Support
  Complete contact information is available
- Instruction Manuals
  Manuals for many products are now available online
- GE Product Software
  The latest working versions of product software
- Technical Drawings
  Many technical drawings are available in either AutoCAD, CorelDRAW, or PDF formats.
- Order Codes
  Order codes for many products can be downloaded and printed
- Technical Publications
  Papers related to power management

Much more is also available. Visit us online at: **www.GEindustrial.com/pm**.