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

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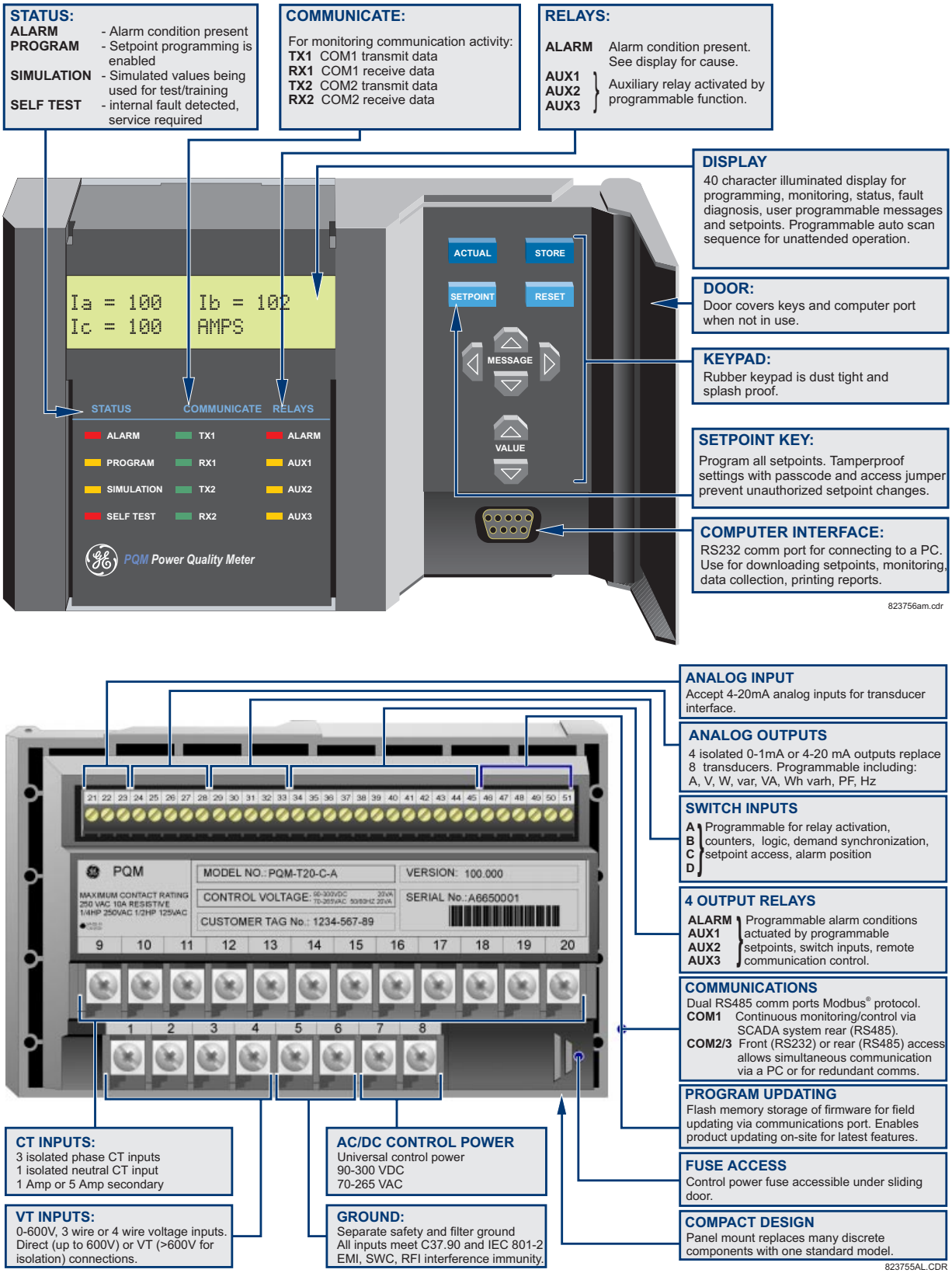

Figure 1–1: PQM FEATURE HIGLIGHTS

- 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

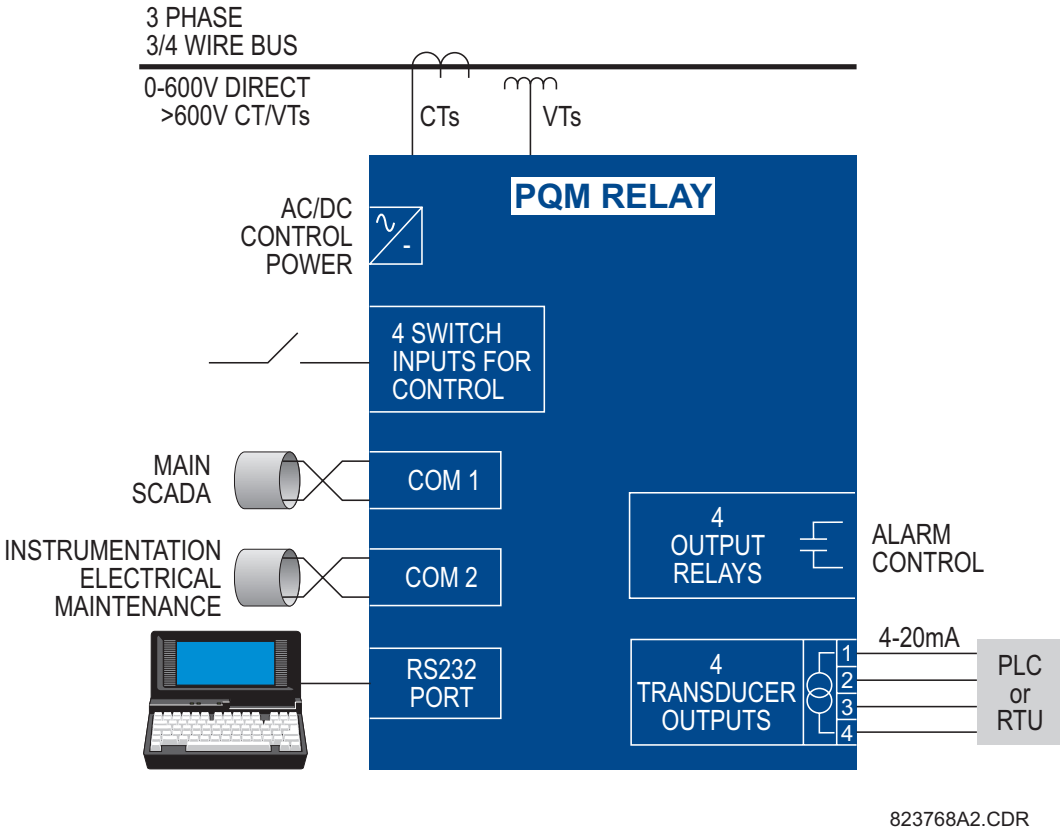

Figure 1–2: SINGLE LINE DIAGRAM

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 liquid crystal display 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.

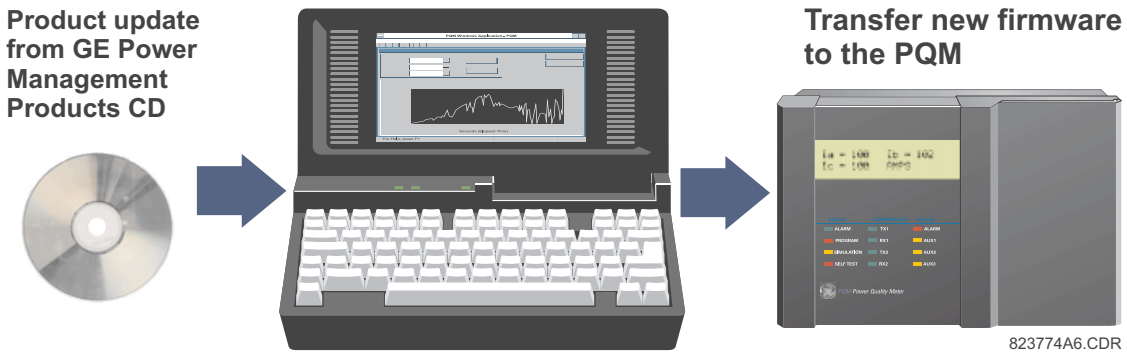

Figure 1–3: DOWNLOADING PRODUCT ENHANCEMENTS VIA THE SERIAL PORT

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.

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.

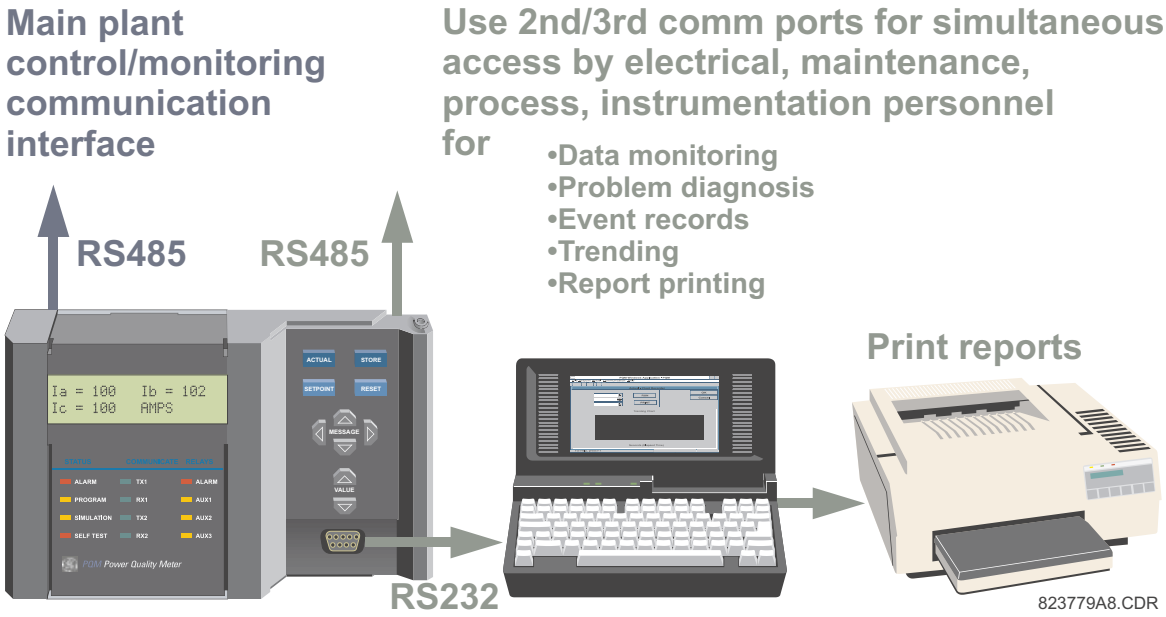

Figure 1–4: ADDITIONAL COMMUNICATION PORT

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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.

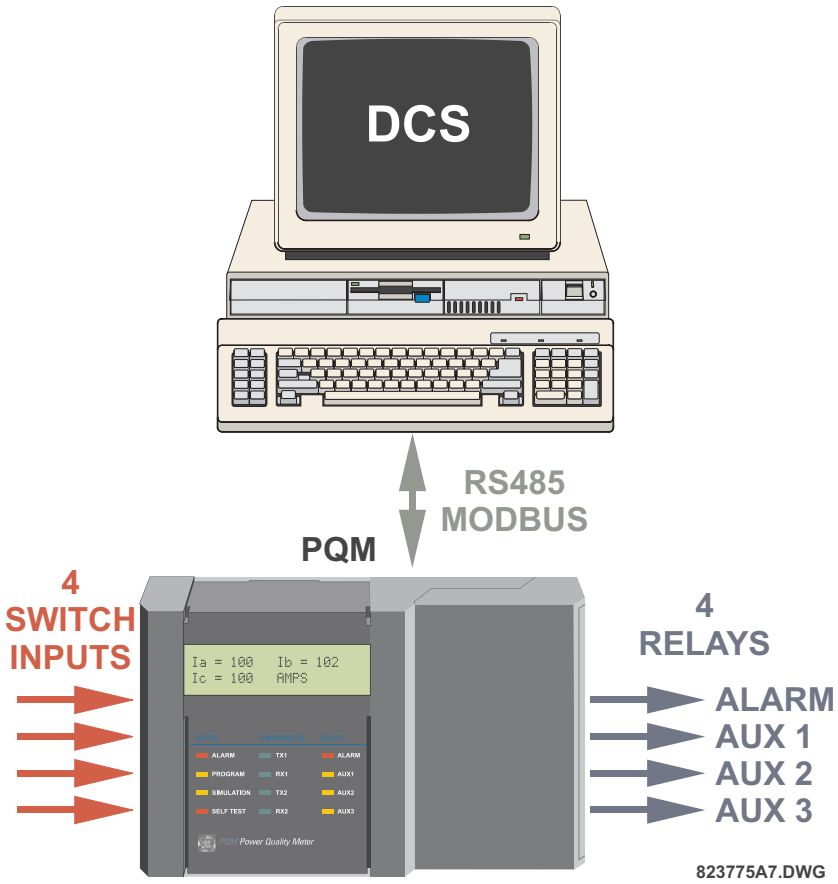

Figure 1–5: SWITCH INPUTS AND OUTPUTS RELAYS

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.

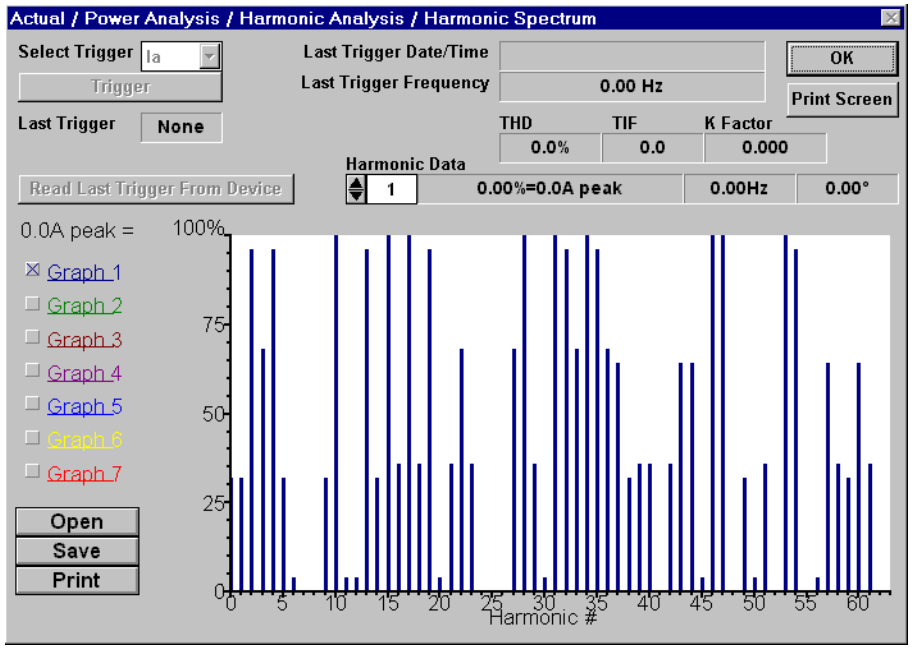

Figure 1–6: HARMONIC SPECTRUM

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.

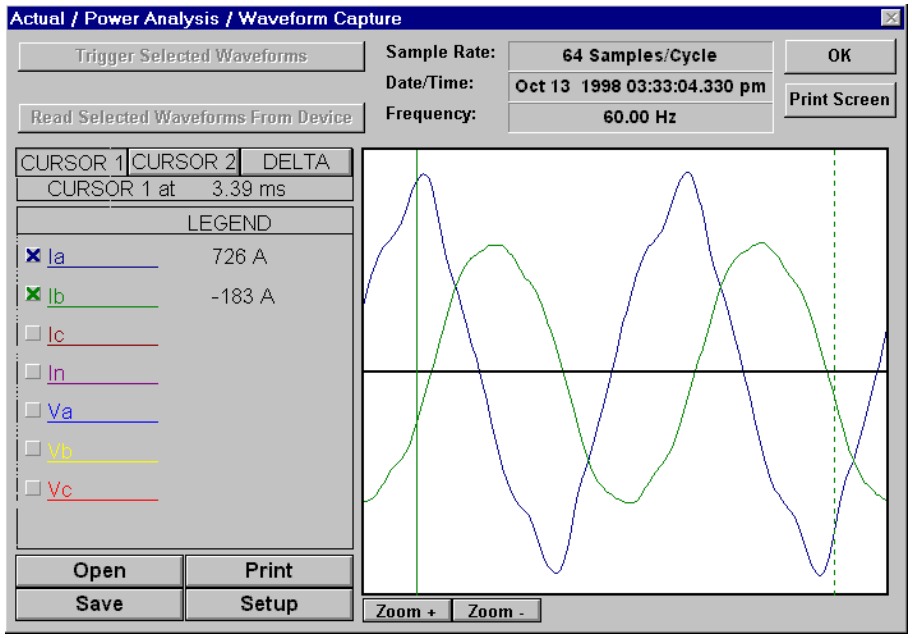

Figure 1–7: CAPTURED WAVEFORM

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.

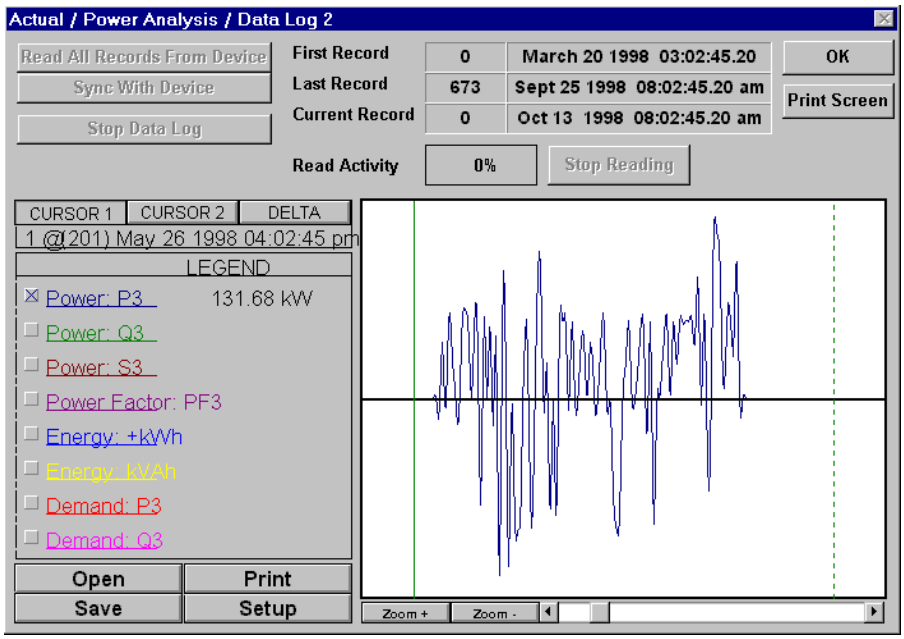

Figure 1–8: DATA LOGGER

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.

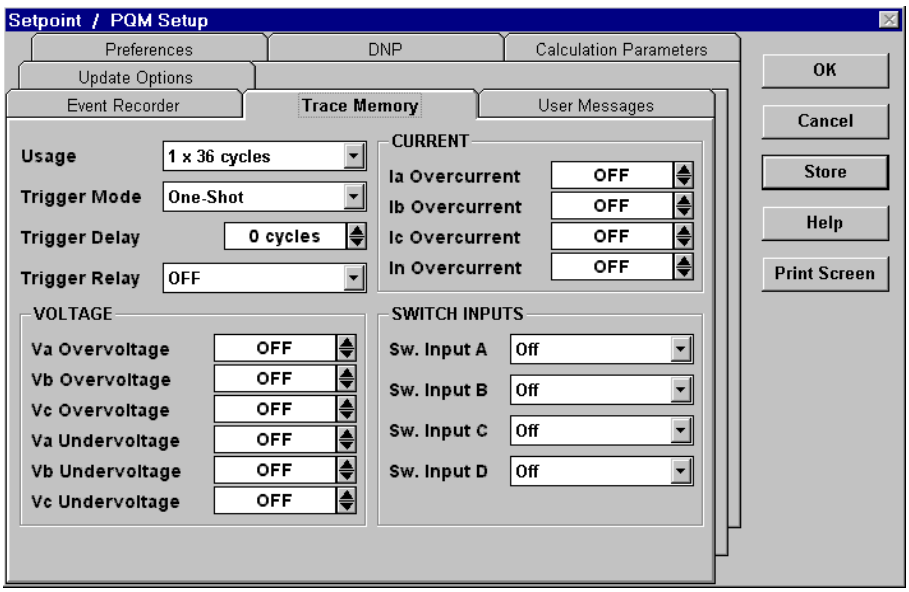

Figure 1–9: TRACE MEMORY TRIGGERS

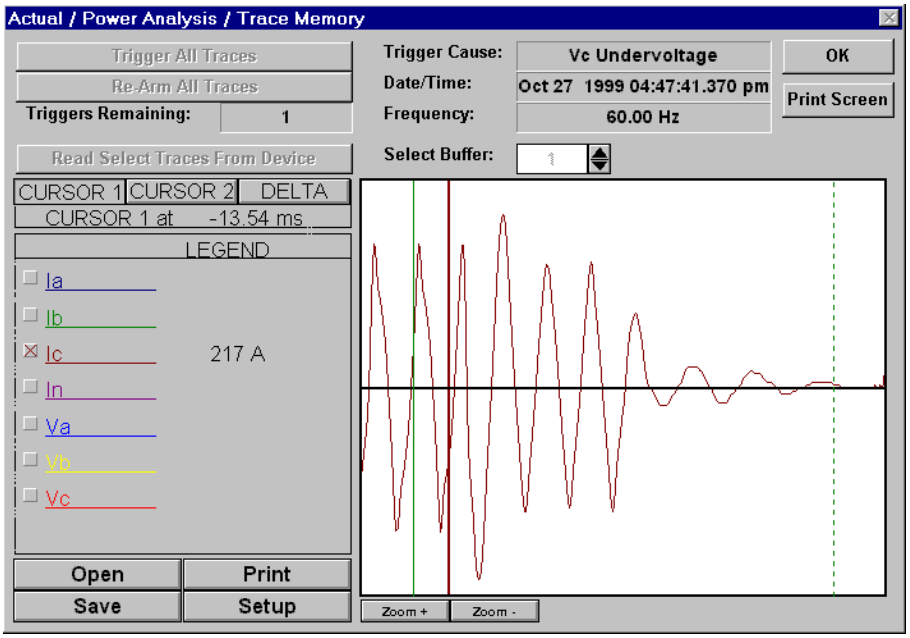

Figure 1–10: TRACE MEMORY CAPTURE

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.

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)

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

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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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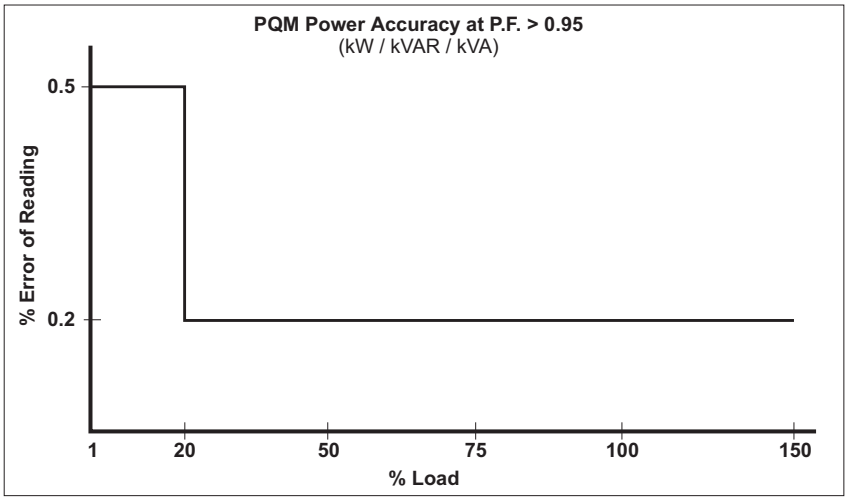
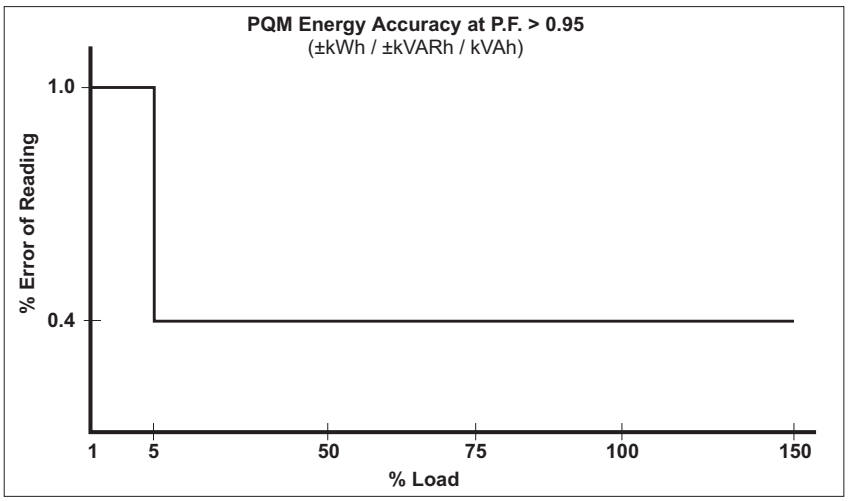
PQM POWER AND ENERGY ACCURACY

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





NOTE

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.