PSL

The **PQube**. Simply the best power monitor. Ever.

PQube®

Go Green. Know your power.™

Power Standards Lab

PQube® AC Power Monitor

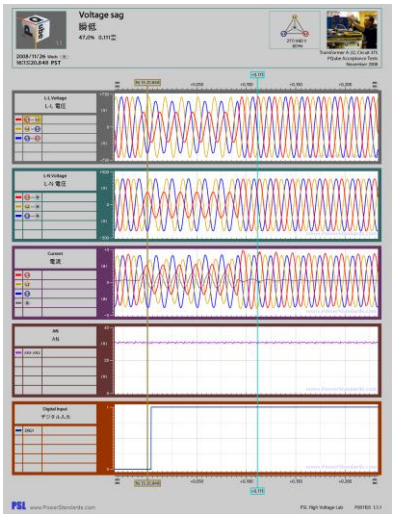
Embedded power quality and energy/carbon monitoring

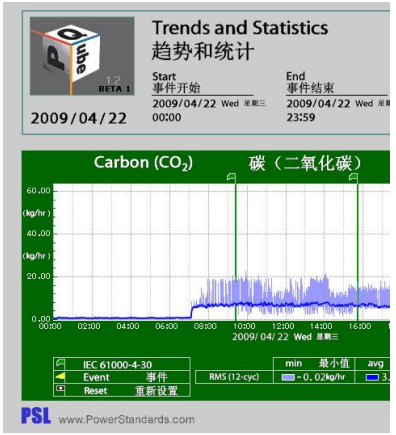
Highlights

- An entirely new idea: combine a hyper-accurate energy monitor with a world-class power quality monitor. Then squeeze it into a compact, low-cost package that doesn't require any software at all.
- Captures disruptive voltage disturbances every time they occur. Time-stamped pictures of the waveforms, and Excel®-compatible CSV spreadsheet files.
- Energy and peak metering, including kilowatt-hours, kVA, kVA-hours, true Power Factor, peak amps, peak kVA, peak watts, unbalance, and a Carbon footprint meter that uses a patent-pending algorithm.
- Tiny. Perfect for embedding in sensitive equipment – quickly reduces service costs and provides critical data for improving energy efficiency.
- As easy to use as a digital camera – everything you need is stored on a standard plug-in SD card.
- Made in USA. No software required. Very low cost.

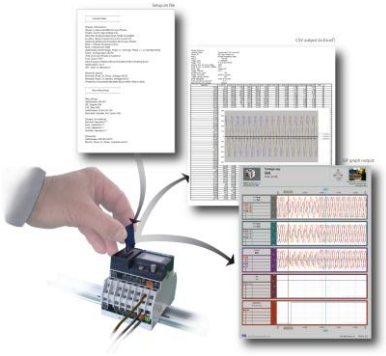
Features

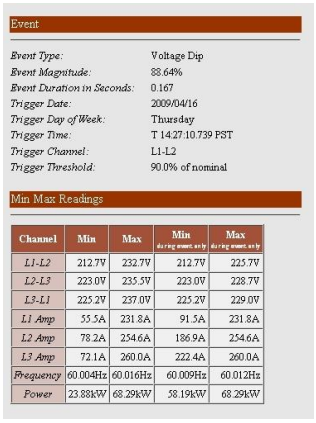
- **General:**
  - Three-phase/single-phase voltage monitoring – standard worldwide voltage configurations up to 690V L-L (400V L-N), 50/60/400Hz nominal.
  - Auto power configuration (patent pending) – detects single-phase, phase-to-phase, delta, wye, corner ground, and many others. Also auto-detects nominal voltage and nominal frequency.
  - One digital input, two additional ±60V analog input channels, one relay contact output, and two temperature-humidity channels.
  - 256 samples-per-cycle recording standard.
  - 4 gigabyte SD-card standard (can use up to 8GB cards). Typically records about 2 GB per year.
  - Full color organic LED display: 30+ languages, date/time setup, most recent events, meters, etc
  - DIN-rail or optional panel mount bracket
  - Power from 24-48VDC/24 VAC, or optional 100~240 VAC power supply. Built-in Li-Ion UPS
  - Free individual NIST calibration certificate for every PQube. Download from www.PowerStandards.com
- **Power Quality monitoring:**
  - Voltage dips, swells, and interruptions – waveforms and RMS graphs
  - Over-frequency and under-frequency events
  - 1-microsecond high-frequency impulse detection
  - Time-triggered snapshots
  - THD, TDD, Voltage unbalance, and current unbalance
  - Harmonics and Interharmonics – up to the 63rd order for voltage and current
  - RMS Flicker – P_{inst}, P_{ST}, P_{LT}
  - Detailed event recording, plus daily, weekly, monthly trends. Cumulative probability, histograms, and more
- **Energy monitoring:** Just snap on a plug-in current module
  - Watts, VA, VAR's, true Power Factor, Watt-hours, VA-hours
  - Carbon footprint meter. You can specify carbon values for various types of electric power, and the ratio of each type supplied by your electric company. Your PQube then measures the carbon footprint directly in kilograms! It even distinguishes between "generated" and "avoided" CO_2.
  - Peaks: single-cycle peak, 1-minute, and 15-minute averages
  - CT ratios support up to 50,000 amps. PT ratios support up to 6,900,000 volts.
  - Daily, weekly, monthly trends, Load duration curves and more.





- **No software required:**
  - Spreadsheets: CSV Excel®-compatible files; events, trends, statistics
  - Pictures: Event and trend/statistics – dual-language graphs output directly from your PQube in universal GIF format
  - PQDIF: the IEEE's standard for power quality data files
  - Text, XML, and HTML summaries: perfect for interfacing with other programs
- **Easy data retrieval:**
  - Easy access to all PQube graphs, spreadsheets, and PQDIF files - simply pop out SD card from front slot. No communications required. No restrictions from your IT department.
  - Open file formats:
    - Graphs in GIF format with dual language labels
    - Spreadsheets in CSV format
    - PQDIF format for events, trends, and statistics
    - Summaries in text, html (web), and XML (computer readable) formats
    - HTML (web browser) indexes make it easy to find files
  - With optional Ethernet plug-in module, you add:
    - Email – trends and statistics and events, straight from your PQube to your PC. Email is a great choice for locations where firewalls are an issue. Your PQube supports encrypted e-mail passwords, too, for greater compatibility with servers that require MD5.
    - Web server built-in – easy viewing and downloading from anywhere in the world.
    - FTP server built-in – easy file transfer from anywhere in the world.
    - Modbus-TCP – meters can be read by thousands of programs
    - Connect to a cellular modem for wireless Ethernet access
- **Easy installation**
  - Snap-together modules for Ethernet, current, optional power supply, and more
  - Direct connection to any world-wide voltage: 100V, 120V, 200V, 208V, 230V, 240V, 277V, 400V, 480V, 600V. 690V.
  - Direct connection to any world-wide frequency: 50 Hz, 60 Hz, 400 Hz, plus DC
  - DIN-rail mount or panel mount. Can snap into standard DIN circuit-breaker box with standard 45mm cutout, or use with optional panel-mount bracket.
  - Built-in UPS with automatically charged Li-Ion battery. Battery can be easily replaced without interrupting PQube monitoring
- **Complies with world-wide standards:**
  - Safety: UL, TUV, ISA-82.02.01 (IEC 61010-1 MOD), CAN/CSA-C22.2 NO.61010-1, Japan S-mark, GS
  - Immunity: IEC 61000-4-5 (6kV peak 100kHz surge), IEC 61000-4-4 (4kV peak EFT bursts), IEC 61000-4-2 Level 1 and MIL-STD-883 (electrostatic discharges), IEC 61000-4-3 (radio frequency fields), IEC 61000-4-8 (magnetic fields)
  - Emissions: EN 55022 and CISPR 22, radiated and conducted RF emissions.
  - Accuracy: Full NIST-trace Certificate for every individual PQube.



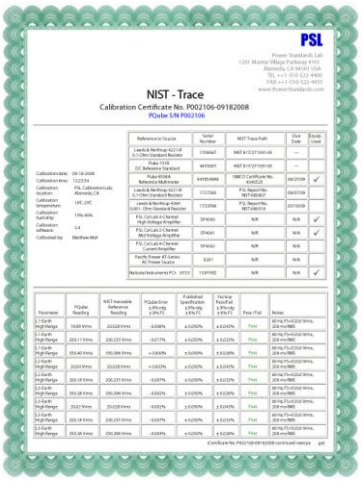


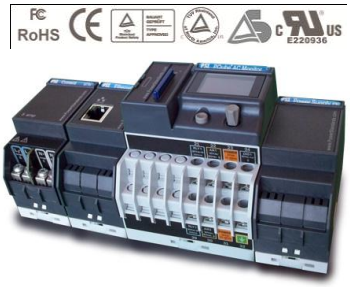
Event

Event Type:	Voltage Dip
Event Magnitude:	88.64%
Event Duration in Seconds:	0.167
Trigger Date:	2009/04/16
Trigger Day of Week:	Thursday
Trigger Time:	T 14:27:10.739 PST
Trigger Channel:	L1-L2
Trigger Threshold:	90.0% of nominal

Min Max Readings

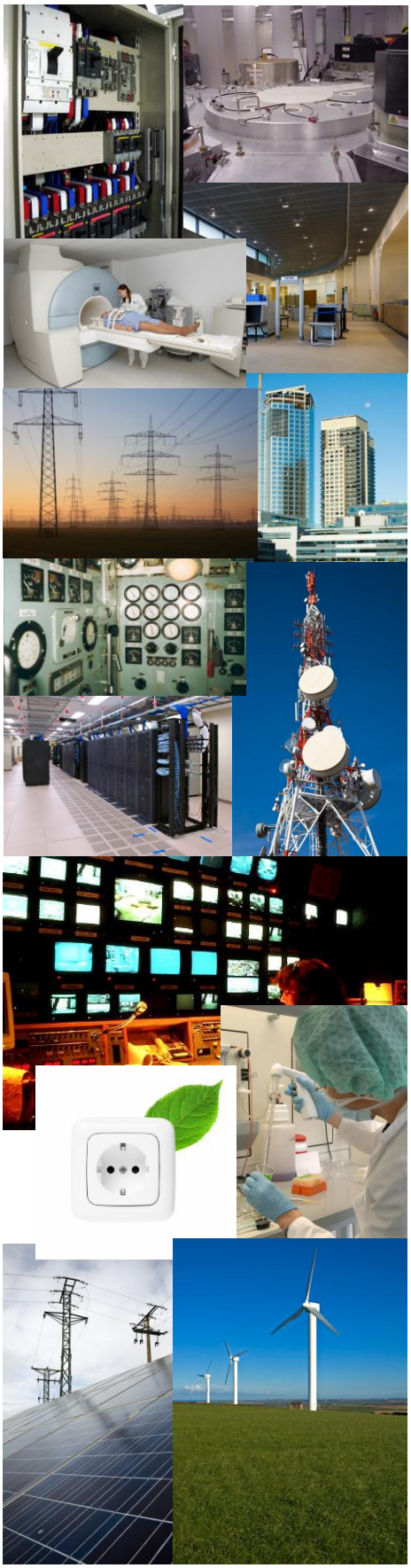
Channel	Min	Max	Min during event, only	Max during event, only
L1-L2	212.7V	232.7V	212.7V	225.7V
L2-L3	223.0V	235.5V	223.0V	228.7V
L3-L1	225.2V	237.0V	225.2V	229.0V
L1 Amp	55.5A	231.8A	91.5A	231.8A
L2 Amp	78.2A	254.6A	186.9A	254.6A
L3 Amp	72.1A	260.0A	222.4A	260.0A
Frequency	60.004Hz	60.016Hz	60.009Hz	60.012Hz
Power	23.88kW	68.29kW	58.19kW	68.29kW



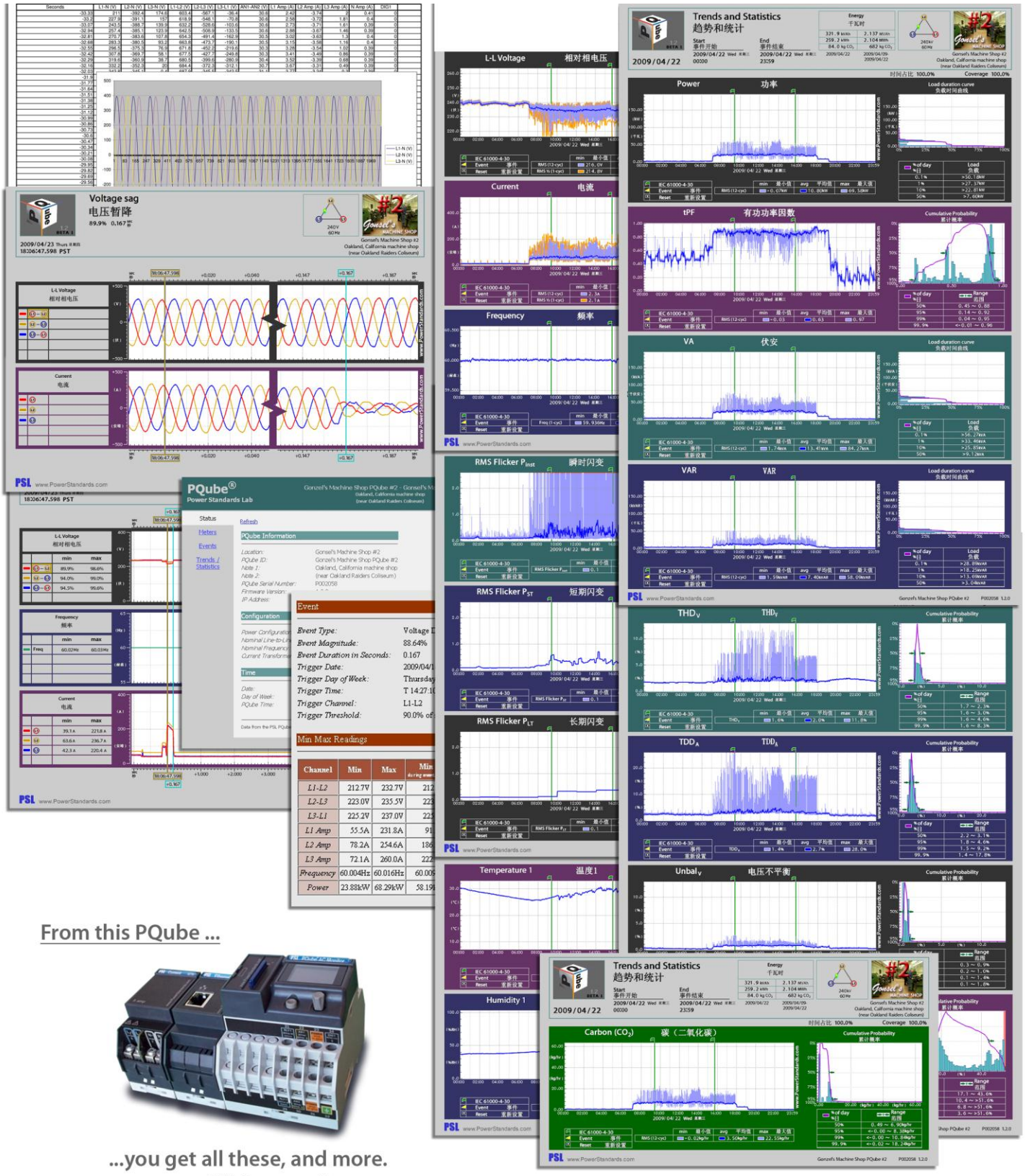


Applications

- **Industrial equipment**
  - Size and price are perfect for embedding in automated machinery
  - Quickly pay for PQube with avoided service calls
  - Track energy trends over time – detect developing leaks, failing motors, and more
- **Medical**
  - Perfect for embedding in MRI and CAT scanners.
  - Detect power quality events that cause intermittent errors, imaging malfunctions.
  - Provide energy monitoring: the first step in improving energy efficiency in medical facilities
- **Security scanning at airports**
  - World-wide necessity – must function perfectly with bad power
  - Scanning errors can be catastrophic - embedded power quality monitoring is critical.
- **Power companies**
  - Monitor key accounts at the meter, and at the critical loads: was it your problem, or a facility problem?
  - Lowest-cost system-wide monitoring – including PQDIF output files
- **Facility management companies**
  - Add value with power quality and energy monitoring
  - PQube is the only monitoring system that doesn't require network infrastructure – just install and get useful data right away
- **Military bases, government campuses, large facilities**
  - Allocate energy costs, and detect energy leaks
  - Full carbon monitoring for green initiatives
  - Start with no network; add e-mail later; then add full network support when needed
- **Data centers**
  - AC and DC monitoring, plus temperature and humidity
  - Monitor input and output of power conditioning – demonstrate your improvements
- **Telecom**
  - 3-phase and 1-phase AC monitoring, with simultaneous capture of disturbances on -48Vdc
  - Trigger on AC disturbances, -48Vdc disturbances, or both
  - Full daily, weekly, and monthly trends and statistics for proof of service
- **Researchers**
  - All data stored in open-format files (Excel®-compatible CSV files) – easy to write your own programs for analysis
  - Voltage, current, and DC oscilloscope waveforms, with sophisticated triggering
  - Daily, weekly, and monthly trends and statistics: voltage, current, frequency, power, temperature, humidity, and more
- **Green initiatives**
  - Direct reading of carbon emissions, using patent-pending algorithms
  - Ultimate precision: 0.05% accuracy for sensitive energy savings measurements
- **Distributed generation - wind and solar**
  - Ultra-precise 3-phase AC measurements, including net power flow
  - Ultra-precise frequency recording and disturbances for stability analysis
  - Detect LVRT (voltage dip) faults – speeds up acceptance tests and payment
  - Available 1500 Vdc and 600-amp DC sensors, simultaneous with built-in AC sensors, for inverter efficiency measurements, recording DC bus disturbances
- **Energy audits and Power Quality consulting**
  - Direct graph outputs (GIF format) that copy/paste into your reports – no software required
  - Accumulated energy, peak energy, and daily/weekly/monthly trends and statistics for full understanding
  - The most accurate, most flexible, easiest-to-use power recorder ever made for energy and power quality



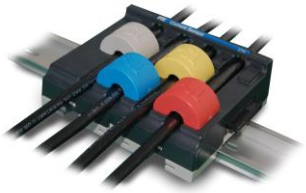
Sample Files



From this PQube ...

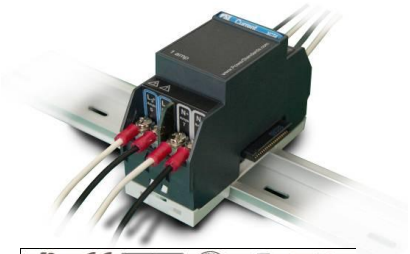
...you get all these, and more.
With no software.

Optional Plug-in Modules



Current Sensing modules

- Up to five channels of current monitoring.
- Simple to set CT ratios in your PQube (up to 50 kiloAmps), with crest factor of 350%.
- Current waveforms, inrush current, and power flow (kW, kWh, kVA, kVAh, kVAR, kVARh, tPF)
- Measure unbalance, harmonics, and interharmonics for current
- Peak meters – peak amps, peak kVA, and peak watts. Single-cycle, 1-minute, and 15-minute peaks. Useful for sizing circuit breakers, UPS, and transformers.
- Carbon footprint meter – input your local electric power source information, and your PQube automatically measures your CO_2 footprint directly in kilograms



CT4 Current Sense module

- Just pass wires through openings in module (0.34in (8.6mm) maximum diameter)
  - Part Number CT4-20A-00 for 20-amp nominal rating
  - Part Number CT4-50A-00 for 50-amp nominal rating.

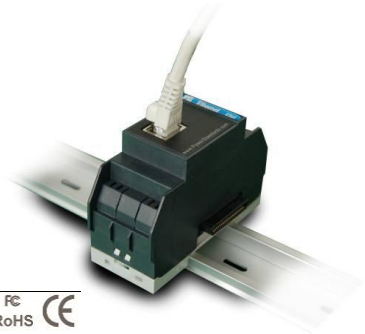
XCT4 Current Transformer Interface module

Connects directly to current transformer secondary wires – 1 or 5 amp

- Part Number XCT4-01A-00 for 1-amp nominal rating
- Part Number XCT4-05A-00 for 5-amp nominal rating

XCT5 Current Transformer Interface module

- Connects directly to voltage secondary wires of your CTs – 1, 5, or 10 volt.
  - Part Number XCT5-0.333V-00 for 0.333-volt nominal rating (can be used with PSL current sensors – see web site for available models).
  - Part Number XCT5-01V-00 for 1-volt nominal rating
  - Part Number XCT5-05V-00 for 5-volt nominal rating
  - Part Number XCT5-10V-00 for 10-volt nominal rating

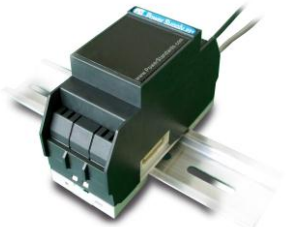


ETH1 - Ethernet module

- Automatically sends you an e-mail whenever a disturbance occurs, complete with picture and Excel® compatible attachments
- Built in web server – see status of your PQube and look at event and trend recordings
- Update your firmware and reset your PQube via email
- Use SNTP for synchronizing (2 second absolute) to UTC time standard
- DHCP/Fixed IP, POP, SMTP, FTP, Modbus-over-TCP
  - Part Number ETH1-10T-00

CTE1 – Combine network connectivity and current monitoring

- Combined ETH1 ethernet module and XCT5 current module in one small package
- Smaller footprint – ideal for panel mounting with limited space available
  - Part Number CTE1-10T-0.333V-00 for 0.333V nominal rating
  - Part Number CTE1-10T-1 V-00 for 1V nominal rating
  - Part Number CTE1-10T-5V-00 for 5V nominal rating
  - Part Number CTE1-10T-10V-00 for 10V nominal rating



PS1 - Power Supply module

- PS1 Power Supply Module lets your PQube take power from 100V~240V, 50/60 Hz. (Your PQube takes power from 24VAC, 24Vdc - 48Vdc without any optional modules.)
- Snap multiple PS1 modules together for redundant power from different feeders
  - Part Number PS1-100~240-00

PS2 - Power Supply module

- PS2 Power Supply Module lets your PQube take power from 100V~240V, 50/60 Hz
- 24VDC output to power external accessories
    - Part Number PS2-100~240-00

TH1 – Temperature-Humidity probe

- Monitors ambient temperature and humidity
- Every PQube accepts two electrically-isolated probes
- Use one probe for local ambient temperature-humidity, and put the other on an optional extension cable for monitoring remote conditions
- Temperature accuracy- Typical: ± 0.5°C
- Humidity accuracy: Typical: ± 4.5%RH (20~80% R.H)
    - Part Number TH1-80C-00

ATT1 – DC Voltage Monitoring

- For High Voltage DC monitoring
- Measure 1 differential voltage or 2 voltages relative to earth available
    - Part Number ATT1-0600V-00 for 600V nominal rating
    - Part Number ATT1-1200V-00 for 1200V nominal rating

ATT2 – DC Power and Energy

- For DC power and energy monitoring
- Measures DC voltage (up to 600V) and current
    - Part Number ATT2-0600V-00

PQube front terminals – actual size

Actual Size

PQube back terminals – actual size

Abbreviated PQube Specifications Version 1.4.0 -- Full specification available at www.PowerStandards.com

Reference conditions for factory tests: 19~25°C, 15%~50% RH, steady-state 10/12 cycle signals. ±1/2 display count on all accuracies.

Inputs	
Mains Voltage Measuring Channels	
Connection	L1, L2, L3, N PQube screw terminals [9], [11], [13], [15]
Frequency Range	40 Hz ~ 70 Hz and 320 Hz ~ 560 Hz. Nominal 50 Hz, 60 Hz, or 400 Hz. Specifications below apply at 50/60 Hz.
Mains Configuration	Single-phase, delta, wye or star. User selected or auto-selected.
Range of Nominal Input Voltage	100 VAC ~ 690 VAC L-L (69 VAC ~ 400 VAC L-N). User selected or auto-selected.
Measurement Channels	Line-to-Neutral, Line-to-Line, Neutral-to-Earth
Sampling Rate	256 samples per cycle, phase-locked to input frequency
Measurement Range	0 VAC ~ 900 VAC L-L (520 VAC L-N)
Accuracy	±0.05% rdg ±0.05% FS typical (10% ~ 150% of nominal). Factory tested at better than ±0.04% rdg ±0.04% FS.
RMS Measurement Method	True single-cycle RMS, phase-locked to each channel, updated every 1/2 cycle. URMS½ per IEC 61000-4-30 Class A. Also 10/12 cycle true-RMS per IEC 61000-4-30 Class A.
HF Impulse Detection	L1-E, L2-E, L3-E. ±450 Vpk nominal threshold detected through 2-pole high-pass 4.8 kHz nominal filter.
Unbalance – Voltage	Measurement method ANSI C84.1. Range: 0.0% ~ 100.0%. Accuracy equivalent to rms voltage specification applied to measurement method.
THD – Voltage	Measurement method: DFT of phase-locked 256 samples-per-cycle. Range: 0.0% ~ 100.0%. Accuracy: ±0.2% at 60-Hz test waveform having typical harmonic content (5% 5th, 2.5% 7th, 1.5% 9th, and 1% 11th)
RMS Flicker	Pinst – average absolute difference between URMS½ and 1-second RMS, in percent of nominal, multiplied by scaling factor for improved compatibility with Incandescent Flicker in IEC 61000-4-15.
Harmonics and Interharmonics	Range: 0% ~ 100% of fundamental, measured up to the 63rd order (harmonics displayed up to the 50th order). Harmonic accuracy: IEC 61000-4-7:2002 Class II, typical, up to the 50th order, for units manufactured after February 2010. (Preliminary specification, subject to further evaluation)
Installation Category	CAT IV UL/IEC 61010 for voltages up to 300 VAC L-N (equivalent to 480 VAC L-L), CAT III for higher voltages
Analog Input Channels	
Nominal Input	0 ~ 30 VAC or ±60 VDC to Earth max, input impedance: 800 kΩ to Earth
Full Scale	70 VAC, ±100 VDC
Measurement Channels	AN1-Earth, AN2-Earth, AN1-AN2
Accuracy	±0.2% rdg ±0.2% FS typical (10% ~ 100% FS) to Earth. Factory tested at better than ±0.1% rdg ±0.1% FS AC
Digital Input	
Rating	60 VDC to Earth
Threshold	1.5 V ±0.2 V with respect to PQube's Earth terminal, with 0.3 V hysteresis typical
Optional Current Measuring Modules	
CT4-20A-00, CT4-50A-00	
Measurement Type	Pass-through (built-in current transformers)
Nominal Input	20 amps RMS for CT4-20A, 100 amps RMS for CT4-50A
Crest Factor	3.5 (±70 amps instantaneous for CT4-20A, ±350 amps instantaneous for CT4-100A)
Accuracy	±0.2% rdg ±0.2% FS typical (10% ~ 120% FS). Factory tested at better than ±0.15% rdg ±0.15% FS
XCT4-1A-00, XCT4-5A-00	
Measurement Type	External current transformer
Nominal Input	1 amp RMS for XCT4-1A, 5 amps RMS for XCT4-5A, CT Input Ratio Range 1:1 to 10000:1
Crest Factor	3.5 (±3.5 amps instantaneous for XCT4-1A, ±17.5 amps instantaneous for XCT4-5A)
Accuracy - excluding CT's	±0.2% rdg ±0.2% FS typical (10% ~ 120% FS). factory tested at better than ±0.15% rdg ±0.15% FS
XCT5-0.333V-00, XCT5-1V-00, XCT5-5V-00, XCT5-10V-00, CTE1	
Measurement Type	External current transformer
Nominal Input	0.333 V RMS, 1 V RMS, 5 V RMS, or 10 V RMS, CT Input Ratio Range 1:1 to 10000:1
Crest Factor	3.5 (±1.17 Vpk, ±3.5 Vpk, ±17.5 Vpk, or ±35 Vpk)
Accuracy - excluding CTs	±0.2% rdg ±0.2% FS typical (10% ~ 120% FS). Every PQube factory tested at better than ±0.1% rdg ±0.1% FS
Instrument Power	
Screw Terminals	(AC or DC) PQube POWER screw terminals [23], [31]
AC Input	24VAC ± 20% 50/60 Hz
DC Input	24-48VDC ± 20% (polarity independent)
Optional PS1 Plug-in Module	
AC Input	100~240VAC ± 10%. 50/60 Hz
Power Required	25VA max
Power Measurements	
Inputs	
Voltages	L-N, or L-Nm for delta configurations. Nm defined as measurement neutral, the instantaneous average L-E voltage. All voltages scaled up to 10000:1 for potential transformers.
Currents	L1, L2, L3, N, E currents. Optional user-selected calculated current on one channel for installations with N-1 current transformers. All voltages scaled up to 10000:1 for current transformers.
Measurement interval	Phase-locked, 10-cycles (50 Hz nominal) or 12-cycles (60 Hz nominal). Approximately 5 readings per second.
Accuracy excluding external CTs	
Watts (power)	±0.2% typical at unity power factor, nominal voltage, 20% ~ 100% FS current. Better than ±0.25% rdg ±0.25% FS plus error due to phase angle uncertainty (<1.5° typical) for Θfundamental < ±30°, nominal voltage, 10% ~ 120% FS current. Θfundamental = angle between fundamental voltage and fundamental current
Volt-Amps (apparent power)	Better than ±0.25% rdg ±0.25% FS typical (10% ~ 120% FS)
Agency Approvals and Listings	
UL	UL-recognized, cULus – File Number E220936
RoHS	Certified – PSL Construction File PQube-001
CE	Certified - PSL Construction File PQube-001, TUV CB Test Certificate US-TUVR-4368-A2
EMC	Certified - 20080102-01-CE, 20080326-01-RI
TUV Bauart-mark	Certified – TUV Report 30880881.009
ABS Shipyard	Certified – 2009 Steel Vessels Rules 1-1-4/7.7, 4-8-3/Table 2, 2008 MODU Rules: 43-3-3/Table 1

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