PSL

PQube Specifications

PQube Specifications 2.1

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 auto, 320-560 Hz manually selected. Specifications below apply at 50/60 Hz.
Mains Configuration	Single-phase, split-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. Note: FS = 345 VAC or 520 VAC, selected based on nominal line-to-earth voltage.
RMS Measurement Method	True single-cycle RMS, phase-locked to each channel, updated every cycle or every 1/2 cycle. $U_{RMS½}$ 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. Every PQube factory tested with 1-µsec 10%-to-90% impulses; trigger required at ±650 Vpk, must not trigger at ±250 Vpk.
Unbalance – Voltage	Measurement method: ANSI C84.1, IEC, and GB. Range: 0.0% ~ 100.0%. Accuracy equivalent to RMS voltage specification applied to measurement method. Supports ANSI, GB, IEC (positive and negative sequence).
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)
Flicker	±5% rdg at all reference points on the eye-response curve defined in IEC 61000-4-15 for P_{ST}≥1.
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)
Isolation	PQube provides more than 7500 VDC isolation to Earth. UL/IEC 61010 reinforced insulation.
PT Input Ratio Range	1:1 to 10000
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. Polution degree 2.
Analog Input Channels	
Connection	AN1, AN2 PQube screw terminals [22], [30
Nominal Input	High range: 0 ~ 30 VAC or ±60 VDC to Earth max. Low range: 0 ~ 7VAC or ±10VDC to Earth max.
Input impedance	800 kΩ to Earth
Full Scale	High range: 70 VAC, ±100 VDC, Low range 7 VAC, ±10 VDC.
Measurement Channels	Standard: AN1-Earth, AN2-Earth, AN1-AN2. DC Energy Mode: DC Power and DC Energy.
Accuracy	±0.2% rdg ±0.2% FS typical (10% ~ 100% FS), ANx-Earth. Every PQube factory tested at better than ±0.1% rdg ±0.1% FS AC
Digital Input	
Connection	DIG1 PQube screw terminal [24]
Rating	60 VDC to Earth
Wetting	5.4 VDC at 3 µA
Threshold	1.5 V ±0.2 V with respect to PQube's Earth terminal, with 0.3 V hysteresis typical.
Sampling Rate	12.8 kHz or 15.4 kHz (sampled at same rate as mains voltage measuring channels.
Frequency Measurement	
Range	40 Hz to 70 Hz and 320 Hz to 560 Hz.
Accuracy	±0.01 Hz, steady state.
Method	Cycle-by-cycle zero-crossing detection on L1-E or L2-E (auto-selected). Firmware phase-locked for frequency slew rate up to 5 Hz/sec. For 50/60 Hz, measured through an 9-pole low-pass analog filter, 3-dB frequency 76 Hz. For 400 Hz, measured through 7-pole low-pass filter, 3-dB frequency 1 kHz. Poles and 3 dB frequency are auto-selected based on nominal frequency.
OptionalTemperature/Humidity Probes	
Connection	2.5 mm stereo jack. Functional electrical isolation from PQube.
Location	Optional probes plug into the PQube directly or through PSL-provided extension cable.
Scan Time	5 seconds max.
Temperature Accuracy	Typical: ±0.5ºC. Max: ±2ºC (-20 ~ +80ºC).
Humidity Accuracy	Typical: ±4.5% RH (20 ~ 80% RH), max:±7.5% (0 ~ 100% RH).
Note: For optimal ambient temperature and humidity accuracy, use extension cable to avoid self-heating of probe by PQube.	
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)
Power Required	5VA max.
Isolation	PQube provides more than 150VDC isolation to all other circuits.
Internal UPS	
Type	Lithium Polymer Battery (replacement batteries available from PSL).
Capacity	600mAH.
Backup Period	User controlled. 1 to 10 minutes, 3 minute default.
Storage & Discharge Temp.	-20ºC to +60ºC
Charge Temperature	0ºC to +45ºC
Charging Cycles	>500 full cycles.
Lifetime	Estimated 5+ years, depending on operating and environmental conditions.
Replacement Method	User-replaceable while PQube is operating (tool required).
Optional PS1 Plug-in Module	
AC Input	100~240VAC ± 10%. 50/60 Hz
Power Required	25VA max
Isolation	Module provides more than 3200VDC isolation to all other circuits

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PQube Specifications

PQube Specifications 2.1 (continued)

Power Measurements

Definitions	
Watts (power)	Sum of true instantaneous per-phase power.
Volt-Amps (apparent power)	Sum of per-phase product of RMS voltage and RMS current, taken over the measurement interval.
Power Factor	True power factor—ratio of Watts to Volt-Amps, displacement PF—cosΘ.
VARs (volt-amps reactive)	Budeanu definition or fundamental VARs—user-selectable.
Carbon (CO_2 rate & accumulated)	Based on patent-pending algorithm using watts and user-selected proportions of generator sources, and user-supplied carbon generation rates for each source.
Current Unbalance	Measurement method ANSI C84.1.
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 = Θfundamental=angle between fundamental voltage and fundamental current.
Volt-Amps (apparent power)	Better than ±0.25% rdg ±0.25% FS typical (10% ~ 120% FS)

OUTPUTS

Signal Relay	
Connection	RLY1 PQube screw terminals [21], [29]. RLY2 PQube screw terminals [20], [28] with factory installed RLY option. RLY3 PQube screw terminals [19], [27] with factory installed RLY option.
Rating	30 VAC/30 VDC, 300 mA max.
Function	Normally closed. Contacts open for duration of event or 3 seconds (whichever is longer).
Operate Time	20 milliseconds.
High Current Relay	
Connection	RLY4 PQube screw terminals [17], [25]
Rating	30 VAC/30 VDC, 2 A max.
Function	Normally closed. Contacts open for duration of event or 3 seconds (whichever is longer).
Operate Time	20 milliseconds.

COMMUNICATIONS

USB	
Connection	Mini-B USB socket.
Future Applications	Future: USB mass storage device, and USB-based serial COM port.
Isolation	PQube provides at least 150VDC isolation to Earth (eliminates ground loops).
Optional Plug-in Ethernet Module	
Connection	Standard RJ-45 socket (wired Ethernet).
Email	Sends emails after every event with data attached; user request real-time meters via e-mail, PQube firmware upgrade via email, change PQube setup via email, incoming e-mail filters. Includes GIF graphs, CSV spreadsheet files, PQDIF, HTML and XML summaries.
Web Server	Real-time meters. All events, trends and statistics recordings. Includes GIF graphs, CSV spreadsheet files, PQDIF, HTML and XML summaries.
Modbus over TCP	Real-time meters with update rate of approximately 1 second. Event/trend-statistics counters can be used for triggering downloads via FTP or web server.
FTP Server	File Transfer Protocol. Transfers files from PQube SD card to and from any computer. Limit: one simultaneous connection.
SNTP	Simple Network Time Protocol for synchronizing PQube real-time clock to UTC. (2 second absolute - UTC referenced).

CLOCK TIMING

Internal Real-Time Clock	
Accuracy	Typical ±30 seconds/yr. Temperature compensated. ±120 seconds/yr max drift
Optional SNTP (Requires ETH1)	
Accuracy	±2 seconds absolute, UTC time.

OPERATING ENVIRONMENT

Ambient Conditions - Operating	-20°C ~ 50°C, 5% RH ~ 95% RH non-condensing
Transient Voltages	100kHz ring wave, 6 kV pk, IEC 61180, IEC 61000-4-5. Applied to voltage measuring terminals with Performance Evaluation Class 1. (When applied to optional power supply mains terminal, supply's fuse may operate in PE Class 3 at test levels greater than 4 kV.)
EFT Burst Immunity	4 kV pk, IEC 61000-4-4, Performance Evaluation Class 1. Applied to power measuring terminals and optional PS1 power supply mains terminals.
RF Field Strength Immunity	3V / m, IEC 61000-4-3 Test Level 2
Magnetic Field Strength Immunity	30A / m, IEC 61000-4-8 Test Level 4
Ingress Protection (IP) Rating	IP20H, IEC 60529
ESD Immunity	IEC 61000-4-2 Level 1 and MIL-STD-883

PHYSICAL

Dimensions	2.8in x 3.5in x 3.2in (72mm x 90mm x 80mm)
Weight	8.7oz (247g)
Mounting Standard	35mm DIN rail. Optional panel mounting clips available.
Screw Terminal Torque	7 inch-pounds (0,8Nm)

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
ITC	Certified – 20080102-01-CE, 20080326-01-RI
TUV Bauart-mark	Certified – TUV Report 30880881.009
ABS Shipboard	Certified – 2009 Steel Vessels Rules 1-1-4/7.7, 4-8-3/Table 2, 2008 MODU Rules: 43-3-3/Table 1