

PQube 3 Specifications

– Reference conditions for factory tests: 19~25°C, 10%~70% RH

MAINS VOLTAGE MEASURING CHANNELS

Mains voltage channels	3× Line-to-Neutral, 3× Line-to-Line, 3× Line-to-Earth, 1× Neutral-to-Earth														
Power configuration / Range of nominal input voltage	Single-phase - 69 VAC ~ 480 VAC (L-N) Split-single-phase – 50 VAC ~ 480 VAC (L-N) and 100 VAC ~ 960 VAC (L-L) 3 phase wye/star - 50 VAC ~ 480 VAC (L-N) and 100 VAC ~ 830 VAC (L-L) 3 phase delta - 100 VAC ~ 600 VAC <i>Power configuration and nominal voltages can be user-selected or auto-selected.</i>														
Voltage measurement range	0 VAC ~ 750 VAC (L-N) and 0 VAC ~ 1300 VAC (L-L)														
Magnitude accuracy (±% rdg ±% FS)	<table border="1"> <thead> <tr> <th>Typical</th> <th>100% Factory Test Pass/Fail limit</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>±0.01%</td> <td>±0.025%</td> <td>±0.05%</td> </tr> </tbody> </table>	Typical	100% Factory Test Pass/Fail limit	Specification	±0.01%	±0.025%	±0.05%		10VAC-750VAC L-N, 50/60 Hz.						
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Range of nominal frequencies	16.67 Hz, Nominal 50 Hz, 60 Hz, or 400 Hz auto-selected														
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Frequency measurement range	13.3 Hz ~ 23.3 Hz, 40 Hz ~ 70 Hz and 320 Hz ~ 560 Hz														
Input impedance	4.8 MΩ 7.33 pF to Earth per phase														
Physical connection	L1, L2, L3, N, E pluggable screw terminal block (max torque 5 inch-pounds (0,6 Nm))														
Wire connection	Minimum wire size 20 AWG (0,52 mm ²), maximum 14 AWG (2,1 mm ²) 600 V UL-recognized insulation required.														

CURRENT INPUT CHANNELS

Measurement channels	8 inputs : I1, I2, I3, I4, I5, I6, I7, I8 (typically used as L1, L2, L3, N, E, I6, I7, I8)									
Nominal input (Full scale)	1A, 5A, 20A... 300A, 400A...6000A ranges available through CTs 3000A available through Flexible current sensors Nominal for the CT outputs: 0.333 V _{rms} (Low range) or 3.33 V _{rms} (High range) - user selected.									
Crest factor	3.5 (±1.17 V _{pk}) (Low range) or 3.0 (±10 V _{pk}) (High range)									
Magnitude accuracy - <u>including</u> PSL Ultra-Precise calibrated shielded split-core current sensors (±% rdg ±% FS)	<table border="1"> <tr> <th>Typical</th> <th>Factory-generated CT calibration table: additional uncertainty</th> <th>Specification</th> </tr> <tr> <td>±0.05%</td> <td>±0.035%</td> <td>±0.1%</td> </tr> </table>	Typical	Factory-generated CT calibration table: additional uncertainty	Specification	±0.05%	±0.035%	±0.1%	<table border="1"> <tr> <th>Specification</th> </tr> <tr> <td>At 50/60 Hz, 2.5% FS ~120% FS Additional uncertainty is the uncertainty due to the Factory CT Calibration System, plus uncertainty due to the resolution of the entries in the CT-specific Calibration Table and the algorithms for applying the CT-specific Calibration Table.</td> </tr> </table>	Specification	At 50/60 Hz, 2.5% FS ~120% FS Additional uncertainty is the uncertainty due to the Factory CT Calibration System, plus uncertainty due to the resolution of the entries in the CT-specific Calibration Table and the algorithms for applying the CT-specific Calibration Table.
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Sampling rate	Same rate as mains voltage measuring channels									
Input impedance/burden	33.3 kΩ < 1 VA for CTs									
CT ratio range	1:1 to 50000:1									
Physical connection	Interfaces with External CT (current transformer) with voltage-type secondary or Flexible current sensors 5 or 8 pairs of pluggable screw terminals (Max torque 2 inch-pounds (0,25 Nm)) Connections to feeder wires are done by clamping on split-core CTs around the feeder.									
Wire connection	Connection of the CT voltage output to the PQube 3 input terminal: Min wire size 28 AWG (0,8 mm ²), Max. 16 AWG (1,31 mm ²). 600V UL- recognized insulation required.									

ANALOG INPUT CHANNELS

Measurement channels	User-selected Standard Mode or DC Energy Mode Standard mode: AN1-E, AN2-E, AN3-E, AN4-E (common mode), AN1-AN2, AN3-AN4 (differential mode) DC Energy mode: AN1×AN2, AN3×AN4 (bi-directional DC power), AN1×AN2×hours, AN3×AN4×hours (DC Energy)
Nominal input (Full scale)	High range: ±60 VDC to Earth. Low range: ±10 VDC to Earth.
Measurement range	High range: ±100 VDC, Low range ±10 VDC.
Accuracy	±0.05% rdg ±0.05% FS typical (1% ~ 100% FS), ANx-E
Internal pull-up voltage	2.5 VDC
Analog ratio range	1:1 to 10000:1
Input impedance	1 MΩ to Earth
Physical connection	Pluggable screw terminals (Max torque 2 inch-pounds (0,25 Nm)) AN1, AN2, AN3, AN4 and Earth

DIGITAL INPUT CHANNEL

Rating	Typical 3.3 VDC, 5 VDC, 24 VDC. Maximum input 60 VDC (differential input)
Wetting	2.2 VDC typical. Can be used with NC or NO dry contacts.
Digital threshold	1.5 V ±0.2V with 0.1 V hysteresis typical.
Sampling rate	Same rate as mains voltage measuring channels
Input impedance	>1MΩ
Physical connection	Pluggable screw terminals (Max torque 2 inch-pounds (0,25 Nm)) DIG1+ and DIG1-

SIGNAL OUTPUT RELAY (not yet implemented, will follow with Firmware update soon)

Connection	RLY1 pluggable screw terminals standard
Rating	30 VAC/30 VDC, 300 mA max
Function	When PQube 3 is off, normally open. When PQube 3 is on, normally closed. Contacts open for duration of event or 3 seconds (whichever is longer).
Operate time	20 milliseconds

POWER MEASUREMENTS

Definitions

Watts (power)	Sum of true instantaneous per-phase bi-directional power, taken over the measurement interval.
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
VARs (volt-amps reactive)	Fundamental VARs on L1, L2, L3 and total

Inputs

Voltages	L-N, or L-N _m for delta configurations. N _m defined as measurement neutral, the instantaneous mean of the
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	three L-E voltages.
Currents	L1, L2, L3
Measurement interval	Phase-locked, 10-cycles (50 Hz nominal) or 12-cycles (60 Hz nominal).
Accuracy including PSL Ultra-Precise current sensors	
Watts (power)	±0.1% rdg typical at unity power factor, nominal voltage, 10% ~ 100% FS current. ±0.2% rdg typical at 0.5 power factor, nominal voltage, 10% ~ 100% FS current.
Watt-hours (energy)	Accuracy certified to ANSI C12.20 Class 0.2 and IEC 62053-22 Class 0,2S

CLASS A POWER QUALITY MEASUREMENTS - IEC 61000-4-30 Ed. 3 Class A, full compliance certification

Frequency	Range 40 Hz ~ 70 Hz and 320 Hz ~ 560 Hz, Accuracy ±0.01 Hz, steady state
Voltage amplitude	Range 10% ~ 200% of nominal - Accuracy ±0.1% U _{din} (U _{din} = 120 V, 230 V) Method: True single-cycle RMS, phase-locked to each channel, updated every ½ cycle. U _{RMS½} per IEC 61000-4-30 Class A. Also 10/12 cycle true-RMS per IEC 61000-4-30 Class A.
Flicker	P _{inst} , P _{st} , P _{lt} fully compliant and certified to IEC 61000-4-15 Ed. 2 Class F1
Voltage dips/swells/interruptions	Fully compliant and certified to IEC 61000-4-30 Ed. 3 Class A, Accuracy ±0.2% of nominal voltage, duration accuracy : ±½ cycle at beginning of event and ±½ cycle at end of event, hysteresis selectable
Rapid voltage changes (rvc)	Fully compliant and certified to IEC 61000-4-30 Ed. 3 Class A - Accuracy 0.2%
Unbalance	Fully compliant and certified to IEC 61000-4-30 Ed. 3 Class A Range 0.0% ~ 999.9%, method of symmetrical components, accuracy ±0.15%
Voltage harmonics and interharmonics	Fully compliant and certified to IEC 61000-4-30 Ed. 3 Class A Range 10% ~ 200% of Class 3 of IEC 61000-2-4 Accuracy : ±5% of reading for signals ≥ 1% of nominal, ±0.05% of nominal for signals < 1% nominal voltage Method IEC 61000-4-7 Class I, Gapless FFTs on L1-N, L2-N, L3-N, order up to 63 rd *
Mains signaling voltage	Fully compliant and certified to IEC 61000-4-30 Ed. 3 Class A Range 0% ~ 15% of nominal voltage Accuracy ±5% of reading for signals between 3% ~ 15% of nominal, 0.15% of nominal for signals between 1% and 3% of nominal, no requirements for signals < 1% nominal User-selectable detection threshold recording period mains signaling frequency
Underdeviation and overdeviation	Fully compliant and certified to IEC 61000-4-30 Ed. 3 Class A Range 10% ~ 150% of nominal voltage, Accuracy ±0.1% of nominal voltage

BEYOND CLASS A - 2 kHz-150 kHz CONDUCTED EMISSIONS MEASUREMENT

Measurement method	Fully compliant and certified to IEC 61000-4-30 Ed. 3, Annex C (informative) 200 Hz bin size for the range 2 kHz-9 kHz, 2000 Hz bin size for the range 9 kHz-150 kHz
Range	0-60 V _{pk}

BEYOND CLASS A - HIGH FREQUENCY IMPULSE

Sampling rate	4 MHz on single channel, the channel is user selected. 1 MHz on 4 channels L1-E, L2-E, L3-E and N-E.
Accuracy	±5% typical. Dependent on frequency and type of impulse
Range	±6 kV _{pk} . User-selectable threshold through 2-pole 1.5 kHz high-pass filter, and 1.5 MHz low pass filter
Measurement	Fully compatible with ANSI/IEEE C62.41, C3 and B3 combination wave, ring wave and IEC 61000-4-5 waveforms

ENVIROSENSOR PROBES (TEMPERATURE/HUMIDITY/PRESSURE/ACCELERATION)

Connection	USB. Functional electrical isolation from PQube 3
Sampling rates	1 sample per second typical for temperature, humidity, barometric pressure 8, 16, 32 samples per second, user selected for acceleration
Temperature	Range: -20 °C ~ +80 °C (-4 °F ~ 176 °F)
Humidity	Range: 0 %RH ~ 100 %RH (useful range: 20 %RH ~ 80 %RH)
Barometric pressure	Indicative measurements, resolution better than 0.001 hPa
Acceleration	Full-scale acceleration ±2g, ±4g, ±8g, user selected Trigger on mechanical shock/vibration, seismic motion, or tilt

OPTIONAL ATT1 VOLTAGE ATTENUATOR MODULES FOR ANALOG INPUT CHANNELS

	ATT1-0600V	ATT1-1200V
Rated full-scale voltage	±600 VDC/300 VAC to Earth	±1200 VDC/600 VAC to Earth
Nominal measurement range	±825 V _{pk} to Earth	±1630 V _{pk} to Earth
Test voltage to earth	7250 VDC	14500 VDC
Accuracy	±0.2% reading typical at DC (>10% FS), plus uncertainty of PQube 3 analog input channels	

OPTIONAL ATT2 MODULE FOR DC POWER AND ENERGY

Voltage channel	ATT2-600V	ATT2-1200V
Maximum input voltage	±1000 V _{pk} differential	±2000 V _{pk} differential
Rated full-scale voltage	±600 VDC/300 VAC differential	±1200 VDC/600 VAC differential
Analog input ratio	100:1	200:1
Accuracy	DC: ±0.1% rdg ±0.1% FS 50/60Hz: ±0.15% rdg ±0.15% FS typical (At 23°C ±3°C, 10% – 100% FS, not including uncertainty of PQube 3 analog channels)	
Thermal drift of offset voltage	±0.005 mV/°C typical	
Thermal drift of gain	±0.01% rdg/°C typical	
Current channel	With closed-loop sensors	With open-loop sensors

Rated full-scale current	50A to 600A (depending on sensor model)	50A to 3000A (depending on sensor model)
Maximum input current	150% to 200% FS (depending on sensor model)	110% to 200% FS (depending on sensor model)
Accuracy at calibration current	±0.15% rdg ±0.15% FS typical at DC At 23°C ±3°C. Calibration current = 70% FS or 500A (whichever is smaller). Does not include uncertainty of PQube 3 analog channels	±0.3% rdg ±0.3% FS typical at DC
Hysteresis offset voltage error	< ±20 mV (after excursion of ±100% FS current)	< ±30 mV (after excursion of ±100% FS current)
Linearity (from 10% to 100% FS)	±0.1% rdg ±0.1% FS	±0.5% rdg ±0.5% FS
Thermal drift of offset voltage	±0.1 mV/°C typical	±1 mV/°C typical
Thermal drift of gain	±0.02% rdg/°C typical	±0.1% rdg/°C typical

INSTRUMENT POWER SUPPLY

PQube 3 power supply screw terminals – supports AC or DC

PQube 3 P+ and P- pluggable screw terminals

AC input range	24 VAC ±10% at 50/60/400 Hz, 1.5A max
DC input range	±24 VDC ~ 48 VDC ±10% (polarity independent), 1A max
Power consumption	20W max
Isolation	Internally electrically isolated from all other circuits to avoid ground loops.

PQube 3 - PoE - Power over Ethernet (standard)

Input voltage range	37 ~ 57 VDC
Power consumption	15W max

PM1, PM2 Power Manager Modules (optional)

Rated AC input range	100 ~ 240 VAC ±10%, 50/60 Hz
AC input current rating	400 mA
Supported DC input range	120 ~ 370 VDC
Auxiliary DC power output	24 VDC isolated, up to 5.15W max (Available with PM2 only)
Power consumption	20W max
Isolation	3 kVAC 1min, 4.2 kVDC 1 min
Surge immunity	EN 61000-4-5 Criteria A
Installation category	CAT II 300V

UPS1 BATTERY BACKUP MODULE

PQube 3 backup time	1 ~ 30 minutes, user selected.
Battery	7.4 V 2200mAh Li-ion battery pack
Life expectancy	3 years or 500 cycles (100% depth discharges), whichever comes first.
Operating temperature range	0 °C ~ 45 °C
Operating humidity	45 %RH ~ 85 %RH
Protection	Built-in hardware cutoff for over-voltage, under-voltage, and overcurrent.

UPS2 BATTERY BACKUP MODULE

PQube 3 backup time	1 ~ 60 minutes, user selected.
Battery	6.0 V , with one or several 2500mAh lead-acid external battery packs
Life expectancy	10 years or 300 cycles (100% depth discharges), whichever comes first.
Operating temperature range	-20 °C ~ 65 °C
Operating humidity	45 %RH ~ 85 %RH
Protection	Built-in hardware cutoff for over-voltage, under-voltage, and over-current.

STORAGE/COMMUNICATIONS

USB

Connection	Three USB master ports: one hi-speed USB2.0 port, two standard USB1.0 ports
Isolation	PQube 3 provides functional isolation to Earth (eliminates ground loops).

Removable SD card

Type	microSD
Capacity	8GB standard (stores up to 3 years of data under normal use)

Ethernet Port

Connection	Standard RJ-45 socket (wired Ethernet). Transformer isolated. IP address can be assigned via DHCP or manually set fixed IP.
Email	Sends emails after every event with data attached; user request real-time meters via e-mail, PQube 3 firmware upgrade via email, change PQube 3 setup via email, incoming e-mail filters. Includes GIF graphs, CSV spreadsheet files, PQDIF, HTML and XML summaries Protocols: POP3, SMTP, and SSL over SMTP
Web server	More than 30 real-time meters. All events, trends and statistics recordings. Includes GIF graphs, CSV spreadsheet files, PQDIF, HTML and XML summaries.
Modbus over TCP	More than 50 real-time meters with update rate of approximately 0.5 seconds - see PQube 3 Modbus Specification document. Event/trend-statistics counters can be used for triggering downloads via FTP or web server.
FTP Server	File Transfer Protocol. Transfers files from PQube 3 SD card to and from any computer.
SNTP	Simple Network Time Protocol for synchronizing PQube 3 real-time clock to UTC.

SNMP Support for SNMP v2c and v3

Security Secure FTP-FTPS, HTTPS.

CLOCK TIMING

Internal real-time clock	Fully compliant with IEC 61000-4-30 Ed. 3 Class A Drift: Typical ± 30 seconds/yr. Temperature compensated. ± 70 seconds/yr. max drift
SNTP	Accuracy: ± 10 to 100 milliseconds absolute, UTC time. Dependent on network latency.
NTP	Accuracy: ± 1 to 10 milliseconds absolute, UTC time. Dependent on network latency
GPS (with optional MS1 module and GPS receiver)	Intrinsic resolution 1 microsecond Accuracy better than Class A requirement (by a factor of 10) < 1 ms.

OPERATING ENVIRONMENT

Operating temperature	Minimum -20 °C, Maximum 65 °C with no load on 24V power supply terminals, Maximum 55 °C with 5.15W load on 24V power supply terminals
Operating humidity	5% RH ~ 95% RH non-condensing, indoor use
Altitude	Maximum 2000 meters above sea level
Overvoltage category	For PQube 3 AC mains measuring terminals, Overvoltage Category III 600V. For PM1 input terminals, Overvoltage Category II 300V.
Pollution degree	2
Isolation	UL/IEC 61010:2010 - 3.6 kV AC 1 min, 5.1 kVDC 1 min, 5.4 kVAC (5 sec), 9.6 kV _{pk} impulse.
Surge	UL/IEC 61010:2010 - 3.6 kV AC 1 min, 5.1 kVDC 1 min, 5.4 kVAC (5 sec), 9.6 kV _{pk} impulse.
Installation category	CAT IV UL/IEC 61010 for voltages up to 300 VAC L-N (equivalent to 480 VAC L-L), CAT III for voltages up to 600 VAC L-N. Pollution degree 2.
Transient voltages	100 kHz 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 PM1/PM2 power supply mains terminals.
RF field strength immunity	3 V/m, IEC 61000-4-3 Test Level 2.
Magnetic field strength immunity	30 A/m, IEC 61000-4-8 Test Level 4.
Ingress protection rating (IP rating)	IP20H, IEC 60529.

(*) contact factory for availability



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