

PQube® 3 Power Analyzer

Operation and Reference Manual

Revision 3.1



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WARNING: Death, serious injury, or fire hazard could result from improper connection or operation of this instrument. Carefully read and understand manual before connecting this instrument.

AVERTISSEMENT: Si l'instrument est mal connecté, la mort, des blessures graves, ou un danger d'incendie peuvent s'en suivre. Lisez attentivement le manuel avant de connecter l'instrument.

WARNUNG: Der falsche Anschluß dieses Gerätes kann Tod, schwere Verletzungen oder Feuer verursachen. Bevor Sie dieses Instrument anschließen, müssen Sie die Anleitung lesen und verstanden haben.

ADVERTENCIA: Una conexión incorrecta de este instrumento puede producir la muerte, lesiones graves y riesgo de incendio. Lea y entienda el manual antes de conectar.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Installation, service, and maintenance of your PQube 3 must only be done by qualified personnel for electrical installations.

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Produced in the United States of America.

Symbol	Meaning
	Caution. Consult this manual in all cases where this symbol is marked, in order to find out the nature of the potential hazards and any actions which have to be taken to avoid them.
	Caution. Risk of electric shock
	Alternating current
	Alternating current (a.c.) or direct current (d.c.)
	Double or Reinforced insulation
	Functional earth terminal <u>not</u> relied on for safety

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1 Introduction

Please note that for most users, the PQube 3 Installation Manual covers all of the necessary information for installing the PQube 3 family, selecting and using modules and CTs, and wiring and configuring. The PQube 3 is easy to use with an intuitive interface and is shipped pre-configured to cover a majority of use cases

If more information is required, this Operation and Reference Manual covers user controls, setting up emails, upgrading firmware, maintenance, operating modes, specifications and other detailed references for the PQube 3 family. It also contains detailed error codes and commands for email as well as a list of industry-standard sag curve specifications for reference.

2 PQube 3 Operation

2.1 User Controls

2.1.1 Navigating the Touchscreen Display

Use the touchscreen on your PQube 3 to navigate the display. You can view live meters, recent events, system information, and perform actions like ejecting removable media and rebooting the unit.



Use the Back button on to go back up one level.

Use the Home button (2nd to left) to go directly to the main screen.

You can save screenshots if you have a USB drive plugged in.

System

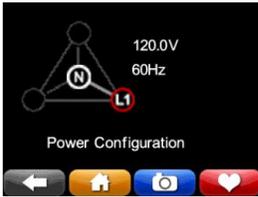


Date/time: You can change the time and day unless you are configured to synchronize on SNTP or NTP, or your PQube 3 is connected to GPS.

Your PQube 3 will automatically set the correct day of week.



If you have enabled SNTP or NTP in your **Setup.ini** file, your PQube 3 will synchronize to UTC time, then it applies the offset from UTC as specified in your Setup file so that all measurements are time tagged with local time (in this example Pacific Time PST).



Power configuration: This screen shows you the power configuration, nominal voltage, and nominal frequency that your PQube 3 is using.



Information: Look up your PQube 3's firmware version, model number, serial number. Status is for internal factory use only.



Language: Select the language for the user interface on your screen. By default the language is English-US.

NOTE: If you get a "Fonts missing" message, re-install your language pack by copying the Languages folder onto a USB drive or microSD card and plugging it into your PQube 3.



Network: Your PQube 3's IP address and MAC address can be found on this screen. This is useful if you have a dynamic IP address. It is also useful for troubleshooting connectivity issues. An external cable must be plugged in.



Advanced: UPS battery status and GPS synchronization status are available here. The relay status function is not supported.

Meters

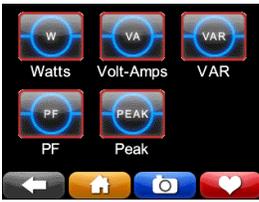


Voltage and Frequency: These are line-to-line, line-to-neutral, and neutral-to-earth true-RMS voltmeters. Different meters will show on these screens, depending on your power configuration. (For example, if the power configuration is “delta”, there will not be any L-N meters, because there is no neutral conductor.) If you have set a potential transformer ratio in your **Setup.ini** file, the values will reflect this ratio.

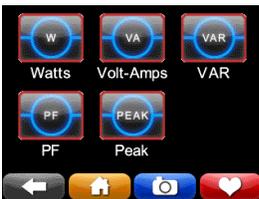


Current: These meters show the true-RMS current. If you have set a current transformer ratio in your **Setup.ini** file, then these meters will use that ratio, so these meters will sometimes show their values in kilo-amps or even mega-amps. Different meters will show on this screen, depending on your power configuration. (For example, if the power configuration is “delta”, this screen will not show a neutral current meter, because there is no neutral conductor in delta power.)

Note: The **PQube3 e** measures **voltage only** and will not show any readings for current or power.



Power: These are the true power, apparent power, and reactive power readings, and they correctly handle harmonics (distorted voltages and distorted currents). If you have set a current transformer ratio and/or potential transformer ratio in your **Setup.ini** file, then these meters will reflect those ratios.

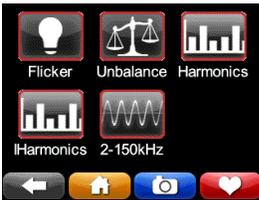


Peaks : These meters show the peak values on Load , Watts and VARS reached . The Peak accumulators can be reset by pressing the Reset button 





Energy: These three meters show the total energy, apparent energy, and reactive energy. The energy accumulators can be reset by pressing the reset numbers.



Class A: You will find additional power quality parameters as defined in IEC 61000-4-30 Class A, the international standard for power quality measurement methods.



Flicker: These meters show flicker according to IEC 61000-4-15 Edition 2 methods. P_{inst} is the instantaneous flicker value for Incandescent Flicker. P_{ST} is the short term flicker, a statistical analysis of P_{inst} after 10 minutes, synchronized to real-time clock. P_{LT} is the mean value of P_{inst} over previous 2 hours, synchronized to real-time clock.



Unbalance: These meters show the voltage unbalance and the current unbalance. You choose in your **Setup.ini** file whether your PQube calculates unbalance using the ANSI C84.1 method, or the IEC method, or the GB method.



Harmonics: Use this screen to view every harmonic up to the 50th for both voltage and current. Select one harmonic at a time. The selected harmonic applies to all channels. (Harmonic values up to the 63rd are recorded in your PQube 3's CSV files.)



Interharmonics: Use this screen to view every interharmonic up to the 50th for both voltage and current. Select one harmonic at a time. The selected interharmonic applies to all channels. (Harmonic values up to the 63rd are recorded in your PQube 3's CSV files.)



2-150kHz: Use this screen to view the conducted emissions in the 2-150kHz range. Useful for monitoring noise due to interference sources including solar inverters.



More Meters: Additional meters can be found here.

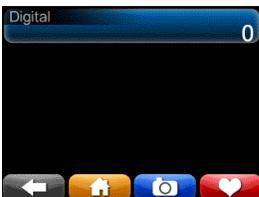


Analog Channels: The Analog meters show the RMS voltage (equivalent to DC voltage for DC signals). You can view the Analog-to-Earth channels (common mode) and the Analog-to-Analog channels (differential mode).

The internal pull-up voltage is 2.5V floating. It will zero out once you connect something to these terminals.



Environmental Meters: If you have ENV2 environmental probes, you can view your temperature, humidity, barometric pressure, acceleration, thermocouple input, and solar irradiance input here.

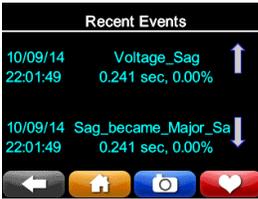


Digital Input: The DIG1 meter shows the average value of the DIG1 digital input averaged over one cycle – useful when the DIG1 signal is changing rapidly, because it will show the duty cycle of the DIG1 signal.



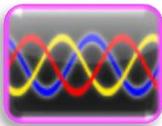
KYZ Pulse Output: Coming soon! Use for revenue-grade energy applications.

Recent Events



Your PQube displays the 10 most recent events. For each event, you get date/time, event type, and magnitude/duration if applicable. Use the up/down arrows to navigate the list.

Actions



Snapshot: You can trigger a Snapshot (waveform capture) event at any time using this button.



Email: Press this button to send a test e-mail.



Trend: Trigger a partial daily trend for today. The data will begin at midnight and end at the time you pressed the button.



Reboot: Use this button to initiate a soft reboot. A confirmation message will appear, choose YES to reboot.



Eject: Use this button to safely remove any flash media (USB or microSD) that you have plugged into your PQube 3.



Clear: Use this button to clear all events and trends from your PQube 3.

Save Files



USB: Use this button to save your recorded data to the USB drive.



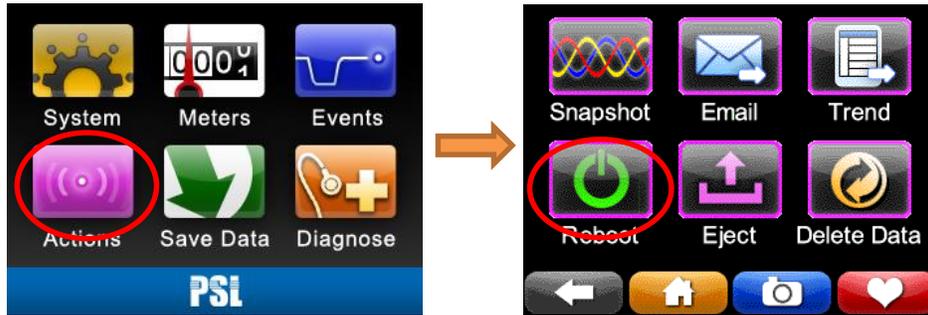
SD: Use this button to copy data to the removable microSD card.

2.2 Rebooting Your PQube 3

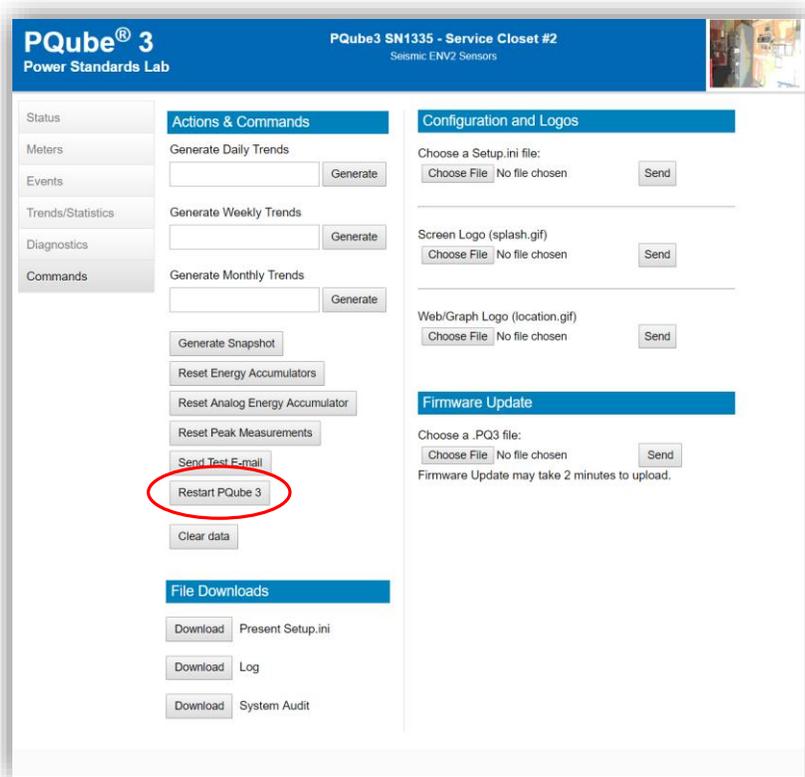
2.2.1 To perform a software reboot

You can do a software reboot your PQube 3 using two methods:

1. Touchscreen – From main menu, go to Actions, then Reboot.



2. Web server – Commands page



2.2.2 To perform a hardware reboot

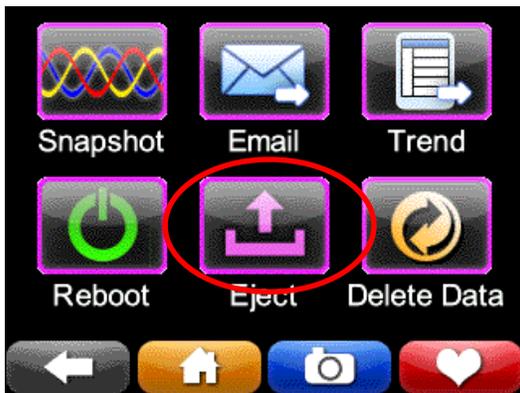
If you cannot perform a software reboot, press the reset button near the microSD card slot with a paperclip.



2.2.3 Ejecting your USB thumb drive or microSD card

You can insert a USB thumb drive or microSD card into your PQube 3. Your PQube 3 will automatically detect it.

To remove the USB drive or microSD card, go to the Actions screen and press the Eject button. After the progress bar is complete, you can remove the drive from your PQube 3.



2.3 Accessing the FTP Server on Your PQube 3

Your PQube 3 has a built-in plain FTP server which you can access using any standard FTP client.

There are 5 different FTP accounts available.

- ftp_user_1, ftp_user_2, ftp_user_3**
 Use these accounts to access events, trends, and logs.
- ftp_config**
 Use this account to upload a new setup file. After the upload is complete, your PQube 3 will automatically reboot and load your new settings. You can also retrieve your PQube 3's existing setup file using this account.
- ftp_updater**
 You can upload new firmware to your PQube 3 using this account. After the upload is complete, your PQube 3 will automatically reboot and install the new firmware.

By default, each FTP account is disabled. To enable access for a particular account, you will need to specify a password for that account.

In the PQube 3 Configurator program, go to the Network Setup tab and locate the FTP Profiles section.

Select the FTP account you would like to use, and hit the Enable button. Specify a password (at least 8 characters long) and save your Setup file. After uploading your setup file, that FTP account will be available for you to use.



2.4 Accessing the HTTP Web Server on Your PQube 3

To access the web server on your PQube 3, it must be:

- Connected to a network
- Have a valid IP address assigned to it (assigned by DHCP or fixed IP)

To access your PQube 3 online, enter the IP address of the PQube 3 into your Internet Browser.



Your browser will automatically direct you to the main Status page.

The screenshot shows the main status page of a PQube 3 device. The page has a blue header with the PQube 3 logo and the text 'Power Standards Lab'. The main content area is divided into several sections: 'PQube 3 Information', 'Configuration', and 'PQube 3 Time'. A left sidebar contains navigation options: Status, Meters, Events, Trends/Statistics, Diagnostics, and Commands. The 'Status' option is selected. The 'PQube 3 Information' section contains the following data:

PQube 3 Information	
Location:	Service Closet #2
PQube 3 ID:	PQube3 SN1335
Note 1:	Seismic ENV2 Sensors
Note 2:	
PQube 3 Serial Number:	P3001335
Model Number:	PQube 3
Firmware Version:	3.7.1.19.03.11
IP Address:	172.17.4.220

The 'Configuration' section contains the following data:

Configuration	
Power Configuration:	Wye/Star
Nominal Line-to-Neutral Voltage	277.1V
Nominal Line-to-Line Voltage	480.0V
Nominal Frequency:	60Hz
Potential Transformer Ratio:	1:1
Current Transformer Ratio:	600:1

The 'PQube 3 Time' section contains the following data:

PQube 3 Time	
Time:	Sun Apr 7 11:11:56 2019 PST
Data from the PSL PQube 3 © by www.PowerStandards.com	

Callouts from the image explain the following fields:

- PQube Location name & PQube ID as specified in your Setup file:** Points to the Location and PQube 3 ID fields.
- Note 1 and Note 2 from your Setup file:** Points to the Note 1 and Note 2 fields.
- PQube 3 serial number and model number:** Points to the PQube 3 Serial Number and Model Number fields.
- PQube3 IP address:** Points to the IP Address field.
- PQube3 date and time (automatically refreshes every few seconds):** Points to the Time field.
- Power configuration, nominal voltage, & nominal frequency:** Points to the Power Configuration, Nominal Line-to-Neutral Voltage, and Nominal Line-to-Line Voltage fields.
- Transformer ratios:** Points to the Potential Transformer Ratio and Current Transformer Ratio fields.

2.4.1 Meters

The page displays and refreshes regularly the various meters. The meters list depends on the power configurations, channels configured to be recorded and environment probes connected.

Meter	Value
L1-N	284.1V
L2-N	283.3V
L3-N	284.8V
N-E	0.07V
L1-L2	490.7V
L2-L3	492.0V
L3-L1	493.6V
L1 Amp	28.0A
L2 Amp	22.0A
L3 Amp	20.6A
N Amp	11.0A
L6 Amp	12.9A
L7 Amp	11.5A
L8 Amp	8.2A
Frequency	59.977Hz
L1-N Voltage Fundamental	284.1V
L1 Voltage Fundamental Angle	0.00deg
L2-N Voltage Fundamental	283.3V
L2 Voltage Fundamental Angle	240.31deg
L3-N Voltage Fundamental	284.8V
L3 Voltage Fundamental Angle	120.33deg
L1 Current Fundamental	27.5A
L1 Current Fundamental Angle	2.68deg
L2 Current Fundamental	21.9A
L2 Current Fundamental Angle	236.78deg
L3 Current Fundamental	20.6A
L3 Current Fundamental Angle	109.67deg

Energy/Power

Meter	Value	
Power	Total	24.58kW
	L1	8.802kW
	L2	7.738kW
	L3	7.956kW
Apparent Power	Total	25.45kVA
	L1	9.128kVA
	L2	7.871kVA
	L3	8.451kVA
True Power Factor	Total	0.965
	L1	0.973
	L2	0.983
	L3	0.941
Reactive Power	Total	6.61kVAR
	L1	2.102kVAR
	L2	1.444kVAR
	L3	2.049kVAR
Energy (since 2018/11/01)	378.656952MWh	
Energy Imported (since 2018/11/01)	378.656982MWh	
Energy Exported (since 2018/11/01)	-0.030042kWh	
Apparent Energy (since 2018/11/01)	418.009MVAh	
Reactive Energy (since 2018/11/01)	158.855MVARh	
Positive Reactive Energy (since 2018/11/01)	158.855MVARh	
Negative Reactive Energy (since 2018/11/01)	-0.037kVARh	
Peak RMS Current (since 2018/04/15)	1 cycle	164.0Arms
	5 minute	96.7Arms
	15 minute	89.5Arms
Peak Power (since 2018/04/15)	1 cycle	107.19kW
	5 minute	65.14kW

ClassA

Meter	Value	
Flicker (L1-N)	P _{max}	0.01
	P _{ST}	0.07
	P _{LT}	0.08
Flicker (L2-N)	P _{max}	0.00
	P _{ST}	0.06
	P _{LT}	0.08
Flicker (L3-N)	P _{max}	0.00
	P _{ST}	0.06
	P _{LT}	0.07
Max 2kHz-9kHz	0.19V @ 2.2kHz(L1-E)	
Max 8kHz-150kHz	0.27V @ 8kHz(L1-E)	
THD-V L1-N	1.06%	
THD-V L2-N	0.97%	
THD-V L3-N	0.95%	
TDD-A L1	2.09%	
TDD-A L2	0.69%	
TDD-A L3	0.84%	
V Unbal Zero Seq	0.03%	
V Unbal Neg Seq	0.34%	
I Unbal Zero Seq	13.16%	
I Unbal Neg Seq	9.59%	

Harmonics

Meter	L1-N	L2-N	L3-N	L1 Amp	L2 Amp	L3 Amp
H3	0.6V	0.8V	0.4V	3.8A	1.1A	1.5A
H5	1.1V	1.6V	1.3V	1.0A	0.1A	0.1A
H7	2.1V	1.3V	1.9V	0.9A	0.6A	0.6A
H9	0.3V	0.4V	0.2V	0.4A	0.3A	0.2A
H11	1.6V	1.5V	1.1V	0.4A	0.3A	0.3A
H13	0.5V	0.5V	0.7V	0.0A	0.1A	0.1A
H15	0.2V	0.2V	0.1V	0.2A	0.1A	0.1A
H17	0.3V	0.2V	0.3V	0.3A	0.1A	0.0A

Floor_Seismic

Meter	Value
Temperature	20.0°C
Humidity	42.9%RH
Pressure	1029.32hPa
Probe A X Acceleration	-0.010m/s ²
Probe A Y Acceleration	0.000m/s ²
Probe A Z Acceleration	0.000m/s ²
Probe A Vector Acceleration	0.017m/s ²

Inside_Box

Meter	Value
Temperature	27.5°C
Humidity	26.6%RH
Pressure	1029.18hPa
Probe B X Acceleration	-0.019m/s ²
Probe B Y Acceleration	-0.019m/s ²
Probe B Z Acceleration	-0.010m/s ²
Probe B Vector Acceleration	0.021m/s ²

2.4.2 Events

The page displays the list of events organized around years, and months. Clicking the links provides access to more details down the data files and graphs for each of the events. You can refresh the events listing at any time by pressing the refresh button.

PQube® 3 Power Standards Lab
PQube3 SN1335 - Service Closet #2
 Seismic ENV2 Sensors

Status	2019 PQube 3 Events		
Meters	Month	Events	Files
Events	2019/04	12	File List
Trends/Statistics	2019/03	42	File List
Diagnostics	2019/02	47	File List
Commands	2019/01	2	File List
	2019/02	5	File List
	2019/01	64	File List

2018 PQube 3 Events			
Month	Events	Files	
2018/12	2682	File List	
2018/11	62	File List	
2018/10	104	File List	
2018/09	115	File List	
2018/08	252	File List	
2018/07	226	File List	
2018/06	276	File List	
2018/05	152	File List	
2018/04	61	File List	
2018/03	97	File List	
2018/02	46	File List	

Links to the details of the events for a given month.

PQube® 3 Power Standards Lab
PQube3 SN1335 - Service Closet #2
 Seismic ENV2 Sensors

Status	
Meters	
Events	
Trends/Statistics	
Diagnostics	
Commands	

2019/04 PQube 3 Events					
Date	Time	Type	Magnitude	Duration in Seconds	Files
2019/04/08	T 10:00:38.045 PDT	Snapshot	---	---	
2019/04/07	T 10:00:37.286 PDT	Snapshot	---	---	
2019/04/06	T 10:00:36.455 PDT	Snapshot	---	---	
2019/04/05	T 10:00:35.614 PDT	Snapshot	---	---	
2019/04/04	T 13:22:31.251 PDT	Probe B Mechanical Shock	0.87m/s²	---	
2019/04/04	T 13:18:27.679 PDT	Probe B Mechanical Shock	0.12m/s²	---	
2019/04/04	T 13:17:05.441 PDT	Probe B Mechanical Shock	0.13m/s²	---	
2019/04/04	T 10:00:34.645 PDT	Snapshot	---	---	
2019/04/03	T 10:00:33.874 PDT	Snapshot	---	---	
2019/04/02	T 15:21:19.217 PDT	Probe B Mechanical Shock	0.58m/s²	---	
2019/04/02	T 10:00:33.147 PDT	Snapshot	---	---	
2019/04/01	T 10:00:32.602 PDT	Snapshot	---	---	

Links to the data files and waveform and RMS graphs for each event

Service Closet #2 2019/04/08 (T 10:00:38.045 PDT) Snapshot			
Graphs	PQDIFF	Spreadsheets	Summaries
P3001335_2019-04-08_T_10-00-38-045_Snapshot_Current_Harmonic.gif P3001335_2019-04-08_T_10-00-38-045_Snapshot_RMS.gif P3001335_2019-04-08_T_10-00-38-045_Snapshot_Voltage_Harmonic.gif P3001335_2019-04-08_T_10-00-38-045_Snapshot_Waveform.gif	P3001335_2019-04-08_T_10-00-38-045_Snapshot_PQDIFF.pqdif	P3001335_2019-04-08_T_10-00-38-045_Snapshot_Harmonic.csv P3001335_2019-04-08_T_10-00-38-045_Snapshot_RMS.csv P3001335_2019-04-08_T_10-00-38-045_Snapshot_Waveform.csv	P3001335_Event.htm P3001335_Event.txt P3001335_Event.xml

2.4.3 Trends

You can refresh the trends listing at any time by pressing the refresh button.

PQube® 3
Power Standards Lab

PQube3 SN1335 - Service Closet #2
Seismic ENV2 Sensors

- Status
- Meters
- Events
- Trends/Statistics**
- Diagnostics
- Commands

2019 PQube 3 Trends and Statistics

Month	Trends/Statistics	Files
2019/04	7	File List
2019/03	32	File List
2019/02	29	File List
2019/01	33	File List
2019 Weekly	13	File List

2018 PQube 3 Trends and Statistics

Month	Trends/Statistics	Files
2018/12	32	File List
2018/11	31	File List
2018/10	32	File List
2018/09	31	File List
2018/08	32	File List
2018/07	32	File List
2018/06	31	File List
2018/05	32	File List

Links to daily/weekly/
monthly trend files

Clicking on "File
List" brings the
list of daily
trends for each
day

PQube® 3
Power Standards Lab

PQube3 SN1335 - Service Closet #2
Seismic ENV2 Sensors

- Status
- Meters
- Events
- Trends/Statistics**
- Diagnostics
- Commands



2019/04 PQube 3 Trends and Statistics

Type	Date	Files
Daily	2019/04/07 (Sunday)	File List
Daily	2019/04/06 (Saturday)	File List
Daily	2019/04/05 (Friday)	File List
Daily	2019/04/04 (Thursday)	File List
Daily	2019/04/03 (Wednesday)	File List
Daily	2019/04/02 (Tuesday)	File List
Daily	2019/04/01 (Monday)	File List

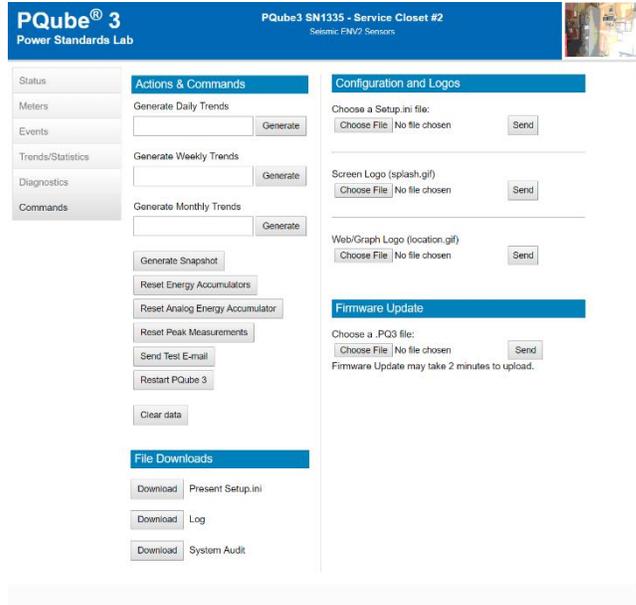
Clicking on "File
List" brings the
daily trend files

Service Closet #2
Daily Trends and Statistics

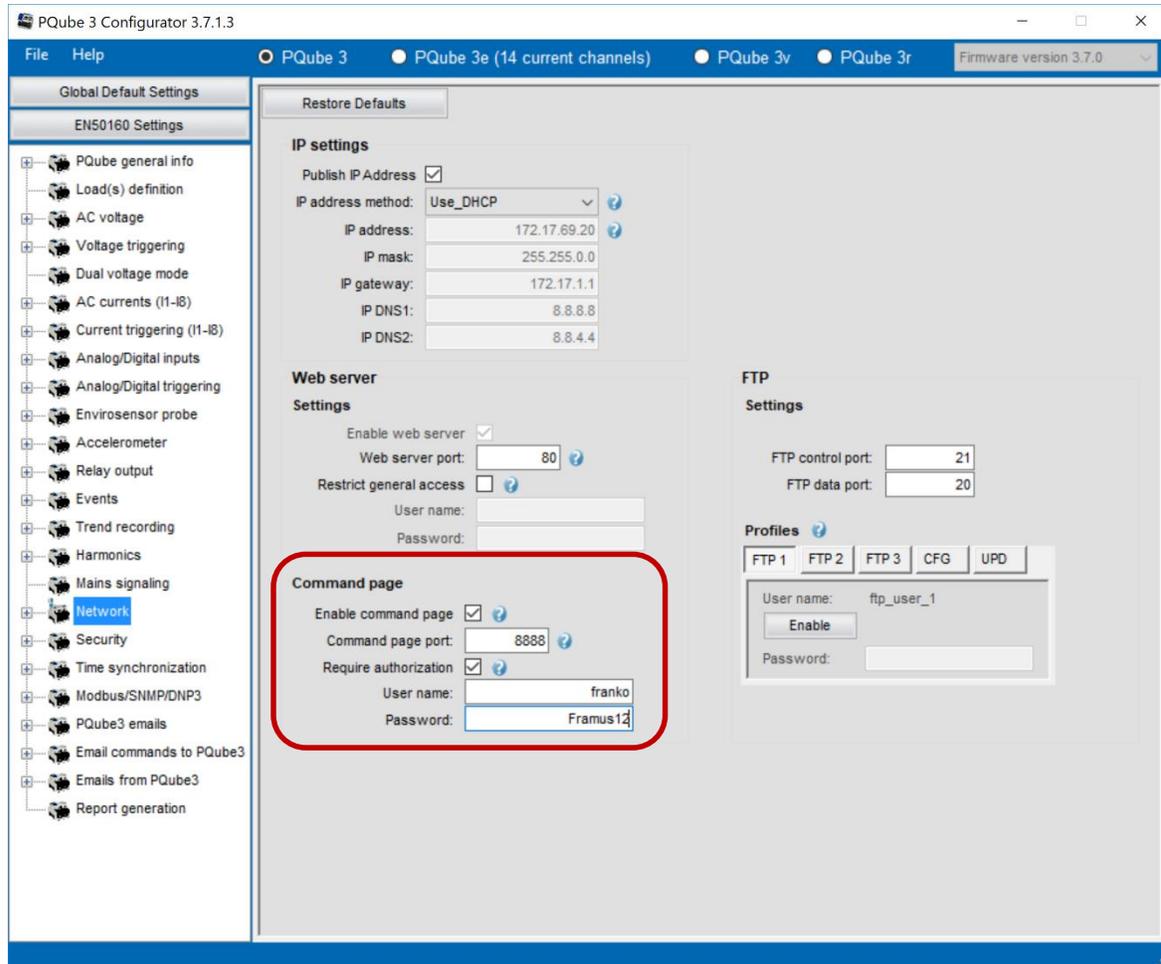
Graphs	PODIF	Spreadsheets	Summaries
P2001335_2019-04-07_2kHz_150kHz_Spectrum.pdf P2001335_2019-04-07_IndividualRemoval.tif P2001335_2019-04-07_Flicker_Trends.tif P2001335_2019-04-07_TTC_Chart.tif P2001335_2019-04-07_Individual_Curves_Trends.tif P2001335_2019-04-07_Individual_Power_Trends.tif P2001335_2019-04-07_L_Voltage_Trends.tif P2001335_2019-04-07_L_N_Voltage_Trends.tif P2001335_2019-04-07_Power_Trends.tif P2001335_2019-04-07_TTD_LibBalance_Trends.tif P2001335_2019-04-07_Temperature_Humidity_Trends.tif P2001335_2019-04-07_Voltage_Current_Trends.tif	P2001335_2019-04-07_10Min_ClassA.pdf P2001335_2019-04-07_10Min_ClassA_PODIF.pdf P2001335_2019-04-07_Power_Energy_Matrs.pdf P2001335_2019-01-07_Trends_Summary.pdf	P2001335_2019-04-07_10Min_ClassA.csv P2001335_2019-04-07_100Sec_Energy.csv P2001335_2019-04-07_2Hz_ClassA.csv P2001335_2019-04-07_2kHz_150k.csv P2001335_2019-04-07_2kHz_9k.csv P2001335_2019-04-07_Power_Energy.csv P2001335_2019-04-07_Summary.csv P2001335_2019-04-07_Trends.csv	P2001335_2019-04-07_TrendsStat.htm P2001335_2019-04-07_TrendsStat.txt P2001335_2019-04-07_TrendsStat.xml

2.4.4 Commands

From the Commands page, you can trigger snapshots or daily trends, send test emails, or reset your PQube 3. You can also apply new setup files and firmware updates from here.



You can restrict access to this page by specifying a username and password for the HTTP Administrator in your setup file.



2.5 PQube 3 Email Setup

You can configure your PQube 3 to send you an email if there is any system activity and whenever new data is available. PQube3 can send an email when there is a power quality event such as a voltage sag or high frequency impulse. You can also execute commands on your PQube 3 by sending emails with the command name in the subject line. All you need to do is provide a dedicated email account for your PQube 3, and define a list of authorized email recipients.

2.5.1 Setting up an email account for your PQube 3

Your PQube 3 needs its own email account. All emails from your PQube will be sent from this email address, and all email commands from you will be sent to this email address.

PSL provides a free email account for every PQube 3. Use the PQube 3 Configurator to automatically set up the pqube.com email account for your PQube 3.

If you don't want to use your free pqube.com email account, our PQube 3 supports accounts from common email providers such as GMAIL. At this time, Microsoft Exchange Server is not supported. Make sure you allow for less secure apps for GMAIL account.

If you want to use an email account using your own company's domain, go to the PQube3 Email Setup section of your Setup file and enter the following information below. You will need to obtain this information from your IT or System Administrator.

Please tell your System Administrator that:

- Your PQube 3 is a standard e-mail client.
- For outgoing mail, your PQube supports plain-text authentication, SSL, Cram-MD5, or MD5-Digest login protocols.
- For incoming mail, your PQube supports plain-text authentication, SSL, Cram-MD5, MD5-Digest, USER-PASS, or APOP login protocols.
- Ask your System Administrator to set up an e-mail account, and get the following information from them:

SMTP Server: _____ Port: _____ Auth method: _____

POP Server: _____ Port: _____ Auth method: _____

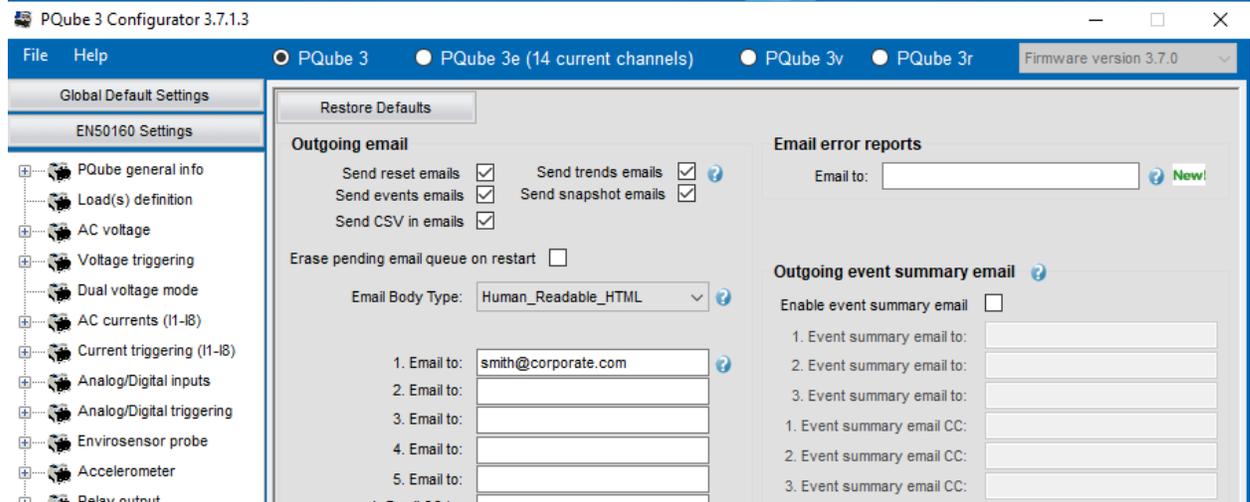
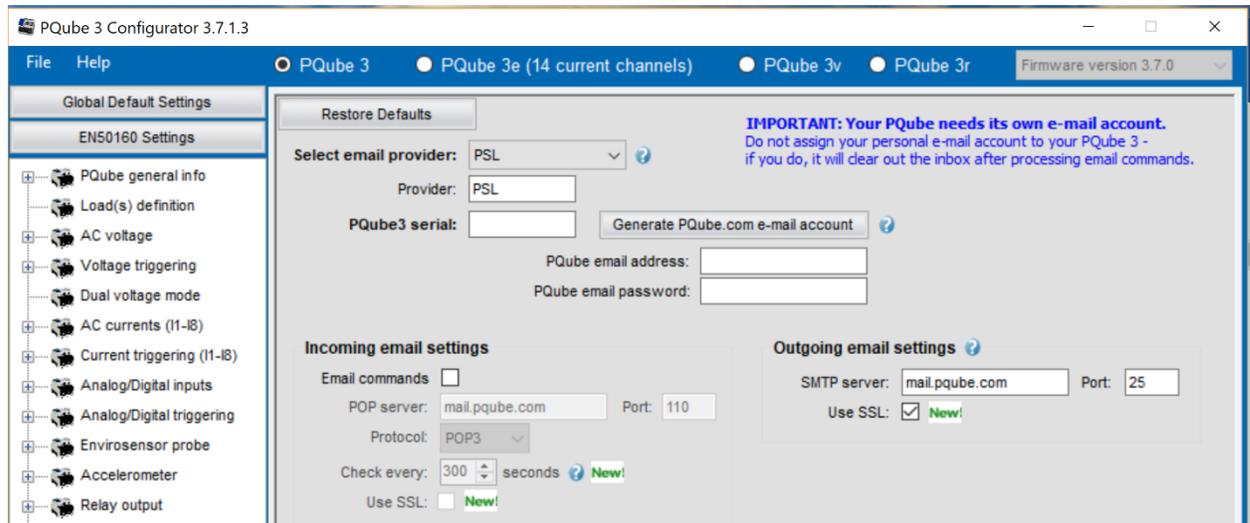
PQube e-mail address: _____

PQube e-mail user name: _____

PQube e-mail password: _____

- Use this information to fill in your **Setup.ini** file in the PQube3 Email Setup tab.

Use the PQube 3 Email tab to setup how often it checks for email and whether you wish to use SSL for added security.



WARNING

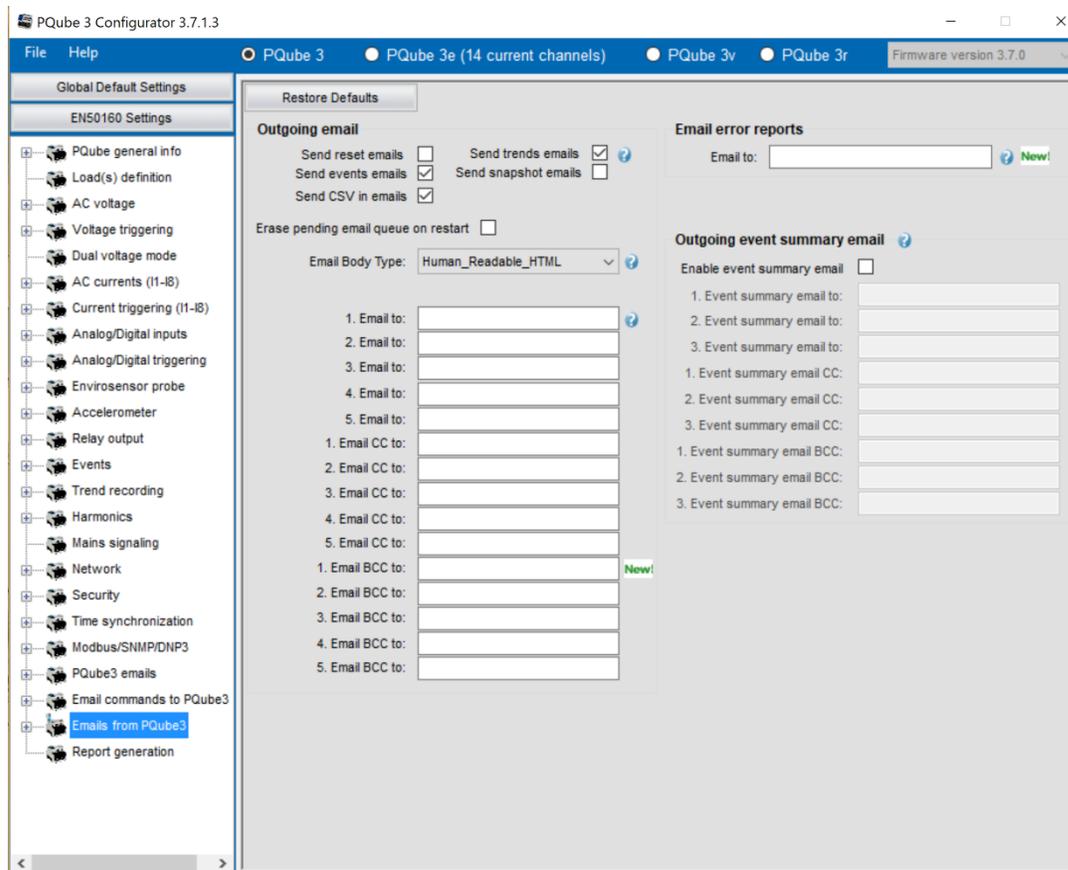
Do not assign your personal email address to your PQube 3. Your PQube 3 must have its own dedicated email address that it can use to send and receive email. Power Sensors Ltd. is not responsible for any loss of data.

2.5.2 Getting event notifications and trend data from your PQube 3 by email

You can choose the type of data you would like to receive from your PQube 3 using the From_Email Commands including Event data, Trend data, Reset emails, and can include output files as attachments where appropriate.

You can specify who will receive these emails by selecting up to five Email_To recipients, five Email_CC_To recipients, and five Email_BCC_To recipients.

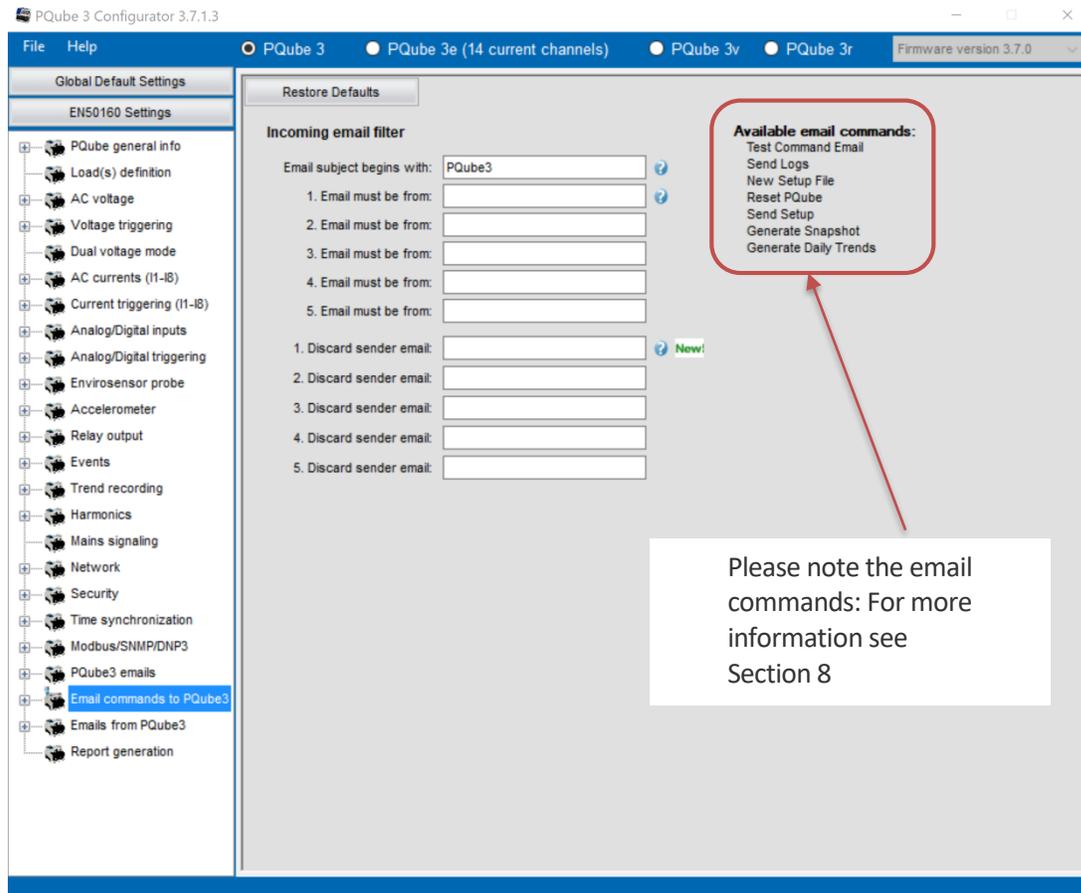
You can also set up to nine total recipients for event summary emails. You can select for people who only need quick notifications that an event has occurred, rather than detailed waveforms and graphs.



2.5.3 Sending commands to your PQube 3 over email

Using the Email_To Commands tab you can enable Incoming Emails to your PQube 3 by checking the appropriate boxes.

For added security you may want to specify a subject keyword and add names to the email whitelist. Only those emails on the whitelist with the first word in the subject will be successfully processed,



Communicating real time - Modbus Setup

2.6 Basics

Your PQube 3 has a built-in Modbus-over-TCP server that you can use to read meters in realtime and determine when new event or trend recordings are available.

You can set the following parameters in your PQube 3's setup.ini file:

Modbus Base Address: The global base address from which all registers are offset. Default is 0x7000.

Modbus Query Port: The TCP/IP port on which the Modbus server listens. Default is port 502.

Modbus Byte Order: Data values spanning multiple registers (such as floats) can be reported in BIG ENDIAN or LITTLE ENDIAN. Default is BIG_ENDIAN.

Modbus Slave ID: The PQube can be assigned a slave ID required in queries. Default value is 0x1.

2.7 Scan Rates, Client Load, and Limitations

The Modbus protocol limits single query register results to 125 registers per scan. A scan of sets of registers can occur at client, PQube, and network speeds. **However, the PQube3 modbus register values only update at the internal meter update rate, which is around 2 Hz.** Therefore, high rate scans of values in sets of registers will only change returned at 2 Hz, even if scanning at higher rates is supported.

The PQube supports multi-client, multi-session modbus, with conventional limit to 10 clients at a time. This value can be changed internally in software.

2.8 Supported Clients

The PQube3 supports the **PSL Modbus Client**, third party free Modbus clients, or any software conforming to the Modbus protocol (such as groov).

2.9 Register List (refer to Modbus Reference Manual)

Refer to the **PQube 3 Modbus Reference Manual** for the register tables.

2.10 Downloads

The **PSL Modbus Client** and **PQube 3 Modbus Reference Manual** are available for download at:

<https://www.powerstandards.com/download-center/pqube-3-3e/>

3 Upgrading the Firmware on your PQube 3

The process to perform firmware updates is similar to applying new setup files.

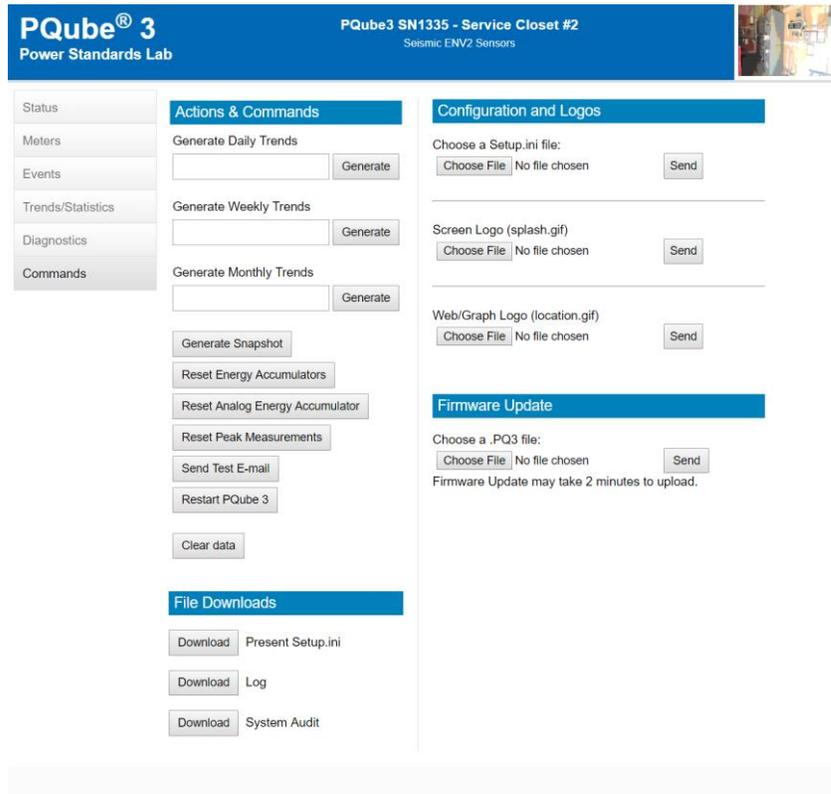
3.1 To Apply Firmware Updates Locally

Copy the firmware (.PQ3) onto a USB thumb drive, then insert it into your PQube 3. The update process will begin automatically and the device will restart after several minutes. PSL provides the firmware updates as compressed files. Make sure you unzip the file the file when you copy it to your flash drive.

After successful update and reboot, your PQube 3 automatically appends the firmware filename with YYYYMMDDHHMMSS so it does not repeatedly initiate the firmware update process. Look at the filename to verify that your PQube 3 successfully processed the firmware update.

3.2 To Apply Firmware Updates over the Web

You can also update the firmware through the Web page <Command> by selecting the file with the [browse] button, and then pressing [send]. Although the browser states that the file is sent, it may take up to 15 minutes for the PQube 3 to update its firmware and reboot, depending on the firmware file size and network connection speeds.



Web page for sending a configuration or updating the firmware

3.3 Apply a Firmware Update over Network

Log into your PQube 3's FTP server with the username **ftp_updater**. Upload the firmware (*.PQ3) into the folder and your PQube 3 will automatically reboot and apply the update.

For instructions on how to access your PQube 3's FTP server, refer to page 53.

3.4 Be Notified When a New Firmware Update is Available

Register at <https://www.powerstandards.com/product/pqube-3/highlights/>

and we'll send you an email whenever a new firmware update is available.

If you prefer not to register, you can also periodically check <https://www.powerstandards.com/product/pqube-3/highlights/> for news and updates.

4 Maintenance

4.1 Turning Off Your PQube 3

Your PQube 3 is designed to be a permanently installed monitor. It does not have an on/off switch because it is designed to run continuously. If you need to turn off your PQube 3, remove your PQube 3's instrument power (either the power screw terminal block on your PQube 3, the optional PM1 Power Supply Module, or PoE). Your PQube 3 will automatically initiate graceful shutdown to prevent any write damage to flash.

If you have a UPS module installed, your PQube 3 will continue to run for the allotted amount of time. To immediately power down the device while on backup power from the UPS module, go to the Actions screen and press Reboot. With no permanent power source available, your PQube 3 will simply turn off.

4.2 Replacing Your PQube 3's Clock Battery

Your PQube 3 uses a user-replaceable, non-rechargeable lithium-manganese coin cell battery to back up the system clock in the event of instrument power loss. PSL recommends replacing this battery every 10 years. When you order a replacement battery, always remember to power off the device first, disconnect mains connections, and verify disconnections.



To remove and replace the battery, insert a small flat-head screwdriver to pry up the label near the USB port and microSD card slot. Remove the old battery and install the new one. It is not possible to install the battery with the wrong polarity.

Follow all applicable federal, state, and local regulations when disposing of the used battery.



Disconnect power to the device before replacing the battery.

Replace battery with a PSL-supplied battery only. Use of another battery may present a risk of fire or explosion. This part must be supplied only by PSL or PSL agents.

4.3 Life Expectancy of the PQube 3 and the PM1 module

The estimated life expectancy of a PQube 3 and its PM1 module is 10 years (estimation based on operating temperature at 20-30degC).

4.4 UPS1 Life Expectancy and Long Term Storage Instructions

The lithium ion batteries in your UPS1 module are rated for 5 years or 500 cycles, whichever comes first. Contact PSL to replace the batteries. Do not attempt to replace the batteries yourself.

If you need to store your PQube 3 and modules on the shelf for 3 months or longer, remember to fully charge the batteries in your UPS1 module before placing them in storage. To fully charge the batteries, turn on your PQube 3 with the UPS1 module plugged in, and let it run for at least 1 day.

PSL recommends charging your UPS1 modules every 6 months while they are in storage. You must store your UPS1 modules at an ambient temperature between -20 – 35°C.

4.5 Cleaning Instructions

If necessary, wipe the accessible parts of your PQube 3 with a slightly damp cloth while it is powered off. Do not use abrasives or chemical cleaners and do not clean your PQube 3 while it is powered on.

4.6 Reasons for Reset

If your PQube 3 is configured to email you whenever system activity occurs, it will notify you whenever it has reset.

Reset reasons	Description
System Timeout reached	One of the processes of the PQube is stuck or takes too much time to complete compared to expected
Setup File Sent	A new setup.ini file has been sent
Update Required Restart	A firmware update was sent and PQube3 restarted
User Triggered Display Reboot	The touch screen <Action> <reboot> has been used
Web Command Reboot	A reset has been requested from the web command page
Battery Timeout Reached. Battery Percentage: XX%	The PQube has shut down after reaching the configured autonomy of battery (see PQube configuration).
Unspecified Reason	No reason identified (default)

4.7 Calibration Information for Your PQube 3

Every PQube 3 is calibrated and traced to NIST at the factory. You can download a free NIST trace certificate that contains the specific calibration information for your PQube 3 by entering your PQube 3's serial number at <https://www.powerstandards.com/?product=pqube-3/certificates>

5 PQube 3 Technical Specifications

The **PQube 3 Technical specifications** are available for download at:

<https://www.powerstandards.com/?product=pqube-3/specifications>

6 Reference:

6.1 List of Recorded Parameters

List of recorded voltage parameters

VOLTAGE		V_RMS (across 3-Phase)	V_RMS (both L-N and L-L)	V_RMS (N-E)	Frequency	Flicker Pinst	Flicker Pst	Flicker PLT				V_NegSeq_Unbalance	V_ZeroSeq_Unbalance	V_THD	V_Harm1	V_Harm2	:	V_Harm 50	V_InterHarm1	V_InterHarm2	..	V_InterHarm49
10 sec	avg				x																	
1 min	avg	x	x	x	x	x	x	x				x	x	x								
	min	x	x	x	x							x	x	x								
	max	x	x	x	x							x	x	x								
10 min	avg	x			x	x	x	x				x	x		x	x	..	x			..	x
	min	x																				
	max	x												x	x	..	x	x	x	..	x	
2 hour	avg	x			x	x	x	x				x	x	x	x	x	..	x	x	x	..	x
	max							x						x	x	..	x					

List of recorded conducted emission parameters

SupraHarmonics						
VOLTAGE 2kHz-9kHz emissions	2000Hz	2200Hz	2400Hz	:	8800Hz	9000Hz
	X	X	X	:	X	X
	X	X	X		X	X

VOLTAGE 8kHz-150kHz emissions	8 kHz	10 kHz	12kHz	:	148 kHz	150 kHzHz
	X	X	X	:	X	X
	X	X	X		X	X

List of recorded current parameters

CURRENT		I_RMS	I_Neurtal	I_GND	I_channel 6	I_channel 7	I_channel 8	I_channel 9 (PQube 3e)	:	I_channel 14 (PQube 3e)		I_NegSeq_Unbalance	I_ZeroSeq_Unbalance	THDi or TDD	I_Harm1	I_Harm2		I_Harm 50	I_InterHarm1	I_InterHarm2	..	I_InterHarm49	
	10 sec	avg																					
1 min	avg	x	x	x	x	x	x	x	..	x		x	x	x	x	x	..	x	x	x	..	x	
	min	x	x	x	x	x	x	x	..	x		x	x	x									
	max	x	x	x	x	x	x	x	..	x		x	x	x									
10min	avg	x										x	x	x	x	x	..	x	x	x	..	x	
	min																						
	max																						
15min /user																							
2 hour	avh	x										x	x	x	x	x	..	x	x	x	..	x	
	max																						

List of recorded environmental parameters

ENVIRONMENT (up to 2 probes)		Temperature	Humidity		Baro pressure	Acceleration (X-axis)	Acceleration (XYaxis)	Acceleration (Z-axis)				Acceleration (vector)
1min avg		x	x		x	x	x	x				x
1min min		x	x		x	x	x	x				x
1min max		x	x		x	x	x	x				x

List of recorded analog channel parameters

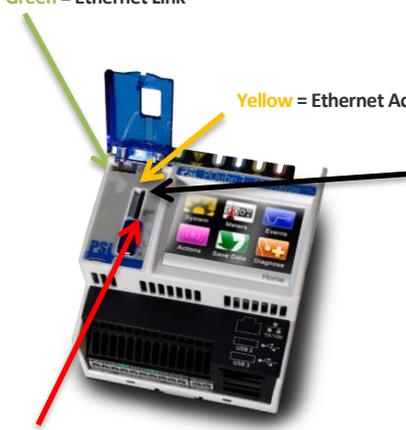
ANALOG CHANNELS	AN1_E magnitude	AN2_E magnitude	AN3_E magnitude	AN4_E magnitude	AN1-AN2 magnitude	AN3-AN4 magnitude	AN1XAN2 magnitude	AN3XAN4 magnitude			AN1XAN2 - Energy	AN3XAN4 - Energy	
1min avg	x	x	x	x	x	x	x	x			x	x	
1min min	x	x	x	x	x	x	x	x					
1min max	x	x	x	x	x	x	x	x					

6.2 PQube 3 Operating Modes

PQube 3 LED Blinking Modes

Green = Ethernet Link

Yellow = Ethernet Activity



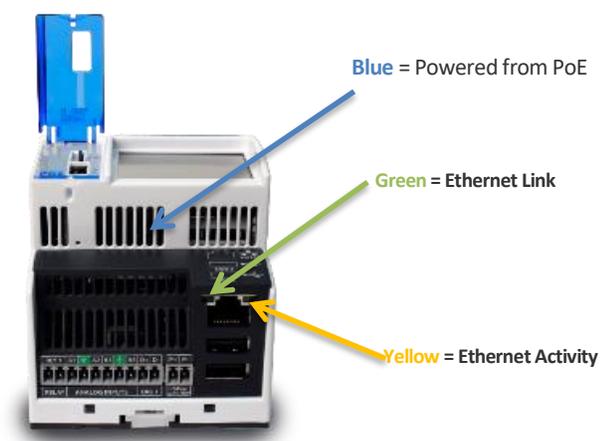
Purple = Seeking phase lock (still waiting to record data)
Green = Locked onto power configuration (recording has started)
Light Blue = firmware update
Orange = seeking voltage to lock onto and measure

Red = Disk activity

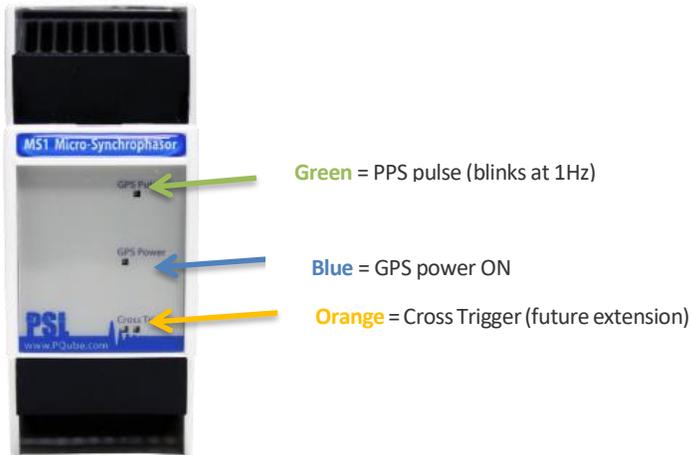
Blue = Powered from PoE

Green = Ethernet Link

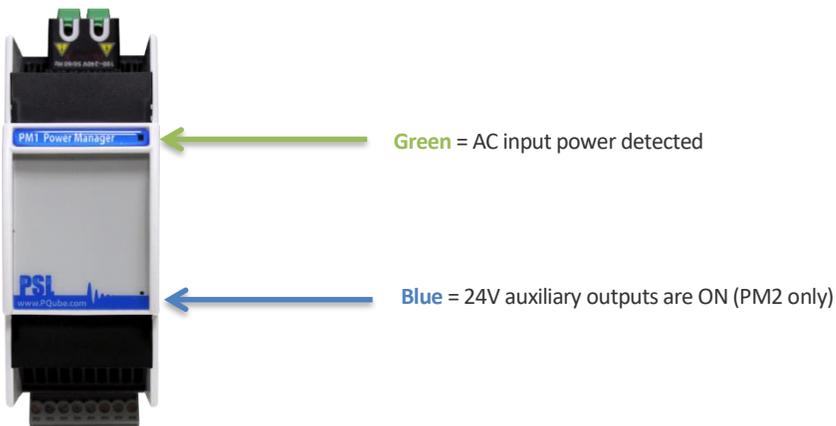
Yellow = Ethernet Activity



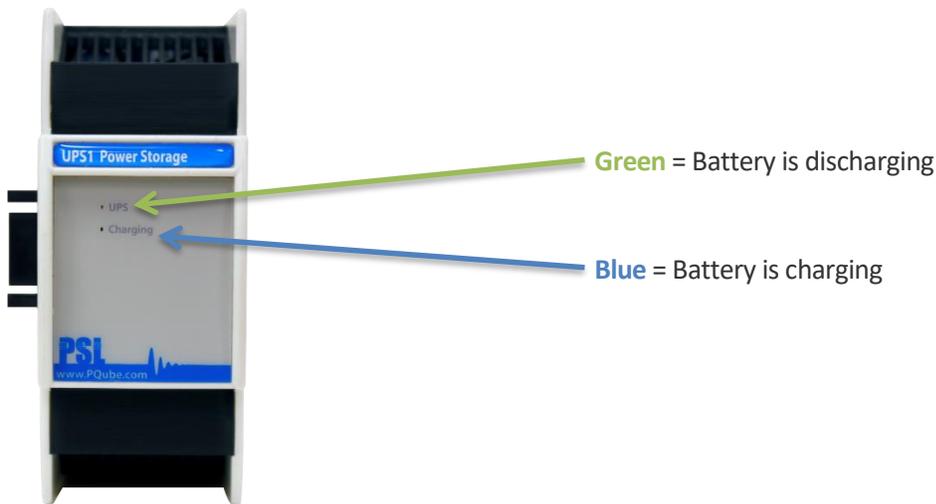
MS1 - LED Indications



PM1/PM2 – LED Indications



UPS1/2/3 – LED Indications



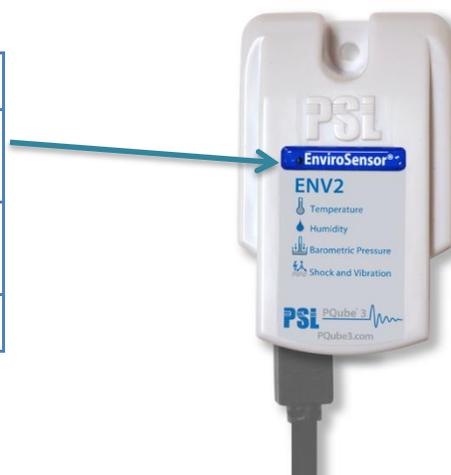
ENV2 – LED Indications

Green blinking at 1Hz = Normal operation

Green blinking at 2Hz = Acceleration event in progress

Red blinking = Powered, but not communicating with PQube 3

Red solid = Transmitting event data to PQube 3



6.3 List of Email Commands

Command (case sensitive)	Description
Test Command Email	This forces the PQube 3 to send a sample email.
New Setup File	Your new setup file must be named Setup.ini , and must be attached to the e-mail. Your PQube 3 will send you two reply e-mails: one when it receives the new setup file, and another when the new setup file has been successfully installed.
Reset PQube	Resets PQube 3 upon receipt of email. This is useful when loading a new setup file or firmware via FTP.
Send Logs	You can ask your PQube 3 to send you its log files via e-mail. The log files can help diagnose PQube setup problems, and they show the complete history of your PQube. For faster technical support, please include these files when contacting our technical support department.
Send Setup	Retrieve the existing setup file from your PQube 3.
Generate Snapshot	Takes a waveform recording of your power.
Generate Daily Trends	Generates the Daily Trends for today. The data ranges from Midnight to the moment the email request is received.

Note: You can test emails using the PQube 3 screen. You can also send an email remotely from the PQube 3 Command Page by pressing the email test command.

6.4 List of Email Error Codes

Fail Codes	Description
1 No SMTP server address specified	There is no SMTP server address specified in the Setup.ini
2 No SMTP server port specified	There is no SMTP server port specified in the Setup.ini
3 Could not ping SMTP server	No ping response from SMTP server. Possible Reasons: <ul style="list-style-type: none"> • Network not available (no Ethernet connection or network down) • Router, DNS, or network configuration error • SMTP server address error (typo)
4 No To recipients specified	No To: Recipients are specified in the Setup.ini
5 SMTP Port connection refused	Could not connect to SMTP port specified Possible Reason: <ul style="list-style-type: none"> • Wrong SMTP port configured
6 Postfix front end error	Postfix didn't like the front-end request

Note: If PQube3 is having trouble reaching the SMTP server, double check that your PQube3 was assigned an IP address as well as try pinging the SMTP server from the same LAN that your PQube3 is connected to. If these seem OK, check in with your network administrator to make sure there are no firewall rules blocking SMTP connections.

6.5 List of Error Messages

These codes (found in PQube log file) can be used to troubleshoot errors in setup when contacting technical support.

Error Codes	Error Message
64	command line usage error
65	data format error
66	cannot open input
67	addressee unknown
68	host name unknown
69	service unavailable
70	internal software error
71	system error
72	critical OS file missing
73	can't create (user) output
74	input/output error
75	temp failure; user is invited to retry
76	remote error in protocol
77	permission denied
78	configuration error

6.6 MS1 module to GPS1 receiver 8-pin cable pinouts:

MS1 Pin-Out with pin 1 on left while looking at module from the front				GPS Receiver Pin-Out based on standard RJ-45 Ethernet pin-out			
Pin #:	Net Name:	Function:	Wire Color*:	Pin #:	Net Name:	Function:	Wire Color*:
1	ANT_PPS-	Pulse Per Second -	Orange/White	1	ANT_PPS-	Pulse Per Second -	Orange/White
2	ANT_PPS+	Pulse Per Second +	Orange	2	ANT_PPS+	Pulse Per Second +	Orange
3	ANT_RX-	Received Data -	Green/White	3	ANT_RX-	Received Data -	Green/White
4	ANT_TX+	Transmitted Data +	Blue	4	ANT_TX+	Transmitted Data +	Blue
5	ANT_TX-	Transmitted Data -	Blue/White	5	ANT_TX-	Transmitted Data -	Blue/White
6	ANT_RX+	Received Data +	Green	6	ANT_RX+	Received Data +	Green
7	ANT_CO M	Power Supply Return	Brown/White	7	ANT_CO M	Power Supply Return	Brown/White
8	ANT_25V	Positive Power Supply	Brown	8	ANT_25V	Positive Power Supply	Brown

*Wire color is based on standard Ethernet cable used to interface between MS1 Module and GPS1 Receiver.

6.7 PQube3 Event Types

Your PQube comes with an embedded library of event triggers. A trigger event is a condition that can be detected by the PQube3. When triggering on an event, the PQube3 will record and store an event summary. For certain types of events, the PQube3 also records a waveform and an RMS evolution will also be recorded.

The PQube3 can trigger on voltage amplitude deviations , such as sag (dips) , swells , interruptions, wave shape changes, on frequency deviations, but it also can trigger on current amplitude exceeded (load current), or inrush currents.

The PQube can also trigger on any of its 4 analog input channels or its digital input channel. If equipped with one or more ENV2 EnviroSensors, the PQube can trigger on temperature humidity and even on external events such as mechanical shocks or seismic type of disturbances.

The chapter below describes the various types of events and what information is recorded:

EVENT TYPE	Recordings		
	Event summary	Waveform	RMS
VOLTAGE events			
Voltage_Sags	X	X	X
Voltage_Swells	X	X	X
Voltage_Interruptions	X	X	X
Major_Sags (see annex 7 below)	X	X	X
Over-frequency	X	X	X
Under-frequency	X	X	X
RVC (Rapid Voltage Changes)	X	X*	X*
Waveshape Changes	X	X	X
High Frequency Impulse (If HF function enabled)	X	X*	X*
CURRENT events			
Phase Current Trigger	X	X	X
Phase Current Trigger	X	X	X
Analog channels Events			
AN1-E (thru AN4-E) Sags	X	X	X
AN1-E (thru AN4-E) Swells	X	X	X
ENVIROSENSOR (ENV) events			
Probe A/B Low temperature	X		
Probe A/B High temperature	X		
Probe A/B Low Humidity	X		
Probe A/B High Humidity	X		
Probe A/B Mechanical Shock	X	X**	
Probe A/B Seismic Disturbance	X	X**	
Note: (*) with PQube3 firmware 3.5.0, (**) acceleration signature			

Triggering mechanism – general overview

Detection – state machine

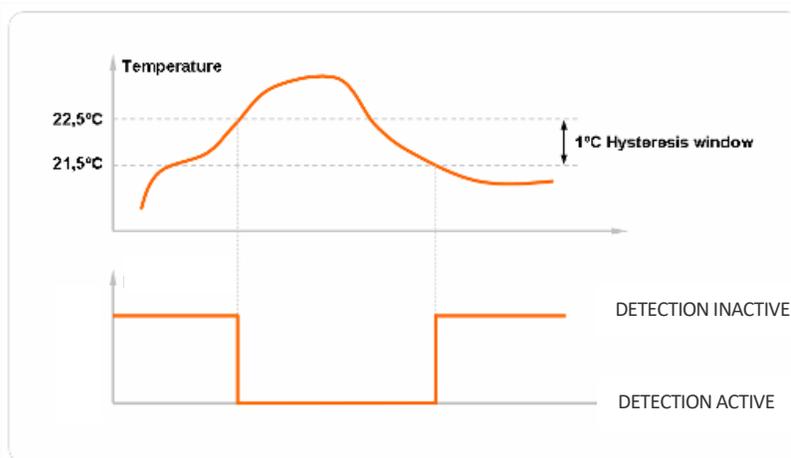
For most of the PQube3 trigger events, the detection algorithm works with a state machine with one (upper) or two (lower and upper) threshold value(s), along with a hysteresis value.

For voltage amplitude, current amplitude and analog input amplitude events, the detection algorithm is based on comparison of “half cycle” RMS amplitudes against the thresholds, referenced as $U_{rms(1/2)}$. The $U_{rms(1/2)}$ values are computed as an RMS value over a window of 1 cycle commencing at the voltage signal zero crossing. The window slides by half a cycle for the next evaluation. Complete definition of $U_{rms(1/2)}$ is described in IEC 61000-4-30 Ed3).

Events such as RVC (rapid voltage changes) and HF impulse have a more complex triggering condition (RVC triggering method is described in IEC 61000-4-30 Ed3).

Hysteresis

The detection (start of event) occurs as soon as the parameter value crosses the threshold value (low or high). The end of the event occurs when the threshold and the hysteresis is crossed. The goal of a hysteresis is to avoid multiple (or bursts of) events when the parameter fluctuates around the threshold value.



The example here shows the use of hysteresis on a high temperature detection with a threshold of 22.5 degC and a hysteresis of 1 degC.

Duration

The duration of an event is the time difference between its start time and end time.

Events with no duration:

The following events, are not characterized with an end portion, and therefore have no duration characteristic:

- Current events (phase current, neutral current, earth current)
- HF impulse events (they are characterized with more advanced parameters).
- Mechanical shocks and seismic disturbances

➤ Temperature/humidity events

3 phase Voltage sags, swells and interruptions events:

A full description of the algorithm is found in chapter 5.4.2 and 5.4.3 of the IEC 61000-4-30 Ed3.

A 3 phase sag starts as soon as one of the phase $U_{rms(1/2)}$ values amplitude crosses the sag (lower) threshold and ends when all 3 phase voltage amplitudes are back within the threshold plus the hysteresis.

A 3 phase swell starts as soon as one of the phase $U_{rms(1/2)}$ values crosses the swell (upper) threshold and ends when all 3 phase $U_{rms(1/2)}$ are back within the threshold minus the hysteresis.

A 3 phase interruption starts when all 3 phase $U_{rms(1/2)}$ values crosses the swell (upper) threshold and ends when at least one of the phase voltage “half cycle” amplitudes are back within the threshold + the hysteresis.

Frequency events:

Frequency events are based on frequency measurements done based on counting of zero crossings on a given period. The frequency triggering method uses a frequency refreshed every cycle, and the value is computed on window of 64 cycles.

Note:

the PQube3 also computes frequency aggregated at a 10s interval as per IEC 61000-4-30 Ed3. This frequency aggregation, however, is not used for triggering, but is recorded in a specific 10s frequency file

Inrush current events:

Inrush triggers have thresholds for magnitude and time. If the current increases by the Inrush Threshold value or more, within the specified time period or less, the PQube will trigger an inrush current event.

Waveshape Change events:

Your PQube 3 triggers a Waveshape Change when the voltage waveform changes abruptly. It uses the “floating window” algorithm to compare each cycle to the previous cycle. It is especially useful for detecting Power Factor Correction capacitor switching.

If the voltage changes from one cycle to the next exceeds the selected threshold, for the selected duration or longer, your PQube will trigger a Waveshape change.

Event parameters

The section below presents a list of recommended /default thresholds for events:

The event [name] is the name that can be seen in the web event list page, is part of the event file names, or email subjects (emails sent by the PQube3).

2016/08/21	T 19:58:35:461 PDT	Voltage Sag	85.08%	0.267	File List
2016/08/21	T 19:58:35:437 PDT	Waveshape Change	---	---	File List(+)
2016/08/21	T 13:07:24:858 PDT	High Frequency Impulse	177.00V	---	File List(+)
2016/08/21	T 12:00:33:807 PDT	Snapshot	---	---	File List(+)

PSL - Alameda, California 2016/08/21 (T 19:58:35.437 PDT) Waveshape Change			
Graphs	PQDIF	Spreadsheets	Summaries
P3001425_2016-08-21_T_19-58-35-437_Waveshape_Change_RMS.gif	P3001425_2016-08-21_T_19-58-35-437_Waveshape_Change_PQDIF.pqd	P3001425_2016-08-21_T_19-58-35-437_Waveshape_Change_RMS.csv	P3001425_Event.htm
P3001425_2016-08-21_T_19-58-35-437_Waveshape_Change_Waveform.gif		P3001425_2016-08-21_T_19-58-35-437_Waveshape_Change_Waveform.csv	P3001425_Event.txt
			P3001425_Event.xml

 p3001425@pqube.com	2016/09/30_12:01:04_-_Snapshot_-_PSL_-_Alameda,_California	Fri 9/30/2016 12:11 PM	2 MB	<input type="checkbox"/>
 p3001425@pqube.com	2016/09/30_07:56:31_-_Waveshape_Change_-_PSL_-_Alameda,_California	Fri 9/30/2016 8:06 AM	2 MB	<input type="checkbox"/>
 p3001425@pqube.com	2016/09/30_07:56:31_-_RVC_-_PSL_-_Alameda,_California	Fri 9/30/2016 8:06 AM	28 KB	<input type="checkbox"/>

Event type/name	Description	Threshold default	Min/max threshold
Voltage events			
Voltage_Sags	Voltage Sags as per IEC 61000-4-30, on Ph-N channels and Ph-Ph channels	90.0%Un (remaining voltage)	99.0~X%Un X=interruption threshold
Voltage_Swells	Voltage Swells as per IEC 61000-4-30, on Ph-N channels and Ph-Ph channels	110.0%Un	101.0 ~200%Un
Voltage_Interruptions	Voltage Interruptions as per IEC 61000-4-30, on Ph-N channels and Ph-Ph channels	10%Un (remaining voltage)	1~10%Un
Major_Sags (see annex below)	Voltage sag with minimum depth and minimum duration criterion(3 Phase, Ph-Ph)	See Annex	See Annex
Over-frequency	Frequency above the upper threshold	100.5% (Nominal Frequency)	100.001%~ 200.000%
Under-frequency	Frequency below the lower threshold	99.5% (Nominal Frequency)	1.000%~ 99.990%
RVC	Rapid voltage changes as per IEC 61000-4-30 Ed3. on Ph-N channels and Ph-Ph channels	6%Un	0.01%~99.99%
Waveshape Change	Wave shape change compared to the previous portion of the wave shape (see definition above)	20% 10 cycles	5%~50% 0.5 ~30 cycles
High Frequency Impulse	Sub millisecond fast transients down to 250ns duration events.	2000V	300V~6000V
Current events			
Phase Current Trigger	Current RMS amplitude exceeds threshold	1A	0.001A~no limit
Phase Current Trigger	Current inrush (current gradient) exceeds a gradient threshold	1A 1 cycle	0.001A~no limit 1 cycle~no limit
Analog channels Events			

AN1/2/3/4 Sag	Analog Channel AN1 through AN4-E Sag (method as per IEC61000-4-30 Ed3)	2V	No limits
AN1/2/3/4 Swell	Analog Channel AN1 through AN4-E Swell (method as per IEC61000-4-30 Ed3)	60V	No limits
ENVIROSENSOR events			
Probe A/B Undertemperature	Temperature below the lower threshold	0 degC	No limit
Probe A/B Overtemperature	Temperature above the upper threshold	50 degC	No limits
Probe A/B Low Humidity	Humidity below the lower threshold	0 %	No limits
Probe A/B High Humidity	Humidity above the upper threshold	90%	No limits

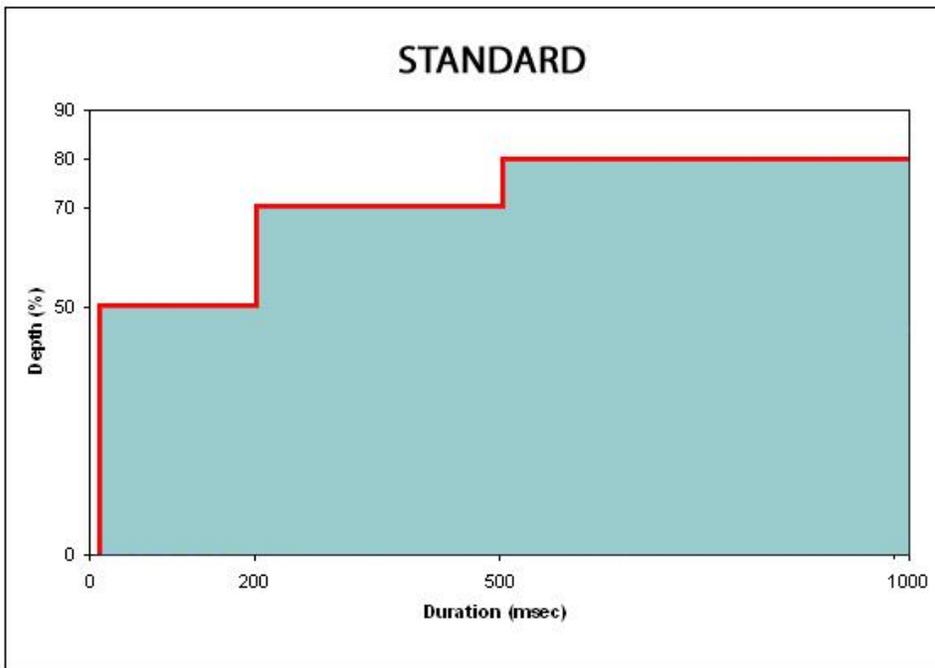


6.8 Major Sag (Dip) Curves

Your PQube supports the following world-wide standards: STANDARD (IEC 61000-4-34), SEMI F47, Samsung Power Vaccine, ITIC, CBEMA, MIL-STD 704E, and MIL-STD 1399. These standards define ride-through curves based on the depth and duration of voltage dips. When the voltage dips below the ride-through curve, your PQube will trigger a Major Dip event. You can specify which standard to use in your **Setup.ini** file.

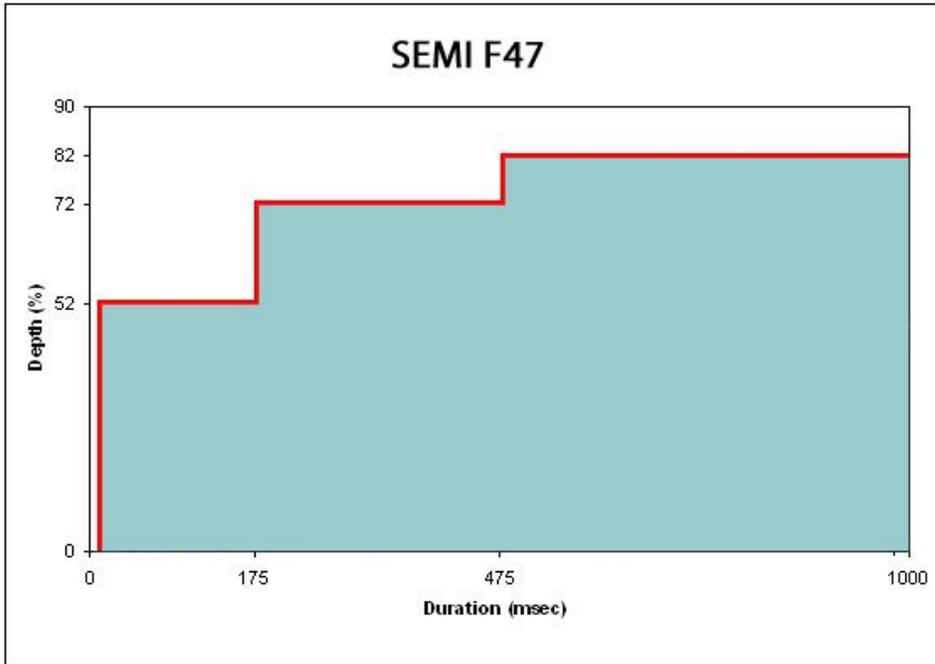
This is especially useful for electrical systems manufacturers, who must design their equipment to withstand voltage sags that do not dip below the ride-through curve.

STANDARD



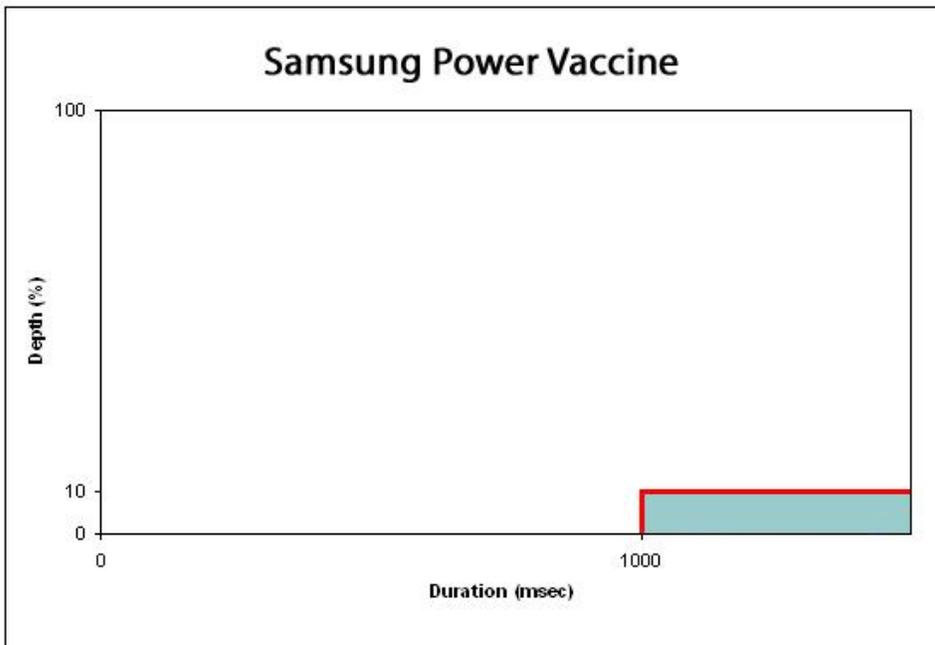
NOTE: Use this curve to detect only events that lie outside the SEMI F47 boundary.

SEMI F47

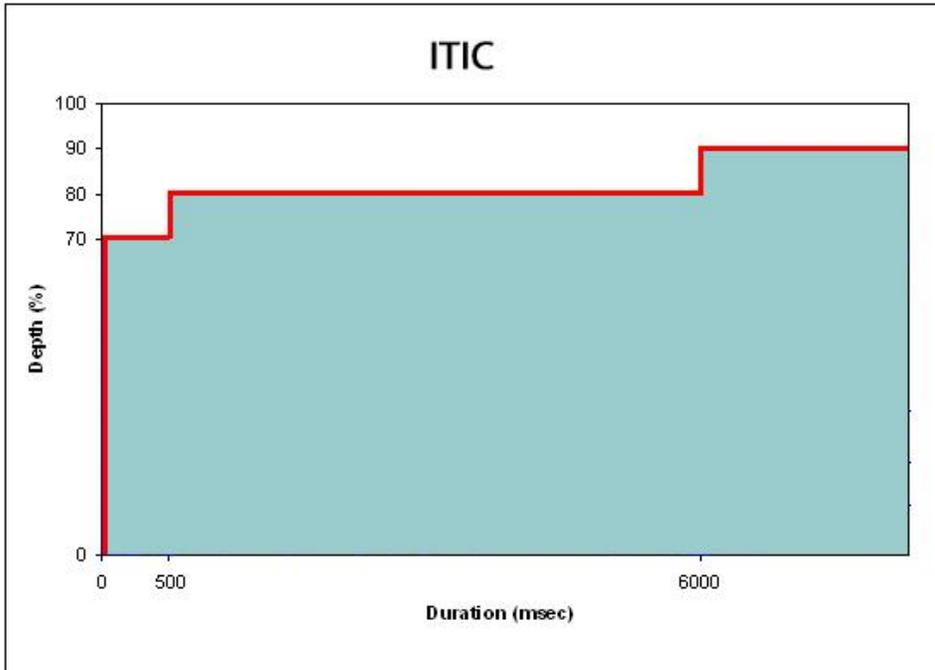


NOTE: Use this curve to guarantee that a Major Dip is detected for events that lie directly on the SEMI F47 boundary.

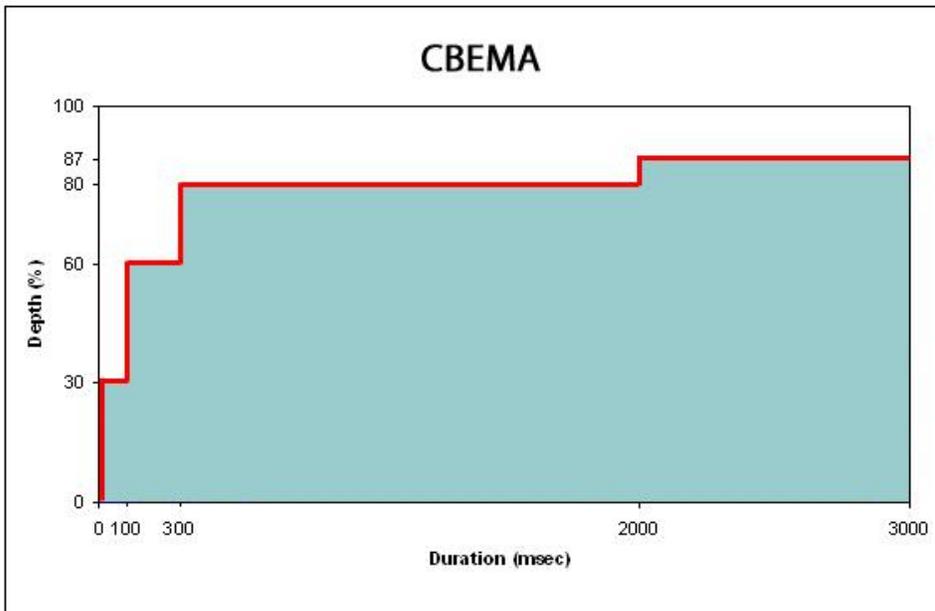
Samsung Power Vaccine



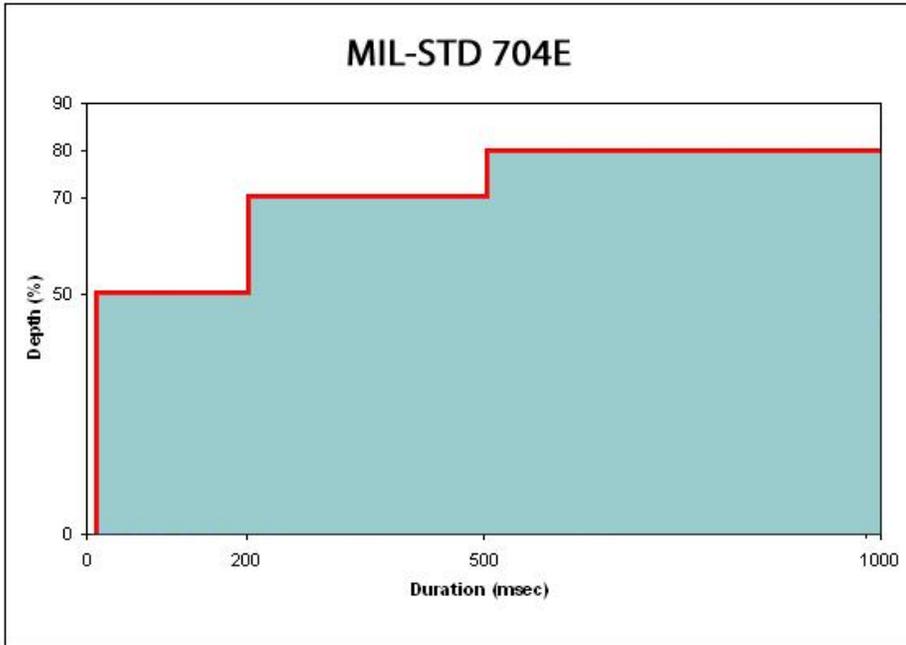
ITIC



CBEMA



MIL-STD 704E



MIL-STD 1399

