

Big Data Solution for the Smart Grid

PQView

For Smart Grid

**The Industry Standard for Power Quality Database
Management and Analysis Software**



www.electrotek.com

What is PQView?

PQView is a multi-component software system developed by Electrotek Concepts® for building and analyzing databases of power quality and energy measurements. Its components build measurement databases, write summary reports, compute power quality indices, view waveforms and rms samples, and trend steady-state quantities via workstations and web browsers. Power providers, industrial power consumers, consulting companies, and university researchers throughout the world widely recognize PQView for its capabilities and flexibility.

PQView builds databases with billions of measurements from thousands of monitoring points taken by many different types of meters, including power quality monitors, voltage recorders, in-plant monitors, and digital fault recorders. It can store and analyze information with the measurements about cause and source of triggered events, as well as evaluate the financial impact of events to both a power provider and a power user. It can quickly extract meaningful information from a one megabyte or one terabyte database.

PQView combines powerful features in a user-friendly interface. Measurements can be stored in either Microsoft® Access or Microsoft SQL Server. A complete PQView system consists of three main applications: the Power Quality Data Manager, the Power Quality Data Analyzer, and PQWeb®.

PQView Power Quality Data Manager

The primary function of the PQView Power Quality Manager (PQDM) is to build power quality databases automatically from data sources. It also automatically sends e-mail notifications using SMTP servers when data sources have finished importing, rms voltage variations (voltage sags, swells, and interruptions) are imported from data sources, or measurements are not collected from a monitoring instrument for a specified

number of days. PQDM also automatically correlates measurements by time stamp and location, and can be combined with add-in modules to provide automatic fault location estimates, voltage sag direction, or capacitor assessment.

PQView Data Sources

PQDM automatically builds power quality databases from data sources. It also automatically sends email notifications using SMTP servers or Microsoft Outlook clients when data sources have finished importing, rms voltage variations are imported from data sources, or measurements are not collected from a monitoring instrument for a specified period. PQDM automatically correlates measurements by time stamp and location. It also deletes old measurements, manually adds missed rms voltage, and performs EN 50160 compliance calculations, automatic derivations, and automatic fault location. In addition, it can update measurement databases automatically once per day, manually, or as fast as once every minute. PQDM integrates data from the following data store formats:

IEEE® Std 1159.3-2003 PQDIF Files

IEEE® Std C37.111-1991/1999 COMTRADE Files

MODBUS® Devices (Optional)

Arbiter® Systems 1133A Power Sentinel (Optional)

Advantech® Corporation ADAM Analog and Digital Modules (Optional)

- Cooper Power Systems CYME
- Dranetz® Signature System® and Encore® Series
- Dranetz PASS® Database and PND5 Archive Files
- Dranetz PES Database
- Dranetz Portable Monitors
- Edison Electric Institute® Load File
- Electro Industries® Nexus Communicator Log Files
- Fluke®/Reliable Power Meters (RPM) Omega and Scenario Databases
- GL Industrial Group/Stoner Software® (Optional)
- Gossen Metrawatt MAVOSYS 10
- GridSense PowerView CSV Files
- GroundedPower Monitoring Data Files
- HIOKI® Hi-View Pro Text File Export

- Landis+Gyr® MAXsys 2510 Paradox Database and Text Files
- OSIssoft® PI System (Optional)
- PQView® Databases and Text File Formats
- Qualitrol®/LEM Instruments (Optional) Qdevice Information System (QIS) Database
- SATEC PAS Site Database
- Schneider Electric® / Power Measurement® PowerLogic ION Enterprise® 4.x and 5.x databases, as well as PEGASYS 3.x databases (Optional)
- Siemens® SICARO PQ Manager Text Files
- Siemens® WinPM.Net (Optional)
- SoftSwitching Technologies® I-Grid® Web Site
- Unipower® (Optional) PQ Secure Database
- BTECH Battery Validation Manager Database
- European Network of Transmission System Operators for Electricity (ENTSO-E) Web Site for Hourly Load Data
- North American ISO/RTO Historical Web Site Data for Hourly Loads for ERCOT, ISO-NE, IESO, NYISO, and PJM
- NOAA Space Weather Prediction Center Web Site for Daily Geomagnetic Data
- General Electric® Communicator Device Log Files
- SilverSpring Networks® Export Document Files

Custom data handlers to bring data from proprietary systems into a PQView database are frequently developed to meet customer needs.

Typically, PQDM automatically updates measurement databases once each day after all of the meters have been polled by their proprietary download software. However, it may be configured to update manually, or as fast as once every minute. Other functions provided by PQDM include deleting old measurements, manually adding missed rms voltage variations, and creating voltage sag and voltage swell records from voltage minimum/maximum strip chart data. PQDM can be combined with add-in modules to provide automatic fault waveform identification and fault location, voltage sag direction, and capacitor analysis.

PQView Power Quality Data Analyzer

The PQView Power Quality Data Analyzer (PQDA) creates trends, histograms, and statistical summary tables of more than 125 steady-state characteristics defined within the IEEE PQDIF standard. It offers scores of charts, event lists, tables, and indices to analyze voltage sags/dips, swells, and interruptions. PQDA interfaces with Microsoft® Word to automatically create summary documents, and allows the user to filter invalid measurements from final analysis.

Trends and Histograms

PQDA allows you to create trends, histograms, and statistics for any steady-state voltage, current, power, and energy quantity (Figure 1 and Figure 2). You can also view trends and histograms for the minimum, average, maximum, standard deviation, count, and any percentile for steady-state data in intervals of minutes, hours, days, weeks, months, and years (Figure 3).

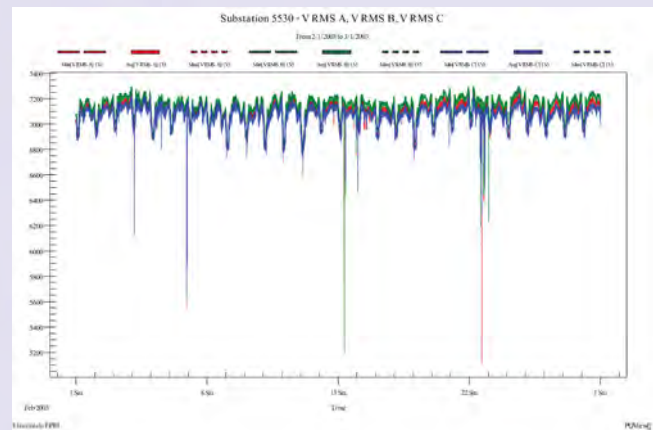


Figure 1: One month trend of minimum, average and maximum.

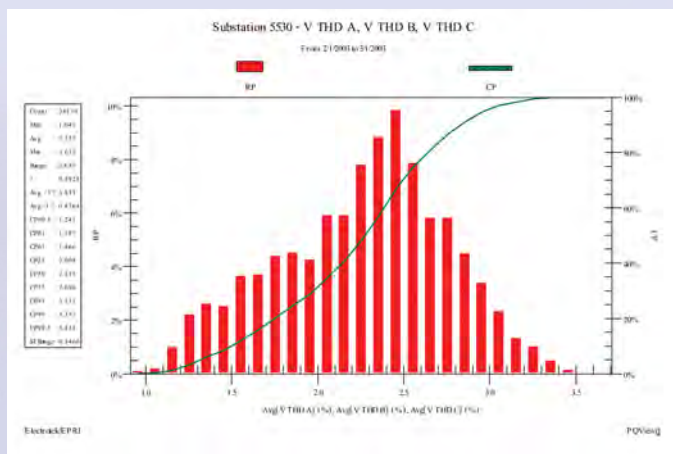


Figure 2: Histogram of voltage THD for three phases
The data for trend and histogram charts can be filtered to not include invalid measurements.

All trends are interactive so you can zoom in with your mouse cursor to an area of interest. Also, each trend can become an event timeline by plotting any associated waveform or rms variation measurements as tick marks along the x-axis. When you click on a tick mark, the waveforms and rms samples recorded with the event will open in a new window. This feature is especially useful when evaluating faults and switching transients.

Each trend and histogram can be copied automatically into Microsoft Word documents or Microsoft Excel spreadsheets or sent to a printer. For example, you could create a report showing the trend and/or histogram of rms voltage or voltage THD for all phases for every meter in your database for a year by specifying only the file name of a Microsoft Word document. Each chart is automatically created and exported to the specified file.

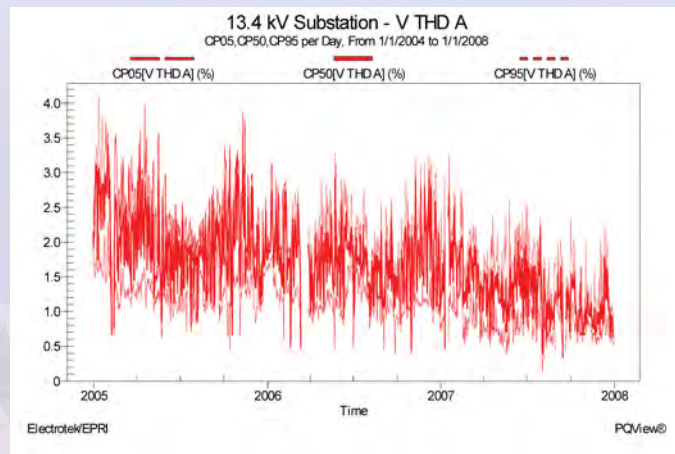


Figure 3: 5th, 50th, and 95th percentile of daily voltage THD from nearly 25000 samples recorded over a four-year period

Event Lists

PQDA can quickly build event lists (Figure 4) from the millions of events recorded in a measurement database. PQView "measurement events" consist of the waveform and rms samples recorded during voltage sags and swells due to faults and motor starting, and voltage transients due to fuse operations, lightning strikes, load switching, and capacitor and cable energizing. The event lists can be built based on simple queries that only select certain meters for a specific date range. Or, they can be more sophisticated. For example, you could request a list of all events in which the rms voltage dropped below 0.7 per unit. Even more sophisticated queries can be run allowing you to search for single-phase sags, three-phase sags, single-phase faults, and three-phase faults. PQView provides methods for viewing waveform samples for events (Figure 5) or recorded rms samples (Figure 6).

Marked	Site Name	Date and Time	Type	Minimum	Maximum
<input type="checkbox"/>	Substation 8010	2/26/2003 23:57:58.1260	IMP	-165.42%	256.42%
<input type="checkbox"/>	Substation DL-8000	2/26/2003 20:57:33.7699	RMS	89.21%	104.69%
<input type="checkbox"/>	Substation SEL-121F	2/26/2003 20:51:32.9493	RMS	91.40%	100.80%
<input type="checkbox"/>	Substation SEL-121F	2/26/2003 19:58:10.7623	RMS	91.05%	100.73%
<input type="checkbox"/>	Substation SEL-121F	2/26/2003 19:51:45.0163	RMS	90.97%	100.38%
<input type="checkbox"/>	Substation SEL-121F	2/26/2003 19:50:44.7243	RMS	90.80%	100.39%
<input type="checkbox"/>	Substation SEL-121F	2/26/2003 19:50:43.6663	RMS	90.76%	100.40%
<input type="checkbox"/>	Substation SEL-121F	2/26/2003 19:50:13.2413	RMS	90.74%	100.63%
<input type="checkbox"/>	Substation SEL-121F	2/26/2003 19:50:11.2703	RMS	89.31%	100.42%
<input type="checkbox"/>	Substation 8010	2/26/2003 19:06:35.3130	OSC	-97.77%	98.25%
<input type="checkbox"/>	Substation 8010	2/26/2003 19:04:03.6890	OSC	-97.74%	99.49%
<input type="checkbox"/>	Substation SEL-121F	2/26/2003 18:58:58.7913	RMS	86.65%	100.84%
<input type="checkbox"/>	Substation 8010	2/26/2003 17:32:10.8750	OSC	-102.78%	99.85%

Figure 4: Event lists of voltage sags, swells and interruptions can be sorted by time and location.

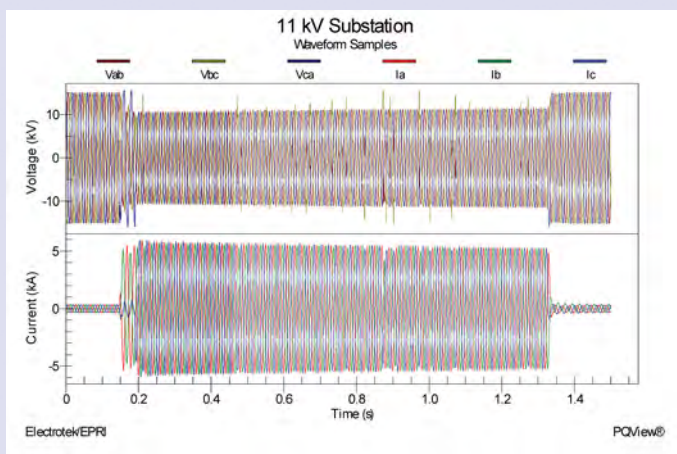


Figure 5: Three-phase voltage and current waveform Samples during a three-phase fault.

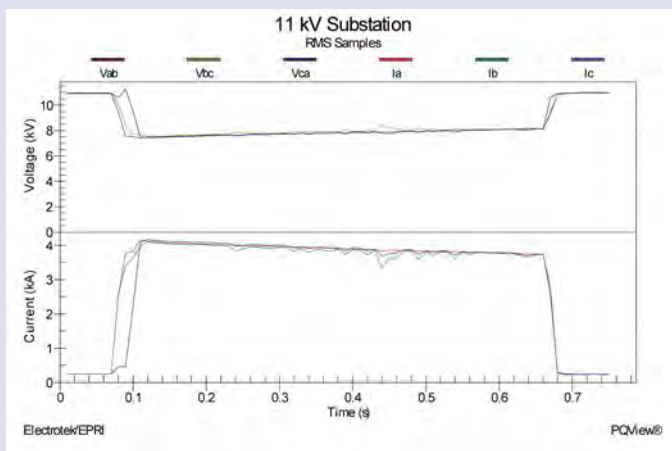


Figure 6: Three-Phase Voltage and Current RMS Samples during a Three-Phase Fault.

PQDA provides numerous methods for deriving quantities from event waveform samples and/or rms samples:

- Reactance-to-Fault
- Radial Fault Location
- Spectrum Charts for 1, 10, 12 and N-Cycle Windows
- Phasors and Harmonic Phasors
- High-Pass Filter and Low-Pass Filter
- First Derivative and Squared Value-Time
- Mean Values and RMS Values
- Load Resistance, Load Reactance, Load Impedance, and Load Impedance Angle
- Real Power, Reactive Power, Apparent Power, and Energy
- Delta Real Power, Reactive Power, Apparent Power, and Energy
- Characteristic Voltage
- Waveform Transformation
- Missing Voltage and Delta Current from First Cycle or from Ideal Waveform
- Symmetrical Components
- Delta Symmetrical Components
- Three-Phase Diode Rectifier Output
- Line Frequency during Event
- Total Harmonic Distortion (THD)
- DC Component, Fundamental Component, and Harmonic Trends during Event
- Links to Map Viewer and Trend Viewer
- IEEE P1159.2 RMS Characteristics
- IEEE P1159.2 Point-in Wave Characteristics
- IEEE P1159.2 Missing Voltage Characteristics
- Dranetz Event Characteristics
- Digital Status Changes
- Operations Summary

RMS Voltage Variation AnalysisA key strength of PQDA lies in its analytical capabilities of rms voltage variations (voltage sags, swells, and interruptions). In addition to being able to build lists of events showing the voltage magnitude and duration of each event, you can build ITIC Charts, CBMA Charts, and SEMI F47 Charts. Custom charts that overlay multiple curves (Figure 7) can be built as well. The measurements from each meter can be plotted optionally in a different color (Figure 8). If you identify the cause code or source code of each event by adding additional information

to your database, then the plots can use a different color for these supplemental codes as well.

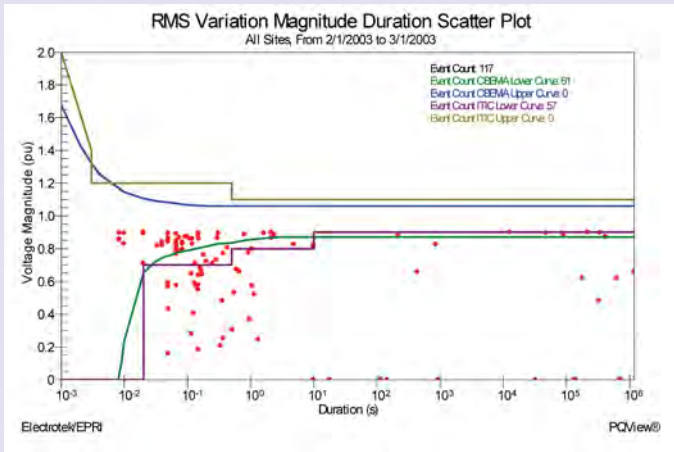


Figure 7: An rms variation magnitude-duration scatter plot overlaid with the sensitivity curves specified by CBEMA in 1987 and by ITIC in 1997

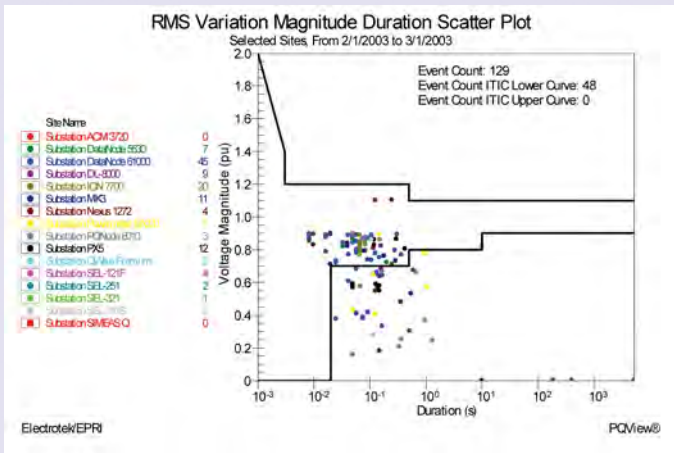


Figure 8: Voltage sag magnitude versus duration scatter plot with ITIC Curves.

Another scatter plot will plot the voltage magnitude of each voltage sag, swell, or interruption versus time (Figure 9). When plotting any of these magnitude-duration or magnitude-time scatter plots, you may click on the point representing each event to see the waveforms and rms samples associated with that event. Because PQDA's rms variation analysis algorithm involves temporal aggregation of multiple events occurring in close in time, you see not only the event that resulted in a particular voltage magnitude

and duration, but also any other events that occurred around the same time at that location.

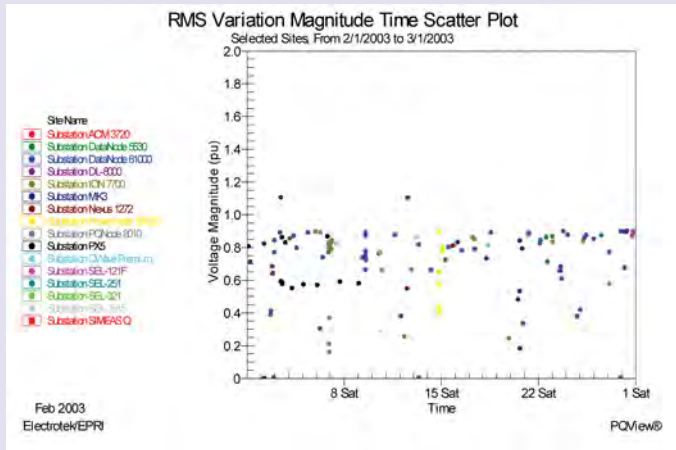


Figure 9: A voltage sag scatter plot of rms voltage magnitude on a one-month time line.

In Figure 10, PQDA temporally aggregated voltage sag measurements by determining the lowest voltage during a 60-second period of time at each meter. Rates of occurrence were calculated by determining the number of days each meter was available during the 31-day analysis period. If a meter had unavailable days, then PQView took them into account when computing the occurrence rates. A chart showing a magnitude-duration distribution (Figure 11) and a distribution of SARFI-80 rates recorded at 241 sites (Figure 12). The height of each column in the SARFI- 80 chart is a count of sites that had a similar rate of voltage sags to below 0.80 per unit. For example, 44 sites had no events resulting in a drop in rms voltage to a level below 0.8 per unit, while 27 sites experienced an event below 0.8 per unit three times during themonth. Only one site experienced 20 events resulting in a voltage sag below 0.8per unit during the 31-day period.

You can automatically create summary reports using Microsoft Word. You need only to specify the sites for the report, specify the desired date range, and which options you want for the report. The rms variation report writer can include monitoring site lists; event lists; SARFI summaries that compute the count or rate

of voltage sags; IEC 61000-2-8 DISDIP tables; CBEMA, ITIC, SEMI F47, and timeline scatter plots; and magnitude, duration, magnitude-duration column charts.

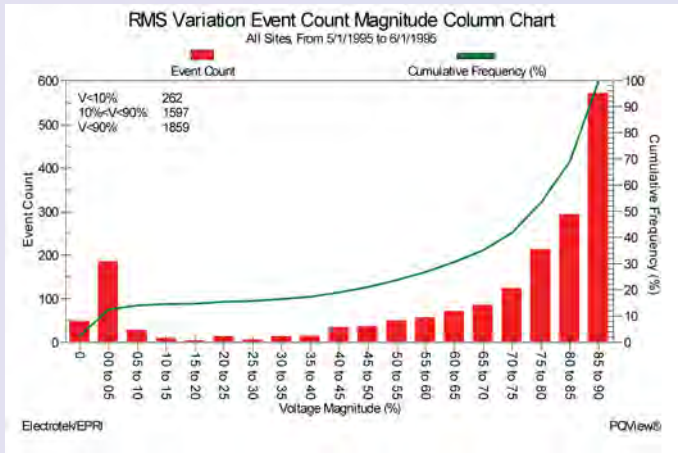


Figure 10: Statistical histogram showing the voltage magnitude distribution for voltage sags measured at 241 power quality meters.

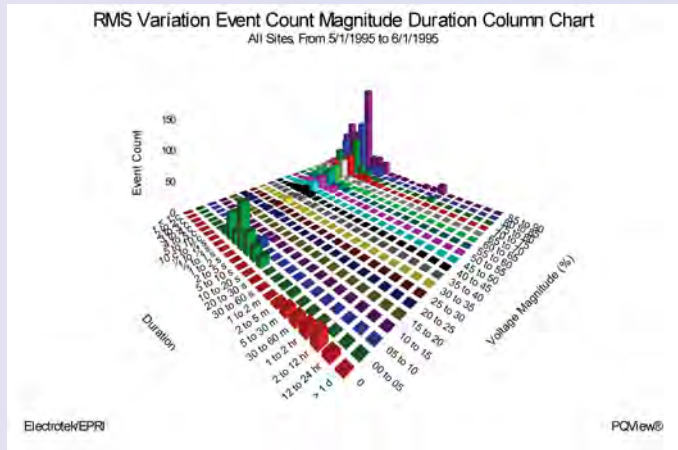


Figure 11: Column chart showing the voltage magnitude and duration for voltage sags measured at 241 power quality meters.

Internet Accessibility via PQWeb

PQView can provide data and reports via the Internet or company intranet. Through PQWeb® a server runs PQView data analysis tasks and allows you to access and view the results using any web browser (Figure 12). With this software, PQView becomes a multiplatform application, able to work across otherwise incompatible operating systems.



Figure 12: PQWeb provides Read-Only Access to PQView Databases via a web browser.

Fault Location

PQView features an optional Reactance-to-Fault Add-in Module that can be used to estimate the distance from a substation monitor to a single-phase or multi-phase fault. When combined with electrical circuit model data from circuits modeling databases, PQView applications can provide maps pinpointing the location of a fault using both desktop and web applications. In Figure 12, the distance between the fault location estimated by PQView and the actual fault was 200 meters.



Figure 13: One-line diagram with aerial map of estimated and actual location.

Support

Support for PQView is provided through the PQView Users Group, which is operated and maintained by Electrotek Concepts. Members receive upgrades, technical support, and enjoy access to online resources. Additional support, such as specialty instrument interfaces or report customization, is provided on a time and materials basis.

Electrotek Concepts, Inc.

1000 New Durham Road, Edison, New Jersey 08817 USA

Telephone: +1-732-248-4281 · Fax: +1-732-248-1834

E-Mail: pqview@electrotek.com

www.pqview.com