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PQDIF Application Guide

Overview, PQView Integration, Representation in XML, and Examples

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PRODUCT DESCRIPTION

Over the last fifteen years, many power quality monitoring instruments have been used in collecting power quality measurements from tens, hundreds, and sometimes thousands of monitoring points in transmission, distribution, and end-user systems. The reasons for monitoring vary and, consequently, so does the structure of data contained in these measurements. The Institute of Electrical and Electronics Engineers (IEEE) Std 1159.3-2002 PQDIF binary file format provides a compact, flexible, extensible means to exchange these diverse measurements between software applications. This PQDIF application guide provides practical information useful in software applications that read and write the IEEE PQDIF format. It includes a PQDIF overview, discusses issues when targeting the EPRI PQView application as a PQDIF reader, presents representations of PQDIF records in XML format, and provides numerous examples.

Results & Findings

The report presents import considerations when creating PQDIF files that target EPRI's PQView application. Numerous examples for representing PQDIF records in XML format will help software engineers support PQDIF reading and writing in their applications.

Challenges & Objective(s)

This report is targeted at software engineers familiar with the basics of IEEE Std 1159.3-2002. It provides examples and source code that will allow software engineers to adapt the IEEE PQDIF standard to their software applications. Using the report will save time and labor usually required to research, experiment, and complete a PQDIF export and/or import project. It also benefits EPRI members by making available new PQDIF files from third-party software and database applications that are already compatible with PQView; EPRI members will no longer find themselves in the role of PQDIF software testing or in PQDIF compliance liaising.

Applications, Values & Use

IEEE Std 1159.3 is being amended in 2007 and 2008 and will include PQDIF application guides, PQDIF representation in XML format, and PQDIF representation in database format. An update to this report will be available in 2008 that provides application examples drawing on this IEEE standards work.

EPRI Perspective

IEEE PQDIF is a core data source format used by EPRI's PQView application. The numerous examples in this report for representing PQDIF files form a comprehensive set. It is EPRI's goal to educate its funding members and the vendors who provide data for these members with

PQDIF files that are both compliant with the IEEE standard and compatible with the PQView application.

Approach

The project team's goals were to provide guidelines for writing PQDIF files that are compatible with EPRI's PQView application. The IEEE 1159.3 Standard document does not provide enough information for most third-party software engineers to develop IEEE PQDIF files without assistance from PQDIF experts. The team wrote this guide drawing on the experience of the active membership in the IEEE P1159.3 Task Force. The guide includes expertise from the software engineers who authored the PQView application, including the modules for reading and writing IEEE PQDIF files. PQView itself was modified to export measurements into easy-to-read text files containing PQDIF records formatted in XML.

Keywords

Power quality
PQView
IEEE 1159.3
RMS variations
Harmonic distortion
Databases
Data formats

ABSTRACT

The Power Quality Data Interchange Format (PQDIF) provides a standard way of representing a large variety of power quality data, allowing exchange of the data between instruments and software from different vendors.

Overview

The need for a common power quality data interchange format has recently become increasingly important. Many utilities are monitoring the quality of the power they deliver to their customers, while some customers are installing their own instruments to measure the utility supply or to monitor their sensitive processes. Power quality software applications have been developed to provide database management and analysis, to run harmonic and transient simulations, to perform economic assessments, and to identify measurements using rules-based expert systems or artificial neural networks. Multiple vendors, each of which has traditionally employed proprietary formats for data storage, produce such PQ monitoring systems and associated software applications. In order to maximize benefits that can be realized by integrating all of these systems, EPRI initiated the development of a common format for power quality measurement data formally known as the Power Quality Data Interchange Format (PQDIF).

PQDIF provides a common format to which all vendors can export and import allowing the end user maximum flexibility in choice of tool and vendor. Power quality data is a broad category that includes many forms of data that are collected, processed, and stored. This can include basic information like raw voltage waveform data to highly processed statistical information on derived quantities such as THD. Because of the wide range of data that may be measured or calculated, a highly flexible, but standard, method of exchanging the data is required. Because PQDIF was developed to allow for the transfer of most power quality data – measurements, simulation results, calculated index values, etc. – in a high fidelity form in a predicable and standard way the file structure is very open and flexible. There are several side effects of this level of flexibility. The most obvious is the complexity. It is indeed a complex format when compared to the simple ASCII files of COMTRADE or other proprietary formats. In addition, the flexibility leads to occasional ambiguities in the ways to model a particular type of data. Without the proper guidance, this flexibility can be confusing and might result in vendors developing PQDIF files that appear to be structurally accurate with regard to allowable PQDIF element tags but are not structured such that the other applications (e.g., EPRI's PQView application) expects the data. Many of the instrument manufacturers that have begun to implement a PQDIF export function to allow integration of their instruments with the PQView system have realized this possible confusion.

This guide presents recommendations on writing IEEE PQDIF files, examples for representing data in XML format, integration issues with PQView, and examples for storing PQDIF measurements using an IEEE library known as PQDCOM4.DLL.

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1
IEEE PQDIF OVERVIEW

Over the last twenty years, many power quality monitoring instruments have been employed in the collection of power quality measurements from tens, hundreds, and sometimes thousands of monitoring points in transmission, distribution, and end-user systems. The reasons for monitoring vary, and consequently so do the structure of data contained in these measurements. The IEEE Std 1159.3-2002 PQDIF binary file format provides a compact, flexible, extensible means to exchange these diverse measurements between software applications.

A file format for power quality data interchange must be sufficiently flexible to encompass the diverse classes of measurements that must be represented. Further, as new monitoring task are identified and new monitors developed to perform these tasks, the format must be easily extended to encompass them. Consider just some of the many power quality monitoring tasks currently supported by PQDIF. Some end-users seek to determine the reasons for equipment compatibility with the electrical supply. Some power providers seek to determine compliance with limits established in standards such as IEEE Std 519-1992 or EN 50160. Others monitor in order to administrate power quality service contracts. Some monitoring systems are put in place in order to provide an enhanced level of customer service by providing access to databases of power quality measurements via the Internet, but more often the extent of web access to these databases is limited to corporate intranets. Other reasons for monitoring include evaluation of custom power solutions, determination of system benchmarks, and the establishment of databases of power quality measurements at delivery points to key customers for providing enhanced information. Still one more reason for power quality monitoring is to examine measurements for predicative maintenance by applying algorithms that search for system components that are about to misoperate.

The following list presents some examples of the types of measurements that are recorded by power quality monitoring equipment:

- Waveforms, rms samples, and characteristics of events that are triggered by system disturbances (e.g., system faults, motor starts, equipment energizing, switching transients, and lightning strikes)
- Logs that represent snapshots or statistics of steady-state quantities (e.g., the minimum, average, and maximum of voltage total harmonic distortion for ten-minute intervals)
- Logs of compliance with standards that limit values above or below a certain value for a specific percentage of an interval (e.g., the number of one-week intervals where voltage unbalance was more than 2% for 5% of an interval)
- Supplemental information that is stored with the monitoring instrument data that details the cause, source, classification, failed equipment, and specific description of power quality disturbances

Structure

A brief introduction to PQDIF is provided in this chapter but the full description of PQDIF, its structure and the tools for creating PQDIF objects is detailed in the proposed IEEE Recommended Practice 1159.3-2002, "Recommended Practice for a Power Quality Data Interchange Format - An Extensible File Format for the Exchange of Power Quality Measurement and Simulation Data." A software development tool kit (PQDIF SDK) is also available from the web site of IEEE P1159.3 Task Force, which can be found on the Internet at http://grouper.ieee.org/groups/1159/3/.

PQDIF achieves its flexibility by segregating the definition of its physical structure from that of its logical structure. The physical structure defines how basic and complex data types are constructed in a file; the logical structure defines how the physical data is interpreted as power quality data.

Physical Structure

PQDIF employs a relatively simple, hierarchical physical structure. At the highest level, a file consists of one or more records:

Record 1
Record 2
Record 3
…
Record N

Each record is composed of a collection of elements. All elements are one of three types: a scalar (single value), a vector (series of values), or a collection of elements.

Record
  Collection 1
    Scalar 1
    Scalar 2
    Vector 1
    Vector 2
  Collection 2
    Scalar 3
    Scalar 4
  Collection 3
    Scalar 5
    Scalar 6
…

Scalar and vector element values are of one of fixed set of types. The complete list of types is presented in Table 1-1.

Table 1-1
Intrinsic PQDIF Data Types

Name	Description
BOOL1	1 byte Boolean
BOOL2	2 byte Boolean
BOOL4	4 byte Boolean
CHAR1	ASCII character
CHAR2	Unicode character
INT1	1 byte integer
INT2	2 byte integer
INT4	4 byte integer
UINT1	1 byte unsigned integer
UINT2	2 byte unsigned integer
UINT4	4 byte unsigned integer
REAL4	4 byte real
REAL8	8 byte real
COMPLEX8	Complex 4 byte real pair
COMPLEX16	Complex 8 byte real pair
DT	Time stamp with microsecond resolution
GUID	16 byte globally unique identifier

Complex data elements are created using collections of elements. Since a collection can contain nested collections, any level of complexity can be obtained without the need to add new intrinsic data types. This is the mechanism used by PQDIF to achieve flexibility while avoiding the need for constant revision.

This simple set of rules defines the physical structure of all PQDIF files. Once an application implements them it can parse any present or future PQDIF file.

Logical Structure

The logical structure defines the rules for how records and record elements are organized to represent power quality data. The low-level details of these records are beyond the scope of this paper; however, a high level understanding of the logical structure is necessary in order to appreciate the organization of the XML representation of a PQDIF file. The essential concepts that must be understood are tags and ids, channels, and record types.

Tags and IDs

Tags and ids are the foundation of the logical structure of PQDIF. Every PQDIF element has a tag that identifies the meaning of the element. For example, the primary collection of each record has a tag identifying the record type. Ids are the range of values that a tag may have. The PQDIF specifications define a standard set of tags and for each tag, its associated element type, its place in the element hierarchy of a record, and its range of id values.

Each tag value is implemented using a globally unique identifier (GUID). Id values can be optionally implemented as GUID or integer values as appropriate. Since a unique GUID can be generated without consulting a central authority, a PQDIF application can create and/or use private tags, only understood by that application. Since all PQDIF applications are required to ignore elements with tags that they do not understand, these private tags have no effect on other applications that parse the PQDIF file. This mechanism ensures that new tags can be added to the PQDIF standard without "breaking" existing applications. GUID-based tag and id values are the part of extensible nature of PQDIF.

Channels

A channel represents one of a set of data streams that are generated by a monitor. Each channel should have unique quantity (e.g., rms voltage, voltage THD, apparent power) and phase (e.g., phase A-N, phase A-B) information. Channels are created for both real measurements (e.g., rms voltage and rms current) and derived measurements (e.g., voltage total harmonic distortion, short-term flicker perception).

Data Source Records

Data source records contain collections of definitions for the channels of a monitor. These channel definition collections contain elements that identify the quantity, phase, units of a channel. The values contained in a channel definition do not change over time. Many observation records share a single data source record. This avoids replicating definition information in each observation record.

Monitor Settings Records

Like data source records, monitor settings records contain collections that are referenced by the channel instance collections of many observation records. Rather than defining the unchanging values of a channel definition, channel settings collections contain elements to store information about the parameters that are in effect when a measurement is captured. For example, trigger threshold might be recorded in a settings record. Monitor settings records avoid the need to replicate channel definitions elements when a settings change is made either by an operator or automatically by the monitor.

Observations Records

Observation records contain the actual measured values. Each observation record contains one more channel instance collections. These collections reference channel definition collections and channel settings collections in the associated data source and monitor settings records respectively. Each channel collection typically contains a vector of time values and one or more vectors of the channel quantity values. For example, separate vectors could be used for average, minimum, and maximum values.

Data source, monitor settings, and observation records are associated by their order in a PQDIF file. The data source record must precede the monitor settings and observation records that reference it. Similarly, a monitor settings record must precede the observation records that reference it.

Other Recommended Reading

This guideline does not address the basics of PQDIF. That information is included as part of the IEEE 1159.3 standard. The material in this document assumes a basic understanding of the structure of PQDIF, the tools used to create PQDIF files or objects, and PQDIF examples included in the development kit.

2
USING PQDIF DATA SOURCES WITH PQVIEW

This chapter is intended to give specific guidance in applying PQDIF for use with PQView®. PQView is a power quality database management and analysis database system. PQView was designed so that measurement data from various proprietary instrument formats could be stored in a common database format allowing system analyses based on data from various instrument sources. The PQView PQDIF characterizer was designed to allow PQView users to import measurement data from any source or format that is exported as a PQDIF file.

Data Types Characterized and Included in PQView Database

PQView is designed to hold and analyze a broad range of power quality data. The data model for PQView is event-centric for disturbance information. Steady-state information is stored as compressed trend data.

Data Processed by the PQDIF Characterizer

Triggered Data or Events

Triggered or event data is are waveform samples, rms samples, or event charateristics gathered as the result of a trigger condition and is meant to be a disturbance or event. The event is usually triggered by channel data from the instrument and can be marked using the trigger method ID_TRIGGER_METH_CHANNEL. An external trigger may also be indicated. Full analysis by the PQView characterizer requires a trigger channel to be specified. As a result, not all characteristics would be available for externally triggered data. The two types of data processed by the PQDIF characterizer are rms samples and waveform samples. The triggered data analysis portion of the characterizer analyzes only voltage-triggered information and processes up to three phases of voltage and current plus neutral, residual, and "net" channels.

Samples of waveform or rms for an event must be represented in a single observation. For example, all of the individual channels recorded for a single event – V_A, I_A, V_B, I_B, etc. – should be included in a single observation. Additionally, all of the data for each individual channel must be stored in a single channel instance of the overall observation. If the data for one of the channels is stored as multiple channel instances within the one event observation, each instance will be processed as though they were separate events. This is only a *recommendation* in the IEEE 1159.3 standard, but a *requirement* for PQView.

Voltage sag, voltage swell, and voltage interruption measurements can be represented using the ID_QT_MAGDURTIME quantity type. This measurement consists of the time stamp, voltage

magnitude, current magnitude, and duration typical of data represented on a CBEMA Curve or an ITIC Curve.

Steady-State Data

Non-triggered information like steady-state voltage, current and power information is handled in a different manner in the characterizer. This information is tagged with the ID_TRIGGER_METH_PERIODIC for the trigger method. Again there are two types of data that fall into the steady-state category, trend data, and periodically sampled waveform information.

Trend data is a time trend of any value supported by PQView. Any values that are not represented in the PQView Channel table are disregarded. Additional channels are periodically added to this table so you should consult EPRI for updated listings if you do not find a channel definition meeting a particular need.

Periodic waveforms are analyzed to provide as much information as possible. Fourier transforms are performed on all data that has at least one full cycle of information that has been sampled at a power of 2 points per cycle. There must be at least 32 points per cycle for full analysis. If Fourier analysis is performed the following characteristics are extracted:

Voltage/Current Waveforms:

- rms, harmonic rms, arithmetic sum, and peak
- crest factor, form factor
- telephone interference factor (TIF)
- total harmonic distortion (THD), THD for even harmonics, THD for odd harmonics
- harmonic spectrum
- positive-sequence component, negative-sequence component, and zero-sequence component
- negative-sequence imbalance, positive-sequence imbalance, line-neutral magnitude imbalance, and line-line magnitude imbalance

If three phases of voltage and current are present power calculations are performed and the following additional characteristics are added to the database:

- active power, reactive power, apparent power by phase and for three phases
- true power factor, displacement power factor by phase
- real and apparent power harmonic spectrum by phase phase

PQDIF Optional Tags Required or Recommended for the Characterizer

A number of tags are listed as optional in the PQDIF specification from IEEE. They are either required or recommended for processing of data by the PQView PQDIF characterizer.

Required for Full Characterization

Data Source Record Tags

- *tagNameDS*: this tag must be at the top level of the Data Source Definition. This entry becomes the name of the site in PQView. Specifically, it is stored in the name field of the Site table (Site.name).
- *tagSeriesNominalQuantity*: this tag should be defined in order to characterize event records, the voltage channels defined for the event records must inform the characterizer of the base voltage.

Observation Record Tags

- *tagChannelTriggerIdx*: this tag indicates the channel or channels that caused the event to be triggered. The value of this tag is the channel definition index referencing the data source.

Highly Recommended

Monitor Settings Record Tags

- *tagNominalFrequency*: this specifies nominal system frequency. If not specified, 60 Hz is assumed.

Data Types Ignored

The PQView PQDIF characterizer continues to evolve as EPRI evaluates the benefits of importing various data types that can be specified by PQDIF but that are not yet compatible with the EPRI PQDIF characterizer. This section identifies several types of data that can be stored in a valid PQDIF file that are not imported into PQView. Some of these types have no PQView equivalent and others have yet to be implemented.

- All statistical data except quantity characteristics that reflect a statistical basis such as flicker (Pst)
- Statistical information such as probability distribution function or histogram data types are not included
- All channels with the following quantity types are currently not supported:
    - ID_QT_RESPONSE
    - ID_QT_FLASH
    - ID_QT_HISTOGRAM
    - ID_QT_HISTOGRAM3D
    - ID_QT_CPF
    - ID_QT_XY

- ID_QT_MAGDUR
- ID_QT_XYZ
- ID_QT_MAGDURCOUNT

RMS Triggered Events Records

This section describes how to define a channel to hold standard rms information that is part of a triggered rms type event. Information for rms variation events is stored as a set of magnitude and duration characteristics that are derived by the characterizer from voltage rms samples. The original triggered trend data can optionally be imported to the database as well.

Some instruments can capture corresponding waveform information along with the rms trace of a triggered rms variation event. The characterizer will maintain the relationship between the rms and waveform data provided all of the data is included in a single observation record. The waveform data will be characterized for transient characteristics as well and stored as shown below in the Transient Events section.

Data Source Definition

For each channel of data, there must be a Data Source definition record to define the data type, including its characteristics and the format in which it is stored. The following PQDIF Data Source record definition shows all of the fields either required or recommended for a triggered rms voltage channel, V_{AB}. The remaining voltage channels (V_{BC}, V_{CA}) would be identical with the exception of the tagPhaseID value. These channel definitions may optionally be followed by definitions for the current channels.

This definition includes minimum, maximum, and average series definitions for each channel. This allows for envelope-based measurements. If only instantaneous values of the rms value are available (and it is not an average over an interval longer than one cycle) only the ID_SERIES_VAL_TYPE_VALUE should be used. If you have just a series of average values over an interval, omit the ID_SERIES_VALUE_TYPE_MIN and ID_SERIES_VALUE_TYPE_MAX series definitions.

All rms variation event data must be reported using the ID_QT_PHASOR quantity type whether phase angle information is available or not. This can be considered an implementation restriction.

All other tags in Figure 2-1 are required in order create valid triggered RMS variation event PQDIF channel so that the PQView characterizer adequately processes the event. The following example data source segment illustrates the hierarchical structure of the required data source elements and is created with the PQDIFR tool available from the IEEE 1159.3 web site.

```
-tag: tagRecDataSource (level 0)
+-tag: tagEffective value: 9/3/1999 15:2:42.000000000
+-tag: tagDataSourceTypeID value: ID_DS_TYPE_MEASURE
+-tag: tagNameDS value: 'Standby'
+- tag: tagChannelDefns (level 1)
| +- tag: tagOneChannelDefn (level 2)
```

```
| | +-tag: tagChannelName value: 'Voltage A'
| | +-tag: tagPhaseID value: 5 (ID_PHASE_AB)
| | +-tag: tagQuantityTypeID value: ID_QT_PHASOR
| | +-tag: tagQuantityMeasuredID value: ID_QM_VOLTAGE
| | +- -- tag: tagSeriesDefns (level 3)
| | | +- tag: tagOneSeriesDefn (level 4)
| | | | +- tag: tagQuantityUnitsID value: ID_QU_SECONDS
| | | | +- tag: tagQuantityCharacteristicID value: ID_QC_RMS
| | | | +- tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_TIME
| | | | +- tag: tagStorageMethodID value: 6
| | | | +-(End of collection)
| | | +- tag: tagOneSeriesDefn (level 4)
| | | | +- tag: tagQuantityUnitsID value: ID_QU_VOLTS
| | | | +- tag: tagQuantityCharacteristicID value: ID_QC_RMS
| | | | +- tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_MIN
| | | | +- tag: tagSeriesNominalQuantity value: 480.000000
| | | | +-(End of collection)
| | | +-tag: tagOneSeriesDefn (level 4)
| | | | +-tag: tagQuantityUnitsID value: ID_QU_VOLTS
| | | | +-tag: tagQuantityCharacteristicID value: ID_QC_RMS
| | | | +-tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_MAX
| | | | +-tag: tagStorageMethodID value: 3
| | | | +-tag: tagSeriesNominalQuantity value: 480.000000
| | | | +-(End of collection)
| | | +-tag: tagOneSeriesDefn (level 4)
| | | | +- tag: tagQuantityUnitsID value: ID_QU_VOLTS
| | | | +- tag: tagQuantityCharacteristicID value: ID_QC_RMS
| | | | +-tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_AVG
| | | | +-tag: tagStorageMethodID value: 3
| | | | +-tag: tagSeriesNominalQuantity value: 480.000000
| | | | +-(End of collection)
| | | +-(End of collection)
| | +-(End of collection)

...The channel definitions repeat to include all recorded phases.
```

Figure 2-1
Required Tags for Triggered RMS Variation Event

Monitor Settings Record

The Monitor Settings records are normally optional in PQDIF. They are not required for the PQDIF characterizer but several of the tags in the Monitor Settings record are highly recommended. Figure 2-2 shows the minimum tags that are highly recommended as part of the Monitor Settings record

The base system frequency is required for a number of calculations with the characterizer. This is specified as a tag in the monitor settings record. The characterizer will assume 60 Hz if this tag is not present.

```
-tag: tagRecMonitorSettings (level 0)
+-tag: tagEffective value: 9/3/1999 15:2:42.000000000
+-tag: tagNominalFrequency (value: 60.000000
+-tag: tagChannelSettingsArray (level 1)
| +- tag: tagOneChannelSetting (level 2)
| | +-tag: tagChannelDefnIdx value: 0
| | +-tag: tagTriggerTypeID value: 3 (ID_TRIG_LOW | ID_TRIG_HI)
| | +-tag: tagTriggerHigh value: 528.000000
| | +-tag: tagTriggerLow value: 432.000000
| | +-(End of collection)
…  Repeated for all channels
```

Figure 2-2
Minimum Recommended Tags for Monitor Settings Record

Observation Record

Observation records carry the actual data for an event or trend of steady-state data. For rms variation event data, the observation needs certain time stamp information for the record including the start time for the record and the trigger time that usually is some time after the beginning of the record. For event records, the trigger information is very important and is required for full characterization of the data.

Figure 3-3 is a sample observation record for an rms variation event. This event was triggered on voltage phase a-n as the rms voltage violated the ID_TRIGGER_METH_LOW trigger value specified in the Monitor Settings record. The software creating this record had elected to name the record "RMS Variation (Sag)." This name is arbitrary and you can choose a title that suits your naming conventions.

As discussed in the Data Source section above, the quantity type for rms records must be ID_QT_PHASOR. The time series must be the first series instance in the channel. If the event is triggered on a base voltage other than the tagSeriesNominalQuantity specified in the channel definition, the tagSeriesBaseQuantity of the observation record is used to override the channel definition base value.

```
- tag: tagRecObservation (level 0)
+- tag: tagObservationName value: 'RMS Variation (Sag)'
+-tag: tagTimeCreate value: 9/15/1999 20:32:50.000000000
+-tag: tagTriggerMethodID value: ID_TRIGGER_METH_LOW
+-tag: tagTimeTriggered value: 9/15/1999 10:11:16.630000000
+-tag: tagTimeStart value: 9/15/1999 10:11:16.630000000
+-tag: tagChannelTriggerIdx values: ID_PHASE_AN
+-tag: tagChannelInstances (level 1)
| +-tag: tagOneChannelInst (level 2)
| | +-tag: tagChannelDefnIdx value: 0 References the channel defn.  in data source
| | +-tag: tagSeriesInstances (level 3)
| | | +-tag: tagOneSeriesInstance (level 4) Series 0, Time
| | | | +-tag: tagSeriesScale value: 1.000000
| | | | +-tag: tagSeriesOffset value: 0.000000
| | | | +-tag: tagSeriesValues (Vector of time data)
| | | | +-(End of collection)
| | | +-tag: tagOneSeriesInstance (level 4) Series 1, Average
| | | | +-tag: tagSeriesBaseQuantity value: 480.000000
| | | | +-tag: tagSeriesScale value: 0.100000
| | | | +-tag: tagSeriesOffset value: 0.000000
| | | | +-tag: tagSeriesValues (Vector of average data)
| | | | +-(End of collection)
| | | +-tag: tagOneSeriesInstance (level 4) Series 2, Minimum
| | | | +-tag: tagSeriesBaseQuantity value: 480.000000
| | | | +-tag: tagSeriesScale value: 0.100000
| | | | +-tag: tagSeriesOffset value: 0.000000
| | | | +-tag: tagSeriesValues (Vector of minimum data)
| | | | +-(End of collection)
| | | +-tag: tagOneSeriesInstance (level 4) Series 3, Maximum
| | | | +-tag: tagSeriesBaseQuantity value: 480.000000
| | | | +-tag: tagSeriesScale value: 0.100000
| | | | +-tag: tagSeriesOffset value: 0.000000
| | | | +-tag: tagSeriesValues (Vector of maximum data)
| | | | +-(End of collection)
| | | +-(End of collection)
| | +-(End of collection)
|…for all channels
```

Figure 2-3
Sample Observation Record for RMS Variation Event

Waveform Channels with RMS Triggered Data

Some instruments are capable of capturing waveform information at the trigger time of an rms variation event. This data can be included with rms variation event insuring that the relationship is maintained or it can be saved as separate transient event records. To include waveform information with rms variation events, follow the recommendations given in the following Transient Records section. You may include temporally noncontiguous sections of waveform data by adding multiple instances of each channel of waveform data.

There is no hard limit to the number of "segments" or instances of each channel. By default, PQView 3.42 will import up to twelve "subevents" associated with each event, but this number can be increased. The additional waveform segments' time series must be relative to the observation time stamp to ensure that a viewer or analysis program can show the waveforms in proper time sequence.

Transient Records

Transient event records in the context of the PQDIF characterizer are those triggered events that are composed of waveform data as opposed to rms trend data. This section describes how to define a channel to hold transient event information that is part of a triggered waveform event type.

Briefly, transient records are processed for a number of characteristics including magnitude, duration, and principle frequency among others. The original triggered raw waveform data can optionally be imported to the database as well. The PQView PQDIF characterizer will process up to four voltage and four current waveforms in each observation. For complete characterization, the waveforms must be sampled at a power of 2 points per cycle between 32 points per cycle and 4096 points per cycle. Trigger information from the instrument is important for accurate and complete characterization.

Data Source Definition

The following PQDIF Data Source record definitions show all of the fields either required or recommended for a triggered transient voltage channel, V_A. The remaining voltage channels (V_B, V_C) would be identical with the exception of the tagPhaseID value. These channel definition may optionally be followed by definitions for the current channels.

This channel definition in Figure 2-4 includes a value series for the waveform itself and min and max series with tagValueType of ID_SERIES_VALUE_TYPE_PEAK for passing along the instantaneous maximum and minimum values of the event. The value series is used to hold the waveform data. The time series should contain (or expand to) exactly the same number of points as the waveform series.

Important Note: Note that the tagSeriesBaseQuantity value for the VAL, MIN, and MAX series is set to the "peak" base voltage for a 480 volt system, 678 Volts. For waveform information,

100% or 1 per unit should correspond the peak value of the normal waveform, which should be $\sqrt{2} \cdot$ rms base voltage.

The peak channels are optional and are used to hold peak values of the signal between the individual samples of the waveform. By our convention, these values include low frequency information. The max series hold the positive going peak value and the min series hold the negative going peak.

All transient event data must be reported using the ID_QT_WAVEFORM quantity type. All other tags in the fragment are required in order create valid PQDIF and to adequately process the event.

```
| +-tag: tagOneChannelDefn (level 2)
| | +-tag: tagChannelName value: 'Voltage A'
| | +-tag: tagPhaseID value: ID_PHASE_AN
| | +-tag: tagQuantityTypeID value: ID_QT_WAVEFORM
| | +-tag: tagQuantityMeasuredID ID_QM_VOLTAGE
| | +-tag: tagSeriesDefns (level 3)
| | | +-tag: tagOneSeriesDefn (level 4)
| | | | +-tag: tagQuantityUnitsID value: ID_QU_SECONDS
| | | | +-tag: tagQuantityCharacteristicID value: ID_QC_INSTANTANEOUS
| | | | +-tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_TIME
| | | | +-tag: tagStorageMethodID value: 6
| | | | +-(End of collection)
| | | +-tag: tagOneSeriesDefn (level 4)
| | | | +-tag: tagQuantityUnitsID value: ID_QU_VOLTS
| | | | +-tag: tagQuantityCharacteristicID value: ID_QC_INSTANTANEOUS
| | | | +-tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_VAL
| | | | +-tag: tagStorageMethodID value: 3
| | | | +-tag: tagSeriesNominalQuantity value: 678.822510
| | | | +-(End of collection)
| | | +-tag: tagOneSeriesDefn (level 4)
| | | | +-tag: tagQuantityUnitsID value: ID_QU_VOLTS
| | | | +-tag: tagQuantityCharacteristicID value: ID_QC_PEAK
| | | | +-tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_MAX
| | | | +-tag: tagStorageMethodID value: 3
| | | | +-tag: tagSeriesNominalQuantity value: 678.822510
| | | | +-(End of collection)
| | | +-Collection -- tag: tagOneSeriesDefn (level 4)
| | | | +-tag: tagQuantityUnitsID value: ID_QU_VOLTS
| | | | +-tag: tagQuantityCharacteristicID value: ID_QC_PEAK
| | | | +-tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_MIN
| | | | +-tag: tagStorageMethodID value: 3
| | | | +-tag: tagSeriesNominalQuantity value: 678.822510
| | | | +-(End of collection)
| | | +-(End of collection)
```

Figure 2-4
Required Fields for a Triggered Transient Voltage Channel (V_A)

Monitor Settings Record

There are no special requirements for characterization of transient events in the monitor settings beyond tagNominalFrequency giving the base frequency for the system monitored.

Observation Record

Observation records carry the actual data for an event or trend of steady state data. For transient event data, the observation needs certain time stamp information for the record including the

start time for the record and the trigger time that usually is some time after the beginning of the record. For event records, the trigger information is very important and is required for full characterization of the data.

The peak channels are optional and are used to hold peak values of the signal between the individual samples of the waveform. By our convention, these values include low frequency information. The max series hold the positive going peak value and the min series hold the negative going peak. The values in the peak series are interpreted as follows. If full series of values (one peak value for each entry in the waveform value series) are present then the peak data is analyzed as each point being the peak in the previous time interval. If only one point is present in each of the peak series, those values are assumed to be at the trigger time indicated by the tagTimeTriggered tag. The peak characteristics for the transient are determined by these peak channels, if they are present.

Figure 2-5 is a sample transient data observation record. Trigger information is extremely important for complete characterization of the data. Note that the tagSeriesBaseQuantity tags are not really needed as the tagSeriesNominalQuantity from the data source record provides the correct value.

```
-tag: tagRecObservation (level 0)
+- tag: tagTimeCreate value: 9/15/1999 20:31:33.000000000
+- tag: tagTimeStart value: 9/15/1999 20:28:15.537302083
+- tag: tagTimeTriggered value: 9/15/1999 20:28:15.561000000
+- tag: tagTriggerMethodID value: ID_TRIGGER_METH_CHANNEL
+- tag: tagChannelTriggerIdx values: 4 Trigger was on channel defn.  4 in data source
+- tag: tagChannelInstances (level 1)
| +- tag: tagOneChannelInst (level 2)
| | +- tag: tagChannelDefnIdx value: 4 References the channel defn.  in data source
| | +- tag: tagChannelFrequency value: 60.000000
| | +- tag: tagSeriesInstances (level 3)
| | | +- tag: tagOneSeriesInstance (level 4) Series 0, Time
| | | | +- tag: tagSeriesOffset value: 0.000000
| | | | +- tag: tagSeriesScale: 0.000130
| | | | +- tag: tagSeriesValues (type: INTEGER2) [ 3 ]
| | | | +-(End of collection)
| | | +- tag: tagOneSeriesInstance (level 4) Series 1, Voltage waveform
| | | | +- tag: tagSeriesBaseQuantity value: 678.822510
| | | | +- tag: tagSeriesScale value: 0.100000
| | | | +- tag: tagSeriesOffset value: 0.000000
| | | | +- tag: tagSeriesValues (type: INTEGER2) [ 384 ]
| | | | +-(End of collection)
| | | +- tag: tagOneSeriesInstance (level 4) Series 2, Positive Peaks
| | | | +- tag: tagSeriesBaseQuantity value: 678.822510
| | | | +- tag: tagSeriesScale value: 1.000000
| | | | +- tag: tagSeriesOffset: 0.000000
| | | | +- tag: tagSeriesValues (type: INTEGER2) [ 1 ]
| | | | +-(End of collection)
| | | +- tag: tagOneSeriesInstance (level 4) Series 3, Negative Peaks
| | | | +- tag: tagSeriesBaseQuantity value: 678.822510
| | | | +- tag: tagSeriesScale value: 1.000000
| | | | +- tag: tagSeriesOffset value: 0.000000
| | | | +- tag: tagSeriesValues (type: INTEGER2) [ 1 ]
| | | | +-(End of collection)
| | | +-(End of collection)
| | +-(End of collection)
```

Figure 2-5
Sample Transient Data Observation Record

Trend Data

Trend data records give long-term steady-state trends of any quantity that PQView recognizes. The table of channels accepted by PQView is given in Appendix A. In general, trend data is indicated by specifying a trigger method of ID_TRIGGER_METH_PERIODIC in the observation record and specifying a quantity type of ID_QT_VALUELOG in the data source definition for the channel.

Trend data can be stored in several ways. The simplest of these would have just a series of instantaneous values collected over time. These values could be the average value of the variable over the time interval. In addition, the minimum and maximum values over the interval can be captured.

Data Source Definition

The data source definitions for trend data are similar to the previous types discussed thus far. Typically, there is a time series definition followed by one or more series to hold the data for the channel.

See Table A-1 for a map of PQView channels to IEEE PQDIF tags for value logs.

Figure 2-6 shows a record fragment that displays the definition for phase A rms voltage trend with minimum, maximum, and average value series. As with all data source voltage-based channels definitions, it is recommended to include the base voltage for the record. While the characterizer does not currently use that information, it is passed on to PQView for steady state analysis such as voltage regulation.

```
| +- tag: tagOneChannelDefn (level 2)
| | +- tag: tagChannelName value: 'SS RMS VAN'
| | +- tag: tagPhaseID value: ID_PHASE_AN
| | +- tag: tagQuantityMeasuredID value: ID_QM_VOLTAGE
| | +- tag: tagQuantityTypeID value: ID_QT_VALUELOG
| | +- tag: tagSeriesDefns (level 3)
| | | +- tag: tagOneSeriesDefn (level 4)
| | | | +- tag: tagQuantityUnitsID value: ID_QU_SECONDS
| | | | +- tag: tagQuantityCharacteristicID value: ID_QC_RMS
| | | | +- tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_TIME
| | | | +- tag: tagStorageMethodID value: 1
| | | | +-(End of collection)
| | | +- tag: tagOneSeriesDefn (level 4)
| | | | +- tag: tagQuantityUnitsID value: ID_QU_VOLTS
| | | | +- tag: tagQuantityCharacteristicID value: ID_QC_RMS
| | | | +- tag: tagValueTypeID valueID_SERIES_VALUE_TYPE_MIN
| | | | +- tag: tagStorageMethodID value: 3
| | | | +- tag: tagSeriesNominalQuantity value: 7448.000000
| | | | +-(End of collection)
| | | +- tag: tagOneSeriesDefn (level 4)
| | | | +- tag: tagQuantityUnitsID value: ID_QU_VOLTS
| | | | +- tag: tagQuantityCharacteristicID value: ID_QC_RMS
| | | | +- tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_MAX
| | | | +- tag: tagStorageMethodID value: 3
| | | | +- tag: tagSeriesNominalQuantity value: 7448.000000
| | | | +-(End of collection)
| | | +-Collection -- tag: tagOneSeriesDefn (level 4)
| | | | +- tag: tagQuantityUnitsID value: ID_QU_VOLTS
| | | | +- tag: tagQuantityCharacteristicID value: ID_QC_RMS
| | | | +- tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_AVG
| | | | +- tag: tagStorageMethodID value: 3
| | | | +- tag: tagSeriesNominalQuantity value: 7448.000000
| | | | +-(End of collection)
| | | +-(End of collection)
| | +-(End of collection)
```

Figure 2-6
PQDIF Data Source Record Fragment – Definition for Phase A RMS Voltage Trend

Monitor Settings Record

There are no special requirements for characterization of trend data in the monitor settings beyond tagNominalFrequency giving the base frequency for the system monitored.

Observation Record

Observation records carry the actual data for an event or trend of steady state data. For waveform snapshot data, the observation needs certain time stamp information for the record and the ID_TRIGGER_METHOD_PERIODIC tag.

Figure 2-7 is a fragment of a sample periodic triggered waveform data observation record. Note that the tagSeriesBaseQuantity tags, if specified, supersede the value specified by tagSeriesNominalQuantity in the data source record. The tagSeriesNominalQuantity represents the declared nominal for the measurement location, whereas the tagSeriesBaseQuantity represents the actual base value existing at the time of the observation measurement. These can be different for instruments that support features such as floating base voltages for triggering purposes.

```
- tag: tagRecObservation (level 0)
+- tag: tagObservationName value: 'Steady-state trend'
+- tag: tagTimeCreate value: 11/8/2000 13:44:16.000000192
+- tag: tagTimeStart value: 5/6/1995 0:2:15.000000126
+- tag: tagTriggerMethodID value: ID_TRIGGER_METH_PERIODIC
+- tag: tagChannelInstances (level 1)
| +- tag: tagOneChannelInst (level 2)
| | +- tag: tagChannelDefnIdx value: 26
| | +- tag: tagSeriesInstances (level 3)
| | | +- tag: tagOneSeriesInstance (level 4)
| | | | +- tag: tagSeriesValues (type: REAL4) [ 96 ]
| | | | +- tag: tagSeriesBaseQuantity value: 1.000000
| | | | +-(End of collection)
| | | +-Collection -- tag: tagOneSeriesInstance (level 4)
| | | | +- tag: tagSeriesValues (type: INTEGER2) [ 96 ]
| | | | +- tag: tagSeriesBaseQuantity value: 7448.000000
| | | | +- tag: tagSeriesScale value: 0.232897
| | | | +- tag: tagSeriesOffset value: 0.000000
| | | | +-(End of collection)
| | | +- tag: tagOneSeriesInstance (level 4)
| | | | +- tag: tagSeriesValues (type: INTEGER2) [ 96 ]
| | | | +- tag: tagSeriesBaseQuantity value: 7448.000000
| | | | +- tag: tagSeriesScale value: 0.232897
| | | | +- tag: tagSeriesOffset value: 0.000000
| | | | +-(End of collection)
| | | +- tag: tagOneSeriesInstance (level 4)
| | | | +- tag: tagSeriesValues (type: INTEGER2) [ 96 ]
| | | | +- tag: tagSeriesBaseQuantity value: 7448.000000
| | | | +- tag: tagSeriesScale value: 0.232897
| | | | +- tag: tagSeriesOffset value: 0.000000
| | | | +-(End of collection)
| | | +-(End of collection)
```

Figure 2-7
Sample Fragment of Periodic Triggered Waveform Data Observation Record

Waveform Snapshots

Steady-state data can also be derived from periodic snapshots of voltage and current waveforms. The PQView PQDIF characterizer can process these waveforms to give a full set of steady-state quantities and pass them through to the database. Note that as of version 3.42 of the characterizer, only one cycle of data is analyzed, and that for full processing the number of points per cycle must be a power of 2 between 32 and 4096 points.

Waveform snapshot records are indicated to the PQDIF characterizer by the use of the ID_TRIGGER_METH_PERIODIC tag in the observation record and the ID_QT_WAVEFORM tag in the definition.

Data Source Definition

The Data Source definition for waveform snapshots includes a time series and a value series for each channel. The data source record fragment below shows the definition for Phase A voltage waveform snapshot with time and value series.

```
| +- tag: tagOneChannelDefn (level 2)
| | +- tag: tagChannelName (value: 'Waveform VA'
| | +- tag: tagPhaseID value: ID_PHASE_AN
| | +- tag: tagQuantityMeasuredID value: ID_QM_VOLTAGE
| | +- tag: tagQuantityTypeID value: ID_QT_WAVEFORM
| | +- tag: tagSeriesDefns (level 3)
| | | +- tag: tagOneSeriesDefn (level 4)
| | | | +- tag: tagQuantityUnitsID value: ID_QU_SECONDS
| | | | +- tag: tagQuantityCharacteristicID value: ID_QC_ INSTANTANEOUS
| | | | +- tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_TIME
| | | | +- tag: tagStorageMethodID value: 4
| | | | +-(End of collection)
| | | +- tag: tagOneSeriesDefn (level 4)
| | | | +- tag: tagQuantityUnitsID value: ID_QU_VOLTS
| | | | +- tag: tagQuantityCharacteristicID value: ID_QC_INSTANTANEOUS
| | | | +- tag: tagValueTypeID value: ID_SERIES_VALUE_TYPE_VAL
| | | | +- tag: tagStorageMethodID value: 3
| | | | +- tag: tagSeriesNominalQuantity value: 678.822510
| | | | +-(End of collection)
| | | +-(End of collection)
| | +-(End of collection)
```

Figure 2-8
Record Fragment of Definition for Phase A Voltage Waveform Snapshot with Time and

Monitor Settings Record

There are no special requirements for characterization of snapshot waveform data in the monitor settings beyond tagNominalFrequency giving the base frequency for the system monitored.

Observation Record

A sample observation record for a waveform snapshot is shown in Figure 3-9.

```
- tag: tagRecObservation (level 0)
+- tag: tagTimeCreate value: 9/16/1999 7:18:52.000000000
+- tag: tagTimeStart value: 9/16/1999 7:18:16.620000000
+- tag: tagObservationName value: 'Snapshot'
+- tag: tagTriggerMethodID value: 2
+- tag: tagChannelInstances (level 1)
| +- tag: tagOneChannelInst (level 2)
| | +- tag: tagChannelDefnIdx value: 2
| | +- tag: tagSeriesBaseQuantity value: 678.822510
| | +- tag: tagChannelFrequency value: 60.000000
| | +- tag: tagSeriesInstances (level 3)
| | | +- tag: tagOneSeriesInstance (level 4)
| | | | +- tag: tagSeriesOffset value: 0.000000
| | | | +- tag: tagSeriesScale value: 0.000130
| | | | +- tag: tagSeriesValues (type: INTEGER2) [ 3 ]
| | | | +-(End of collection)
| | | +- tag: tagOneSeriesInstance (level 4)
| | | | +- tag: tagSeriesBaseQuantity value: 480.000000
| | | | +- tag: tagSeriesScale value: 0.100000
| | | | +- tag: tagSeriesOffset value: 0.000000
| | | | +- tag: tagSeriesValues (type: INTEGER2) [ 128 ]
| | | | +-(End of collection)
| | | +-(End of collection)
| | +-(End of collection)
```

Figure 2-9
Sample Record of a Waveform Snapshot

More Recommendations

Waveform Samples with No RMS

It is the responsibility of the instrument or instrument support software to process the waveform information, to identify trigger information from the raw data, and to process the waveform information to create rms data that can be processed as rms variation events.

A good approach is to create a virtual instrument to process the waveforms for both transient and rms variation events. Many trigger algorithms can be applied to the raw waveform information to identify trigger points -- waveshape fault, rate change, deviation from base, etc. Processing of rms also can be done in a straightforward manner by applying a sliding one-cycle rms calculation to the waveform data and checking against specified sag and swell thresholds. Once the trigger point has been determined, the data can be completely processed by the PQDIF characterizer to find a full range of characteristics.

3
EXAMPLE CODE FOR EXPORTING MEASUREMENTS

PQDCOM4 is a COM component that can be used to expedite reading and writing PQDIF files. EPRI's PQView application uses this library both to read PQDIF files and to write them. This chapter contains Microsoft Visual Basic® source code that can be used to write PQDIF files using PQDCOM4. PQDCOM4 is normally installed with PQView.

The C++ source code for PQDCOM4 is supplied with the latest version of the PQDIF Software Developer's Kit (SDK) that can be downloaded from the IEEE P1159.3 Task Force. See http://grouper.ieee.org/groups/1159/3/docs.html.

Example code writing PQDIF files using PQDCOM4.DLL can be found at www.pqdif.com. Examples include exporting waveforms, magnitude-duration for voltage sags, and value logs.

Example PQDIF Exporting Module

This example presents a Visual Basic data structure PQDIF_FILE which can completely model a PQDIF file. The structure can be defined in the declarations section of a Visual Basic module or class. The structure can be saved during the function SavePQDIFUsingPQDCOM4. The Visual Basic project needs to have a reference to PQDCOM4.DLL.

Declarations

Copy the following code listed to the declarations section of a Visual Basic module.

```
Option Explicit

' Primitive PQDIF structures
Private Type PQDIF_Timestamp
    TimeStamp As Date
    Subseconds As Double
End Type

' Structure for PQDIF container
Public Type PQDIF_Container
    fileName As String
    Creation As PQDIF_Timestamp
    VersionInfo(0 To 3) As Long
    Language As String
    Title As String
    Subject As String
    Author As String
    Keywords As String
    Comments As String
    LastSavedBy As String
    Application As String
    Security As String
    Owner As String
    Copyright As String
    Trademarks As String
    Notes As String
    CompressionStyleID As Long
    CompressionAlgorithmID As Long
End Type

' Structures for the PQDIF data source record
Public Type PQDIF_SeriesDefinition
    QuantityUnitsID As Long
    ValueTypeID As Variant
```

```
    QuantityCharacteristicID As Variant
    StorageMethodID As Long
    SeriesNominalQuantity As Double
End Type

Public Type PQDIF_ChannelDefinition
    channelID As Long
    FormatCheckSum As Integer
    QuantityType As String
    channelName As String
    QuantityMeasuredID As Long
    PhaseID As Long
    QuantityTypeID As Variant
    SeriesDefinitionCount As Long
    SeriesDefinition() As PQDIF_SeriesDefinition
End Type

Public Type PQDIF_RecordDataSource
    DataSourceTypeID As Variant
    VendorID As Variant
    EquipmentID As Variant
    EffectiveDate As PQDIF_Timestamp
    SerialNumberDS As String
    VersionDS As String
    NameDS As String
    OwnerDS As String
    LocationDS As String
    TimeZoneDS As String
    ChannelDefinitionCount As Long
    ChannelDefinition() As PQDIF_ChannelDefinition
End Type

' Structures for the PQDIF monitor settings record
Public Type PQDIF_ChannelSettingsArray
    ChannelSettingsCount As Long
    ChannelDefinitionIndex() As Long
End Type

Public Type PQDIF_RecordMonitorSettings
    Effective As PQDIF_Timestamp
    TimeInstalled As PQDIF_Timestamp
    TimeRemoved As PQDIF_Timestamp
    UseCalibration As Long
    UseTransducer As Long
    NominalFrequency As Double
    ChannelSettingsArray As PQDIF_ChannelSettingsArray
End Type

' Structures for the PQDIF observation record
Public Type PQDIF_SeriesInstance
    SeriesScale As Double
```

```
    SeriesOffset As Double
    SeriesBaseQuantity As Double
    ValueType As String
    SeriesValuesCount As Long
    SeriesValues() As Double
End Type

Public Type PQDIF_ChannelInstance
    ChannelFrequency As Double
    ChannelGroupID As Double
    ChannelDefinitionIndex As Long
    SeriesInstanceCount As Long
    SeriesInstance() As PQDIF_SeriesInstance
End Type

Public Type PQDIF_RecordObservation
    ObservationName As String
    TimeCreate As PQDIF_Timestamp
    TimeStart As PQDIF_Timestamp
    TriggerMethodID As Variant
    TimeTriggered As PQDIF_Timestamp
    ChannelTriggerIdx As Long
    ChannelInstanceCount As Long
    ChannelInstance() As PQDIF_ChannelInstance
End Type

Public Type PQDIF_File
    Container As PQDIF_Container
    RecordDataSourceCount As Long
    RecordDataSource() As PQDIF_RecordDataSource
    RecordMonitorSettingsCount As Long
    RecordMonitorSetting() As PQDIF_RecordMonitorSettings
    RecordObservationCount As Long
    RecordObservation() As PQDIF_RecordObservation
End Type

' The number of seconds in a day
Private Const SECONDS_PER_DAY As Double = 86400#

' Use this value as a place holder for null values.  Null values are *not* written to the PQDIF file.
Public Const PQDIF_NULL As Double = -524868428707123#
```

Function Declaration for Saving a PQDIF File using PQDCOM4.DLL

Copy the following code listed to a Visual Basic function or module. The function SavePQDIFUsingPQDCOM4 can be used to save PQDIF files containing multiple observations using PQDCOM4.

```
Public Function SavePQDIFUsingPQDCOM4(ByRef usr_PQDIF_File As PQDIF_File) As Boolean

    Dim lngChannelSettingsIndex As Long
    Dim lngChannelDefinitionIndex As Long
    Dim lngSeriesDefinitionIndex As Long
    Dim lngRecObservationIndex As Long
    Dim lngRecMonitorSettingsIndex As Long
    Dim lngRecordDataSourceIndex As Long
    Dim lngChannelInstanceIndex As Long
    Dim lngSeriesInstanceIndex As Long
    Dim lngSeriesValuesIndex As Long

    Dim objLogicalPQDIF As IPQDIFLogical
    Dim objPhysicalPQDIF As PQDCOM4Lib.PQDCOM4

    Dim lngContainerIdx As Long
    Dim lngDataSourceIdx As Long
    Dim lngDataSourcePtr As Long
    Dim lngChannelDefnIdx As Long
    Dim lngSeriesDefnIdx As Long
    Dim lngSettingsIdx As Long
    Dim lngSettingsPtr As Long
    Dim lngObservationIdx As Long
    Dim lngObservationPtr As Long

    Dim vntValues As Variant
    Dim intValues() As Integer
    Dim lngValues() As Long
    Dim sngValues() As Single
    Dim dblValues() As Double

    On Error GoTo ErrorHandler

    ' Initialize the return value
    SavePQDIFUsingPQDCOM4 = True

    With usr_PQDIF_File

        With .Container

            ' Create a new PQDCOM4 object
            Set objLogicalPQDIF = New PQDCOM4Lib.PQDCOM4
```

```
        Set objPhysicalPQDIF = objLogicalPQDIF

        ' Create a new PQDIF file
        objPhysicalPQDIF.New
        objPhysicalPQDIF.FlatFileName = .fileName

        ' Set the PQDIF container properties
        lngContainerIdx = objLogicalPQDIF.RecordCreateContainer3(.fileName, _
                                                                 .Creation.TimeStamp + _
                                                                 .Creation.Subseconds / SECONDS_PER_DAY, _
                                                                 .VersionInfo(0), _
                                                                 .VersionInfo(1), _
                                                                 .VersionInfo(2), _
                                                                 .VersionInfo(3))
        ' Create the container and set its properties
        objLogicalPQDIF.ContainerSetInfo .Language, .Title, .Subject, .Author, .Keywords, .Comments, _
                                         .LastSavedBy, .Application, .Security, .Owner, .Copyright, _
                                         .Trademarks, .Notes
        objPhysicalPQDIF.CompressionStyle = .CompressionStyleID
        objPhysicalPQDIF.CompressionAlgorithm = .CompressionAlgorithmID

    End With ' .Container

    ' For each data source record...
    For lngRecordDataSourceIndex = 0 To .RecordDataSourceCount - 1

        With .RecordDataSource(lngRecordDataSourceIndex)

            ' Create the data source record
            lngDataSourceIdx = objLogicalPQDIF.RecordCreateDataSource2(lngContainerIdx + 1, _
                                                                       .DataSourceTypeID, _
                                                                       .VendorID, _
                                                                       .EquipmentID, _
                                                                       .SerialNumberDS, _
                                                                       .VersionDS, _
                                                                       .NameDS, _
                                                                       .OwnerDS, _
                                                                       .LocationDS, _
                                                                       .TimeZoneDS)

            ' Get a handle to the new data source record
            objLogicalPQDIF.RecordRequestDataSource2 lngDataSourceIdx, lngDataSourcePtr

            ' Set the effective date of the data source
            objLogicalPQDIF.DataSourceSetEffective lngDataSourcePtr, .EffectiveDate.TimeStamp + _
                                                   .EffectiveDate.Subseconds / SECONDS_PER_DAY

            ' Add the channel definitions
            For lngChannelDefinitionIndex = 0 To .ChannelDefinitionCount - 1

                With .ChannelDefinition(lngChannelDefinitionIndex)
```

```
                ' Add this channel definition
                lngChannelDefnIdx = objLogicalPQDIF.DataSourceAddChannelDefn3(lngDataSourcePtr, _
                                                                              .channelName, _
                                                                              .PhaseID, _
                                                                              .QuantityMeasuredID, _
                                                                              .QuantityTypeID)

                ' For each data series...
                For lngSeriesDefinitionIndex = 0 To .SeriesDefinitionCount - 1

                    With .SeriesDefinition(lngSeriesDefinitionIndex)

                        ' Add the series definitions for this channel
                        lngSeriesDefnIdx = objLogicalPQDIF.DataSourceAddSeriesDefn2(lngDataSourcePtr, _
                                                                                    lngChannelDefnIdx, _
                                                                                    .QuantityUnitsID, _
                                                                                    .ValueTypeID, _
                                                                                    .QuantityCharacteristicID, _
                                                                                    .StorageMethodID)

                        ' If we need to add the nominal voltage for this series definition...
                        If .SeriesNominalQuantity <> PQDIF_NULL Then
                            objLogicalPQDIF.DataSourceSetSeriesDefnNominal lngDataSourcePtr, _
                                                                           lngChannelDefnIdx, _
                                                                           lngSeriesDefnIdx, _
                                                                           .SeriesNominalQuantity
                        End If

                    End With

                Next lngSeriesDefinitionIndex

            End With

        Next lngChannelDefinitionIndex


    End With ' .RecordDataSource

Next lngRecordDataSourceIndex



' For each monitor settings record...
For lngRecMonitorSettingsIndex = 0 To .RecordMonitorSettingsCount - 1

    With .RecordMonitorSetting(lngRecMonitorSettingsIndex)

        ' If there are channel indices to write...
        If .ChannelSettingsArray.ChannelSettingsCount > 0 Then
```

```
            ' Create a new monitor settings record
            lngSettingsIdx = objLogicalPQDIF.RecordCreateSettings2(lngDataSourceIdx + 1)

            ' Get the handle to the new monitor settings record
            objLogicalPQDIF.RecordRequestSettings2 lngSettingsIdx, lngSettingsPtr

            ' Add monitor settings properties
            objLogicalPQDIF.SettingsSetEffective lngSettingsPtr, _
                                                 .Effective.TimeStamp + _
                                                 .Effective.Subseconds / SECONDS_PER_DAY

            objLogicalPQDIF.SettingsSetInstalled lngSettingsPtr, _
                                                 .TimeInstalled.TimeStamp + _
                                                 .TimeInstalled.Subseconds / SECONDS_PER_DAY

            objLogicalPQDIF.SettingsSetRemoved lngSettingsPtr, _
                                               .TimeRemoved.TimeStamp + _
                                               .TimeRemoved.Subseconds / SECONDS_PER_DAY

            objLogicalPQDIF.SettingsSetUseCalibration lngSettingsPtr, .UseCalibration
            objLogicalPQDIF.SettingsSetUseTransducer lngSettingsPtr, .UseTransducer
            objLogicalPQDIF.SettingsSetNominalFrequency lngSettingsPtr, .NominalFrequency

            ' Add the trigger channel settings array
            With .ChannelSettingsArray
                For lngChannelSettingsIndex = 0 To .ChannelSettingsCount - 1
                    objLogicalPQDIF.SettingsAddChannel lngSettingsPtr, _
                                                       .ChannelDefinitionIndex(lngChannelSettingsIndex)
                Next lngChannelSettingsIndex
            End With

        End If ' If there are channel indices to write

    End With ' .RecordMonitorSettings

Next lngRecMonitorSettingsIndex


' For each observation...
For lngRecObservationIndex = 0 To .RecordObservationCount - 1

    With .RecordObservation(lngRecObservationIndex)

        ' Create a new observation
        lngObservationIdx = objLogicalPQDIF.RecordCreateObservation2(lngSettingsIdx + 1 + lngRecObservationIndex, _
                                                                     .ObservationName, _
                                                                     .TimeCreate.TimeStamp + _
                                                                     .TimeCreate.Subseconds / SECONDS_PER_DAY, _
                                                                     .TimeStart.TimeStamp + _
                                                                     .TimeStart.Subseconds / SECONDS_PER_DAY, _
```

```
                                                        .TriggerMethodID, _
                                                        .TimeTriggered.TimeStamp + _
                                                        .TimeTriggered.Subseconds / SECONDS_PER_DAY, _
                                                        .ChannelTriggerIdx)

' Get the handle to the new observation record
objLogicalPQDIF.RecordRequestObservation2 lngObservationIdx, lngObservationPtr

' For each channel instance in this observation record...
For lngChannelInstanceIndex = 0 To .ChannelInstanceCount - 1
    With .ChannelInstance(lngChannelInstanceIndex)

        ' Add a channel definition, then set the channel frequency if necessary
        objLogicalPQDIF.ObservationAddChannel2 lngObservationPtr, .ChannelDefinitionIndex
        If .ChannelFrequency <> PQDIF_NULL Then
            objLogicalPQDIF.ObservationSetChannelFreq lngObservationPtr, _
                                                      lngChannelInstanceIndex, _
                                                      .ChannelFrequency
        End If

        ' For each series instance of this channel instance...
        For lngSeriesInstanceIndex = 0 To .SeriesInstanceCount - 1
            With .SeriesInstance(lngSeriesInstanceIndex)

                ' Store the series data in an array
                Select Case .ValueType
                    Case "INT2"
                        If .SeriesValuesCount > 0 Then
                            ReDim intValues(0 To .SeriesValuesCount - 1) As Integer
                        End If
                        For lngSeriesValuesIndex = 0 To .SeriesValuesCount - 1
                            intValues(lngSeriesValuesIndex) = CInt(.SeriesValues(lngSeriesValuesIndex))
                        Next lngSeriesValuesIndex
                        vntValues = intValues()

                    Case "INT4"
                        If .SeriesValuesCount > 0 Then
                            ReDim lngValues(0 To .SeriesValuesCount - 1) As Long
                        End If
                        For lngSeriesValuesIndex = 0 To .SeriesValuesCount - 1
                            lngValues(lngSeriesValuesIndex) = CLng(.SeriesValues(lngSeriesValuesIndex))
                        Next lngSeriesValuesIndex
                        vntValues = lngValues()

                    Case "REAL4"
                        If .SeriesValuesCount > 0 Then
                            ReDim sngValues(0 To .SeriesValuesCount - 1) As Single
                        End If
                        For lngSeriesValuesIndex = 0 To .SeriesValuesCount - 1
                            sngValues(lngSeriesValuesIndex) = CSng(.SeriesValues(lngSeriesValuesIndex))
                        Next lngSeriesValuesIndex
```

```
                                    vntValues = sngValues()

                                Case Else ' Or, Case "REAL8"
                                    If .SeriesValuesCount > 0 Then
                                        ReDim dblValues(0 To .SeriesValuesCount - 1) As Double
                                    End If
                                    For lngSeriesValuesIndex = 0 To .SeriesValuesCount - 1
                                        dblValues(lngSeriesValuesIndex) = .SeriesValues(lngSeriesValuesIndex)
                                    Next lngSeriesValuesIndex
                                    vntValues = dblValues()

                            End Select

                            ' Add the observation data
                            objLogicalPQDIF.ObservationAddSeriesData lngObservationPtr, _
                                                                     lngChannelInstanceIndex, _
                                                                     vntValues

                            ' Set the series scale, offset, and nominal base.  Note that these calls
                            ' must occur *after* the call to ObservationAddSeriesData
                            objLogicalPQDIF.ObservationSetSeriesScale lngObservationPtr, _
                                                                      lngChannelInstanceIndex, _
                                                                      lngSeriesInstanceIndex, _
                                                                      .SeriesScale, _
                                                                      .SeriesOffset
                            If .SeriesBaseQuantity <> PQDIF_NULL Then
                                objLogicalPQDIF.ObservationSetSeriesBaseQty2 lngObservationPtr, _
                                                                             lngChannelInstanceIndex, _
                                                                             lngSeriesInstanceIndex, _
                                                                             .SeriesBaseQuantity
                            End If

                        End With
                    Next lngSeriesInstanceIndex

                End With

            Next lngChannelInstanceIndex

        End With ' .RecordObservation(lngRecObservationIndex)


        ' Release the observation record's pointer
        If lngObservationPtr > 0 Then
            objLogicalPQDIF.RecordReleaseObservation2 lngObservationPtr
        End If

    Next lngRecObservationIndex

End With ' usr_PQDIF_File
```

```
ExitHandler:
    On Error Resume Next

    objPhysicalPQDIF.WriteNew
    If lngDataSourcePtr > 0 Then
        objLogicalPQDIF.RecordReleaseDataSource2 lngDataSourcePtr
    End If
    If lngSettingsPtr > 0 Then
        objLogicalPQDIF.RecordReleaseSettings2 lngSettingsPtr
    End If
    objPhysicalPQDIF.Close
    Set objLogicalPQDIF = Nothing
    Set objPhysicalPQDIF = Nothing

    Exit Function

ErrorHandler:
    SavePQDIFUsingPQDCOM4 = False
    Resume ExitHandler

End Function
```

Function to Export Voltage and Current Waveforms

Copy the following code to a Visual Basic Module. This function can be used to export voltage and current waveforms to a PQDIF file.

```
Public Sub ExportWaveformsToPQDIF(ByVal strFileName As String, strSiteName As String, strSiteDesc, _
                                  ByVal datWhenStart As Date, ByVal dblStartTime As Double, _
                                  ByVal dblNominalBaseV As Double, ByVal dblFundFreq As Double, _
                                  ByVal lngSampleCount As Long, ByRef dblTime() As Double, _
                                  ByRef sngVa() As Single, ByRef sngVb() As Single, ByRef sngVc() As Single, ByRef sngVn() As Single,_
                                  ByRef sngIa() As Single, ByRef sngIb() As Single, ByRef sngIc() As Single, ByRef sngIn() As Single)

    Dim usr_PQDIF_File As PQDIF_File
    Dim i As Long

    Const MY_FILE_CHANNEL_COUNT As Long = 8
    Const MY_FILE_CHANNEL_VA As Long = 0
    Const MY_FILE_CHANNEL_VB As Long = 1
    Const MY_FILE_CHANNEL_VC As Long = 2
    Const MY_FILE_CHANNEL_VN As Long = 3
    Const MY_FILE_CHANNEL_IA As Long = 4
    Const MY_FILE_CHANNEL_IB As Long = 5
    Const MY_FILE_CHANNEL_IC As Long = 6
    Const MY_FILE_CHANNEL_IN As Long = 7

    Const MY_FILE_SERIES_TIME As Long = 0
```

```
    Const MY_FILE_SERIES_VALUES As Long = 1

    Const SQRT2 As Double = 1.4142135623731

    ' Look up each GUID and ID value
    PQDIF_InitGUIDs

    With usr_PQDIF_File

        ' Set the container record
        With .Container
            .fileName = strFileName
            .Creation.TimeStamp = Now
            .Creation.Subseconds = CDbl(Timer() - Int(Timer()))
            .VersionInfo(0) = 1
            .VersionInfo(1) = 5
            .VersionInfo(2) = 1
            .VersionInfo(3) = 5
            .Language = "US English"
            .Title = "PQView"
            .Subject = "N/A"
            .Author = "N/A"
            .Keywords = "N/A"
            .Comments = "N/A"
            .LastSavedBy = "N/A"
            .Application = "PQView"
            .Security = "N/A"
            .Owner = "N/A"
            .Copyright = "N/A"
            .Trademarks = "PQView is a registered trademark of Electrotek Concepts, Inc.  EPRI is a registered service mark of the
Electric Power Research Institute."
            .Notes = "N/A"
            .CompressionStyleID = ID_COMP_STYLE_RECORDLEVEL ' In this example, we compress each record
            .CompressionAlgorithmID = ID_COMP_ALG_ZLIB
        End With

        ' We only need one data source record
        .RecordDataSourceCount = 1
        ReDim .RecordDataSource(0 To .RecordDataSourceCount - 1) As PQDIF_RecordDataSource

        ' Initialize the data source record
        With .RecordDataSource(0)

            .DataSourceTypeID = ID_DS_TYPE_MEASURE
            .VendorID = ID_VENDOR_EPRI
            .EquipmentID = ID_EQUIP_ETK_PQVIEW

            ' This time stamp should be the date when the settings for this meter become effective
            ' (e.g., when the meter is installed or when the setups last changed).  The date itself
            ' is not important as long as it is at or before the earliest observation record time stamp.
            .EffectiveDate.TimeStamp = datWhenStart
```

```
.EffectiveDate.Subseconds = 0

.NameDS = strSiteName
.OwnerDS = "N/A"
.LocationDS = "N/A"
.TimeZoneDS = "UTC"
.SerialNumberDS = strSiteDesc
.VersionDS = "N/A"

' In this example, we have channel definitions for the three voltage waveforms and
' three current waveforms (Va,Vb,Vc,Ia,Ib,Ic).  We need two series definitions for each
' channel definition: one for time samples, and one for the voltage/current samples.
.ChannelDefinitionCount = MY_FILE_CHANNEL_COUNT
ReDim .ChannelDefinition(0 To .ChannelDefinitionCount - 1) As PQDIF_ChannelDefinition

With .ChannelDefinition(MY_FILE_CHANNEL_VA)
    .channelName = "V Waveform A"
    .QuantityMeasuredID = ID_QM_VOLTAGE
    .PhaseID = ID_PHASE_AN
    .QuantityTypeID = ID_QT_WAVEFORM
    .SeriesDefinitionCount = 2
    ReDim .SeriesDefinition(0 To .SeriesDefinitionCount - 1) As PQDIF_SeriesDefinition
    With .SeriesDefinition(MY_FILE_SERIES_TIME)
        .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
        .QuantityUnitsID = ID_QU_SECONDS
        .ValueTypeID = ID_SERIES_VALUE_TYPE_TIME
        .StorageMethodID = ID_SERIES_METHOD_VALUES
        .SeriesNominalQuantity = PQDIF_NULL
    End With
    With .SeriesDefinition(MY_FILE_SERIES_VALUES)
        .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
        .QuantityUnitsID = ID_QU_VOLTS
        .ValueTypeID = ID_SERIES_VALUE_TYPE_VAL
        .StorageMethodID = ID_SERIES_METHOD_VALUES
        .SeriesNominalQuantity = dblNominalBaseV * SQRT2
    End With
End With ' .ChannelDefinition(MY_FILE_CHANNEL_VA)

With .ChannelDefinition(MY_FILE_CHANNEL_VB)
    .channelName = "V Waveform B"
    .QuantityMeasuredID = ID_QM_VOLTAGE
    .PhaseID = ID_PHASE_BN
    .QuantityTypeID = ID_QT_WAVEFORM
    .SeriesDefinitionCount = 2
    ReDim .SeriesDefinition(0 To .SeriesDefinitionCount - 1) As PQDIF_SeriesDefinition
    With .SeriesDefinition(MY_FILE_SERIES_TIME)
        .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
        .QuantityUnitsID = ID_QU_SECONDS
        .ValueTypeID = ID_SERIES_VALUE_TYPE_TIME
        .StorageMethodID = ID_SERIES_METHOD_VALUES
        .SeriesNominalQuantity = PQDIF_NULL
```

```
        End With
        With .SeriesDefinition(MY_FILE_SERIES_VALUES)
            .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
            .QuantityUnitsID = ID_QU_VOLTS
            .ValueTypeID = ID_SERIES_VALUE_TYPE_VAL
            .StorageMethodID = ID_SERIES_METHOD_VALUES
            .SeriesNominalQuantity = dblNominalBaseV * SQRT2
        End With
    End With ' .ChannelDefinition(MY_FILE_CHANNEL_VB)

    With .ChannelDefinition(MY_FILE_CHANNEL_VC)
        .channelName = "V Waveform C"
        .QuantityMeasuredID = ID_QM_VOLTAGE
        .PhaseID = ID_PHASE_CN
        .QuantityTypeID = ID_QT_WAVEFORM
        .SeriesDefinitionCount = 2
        ReDim .SeriesDefinition(0 To .SeriesDefinitionCount - 1) As PQDIF_SeriesDefinition
        With .SeriesDefinition(MY_FILE_SERIES_TIME)
            .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
            .QuantityUnitsID = ID_QU_SECONDS
            .ValueTypeID = ID_SERIES_VALUE_TYPE_TIME
            .StorageMethodID = ID_SERIES_METHOD_VALUES
            .SeriesNominalQuantity = PQDIF_NULL
        End With
        With .SeriesDefinition(MY_FILE_SERIES_VALUES)
            .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
            .QuantityUnitsID = ID_QU_VOLTS
            .ValueTypeID = ID_SERIES_VALUE_TYPE_VAL
            .StorageMethodID = ID_SERIES_METHOD_VALUES
            .SeriesNominalQuantity = dblNominalBaseV * SQRT2
        End With
    End With ' .ChannelDefinition(MY_FILE_CHANNEL_VC)

    With .ChannelDefinition(MY_FILE_CHANNEL_VN)
        .channelName = "V Waveform N"
        .QuantityMeasuredID = ID_QM_VOLTAGE
        .PhaseID = ID_PHASE_NG
        .QuantityTypeID = ID_QT_WAVEFORM
        .SeriesDefinitionCount = 2
        ReDim .SeriesDefinition(0 To .SeriesDefinitionCount - 1) As PQDIF_SeriesDefinition
        With .SeriesDefinition(MY_FILE_SERIES_TIME)
            .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
            .QuantityUnitsID = ID_QU_SECONDS
            .ValueTypeID = ID_SERIES_VALUE_TYPE_TIME
            .StorageMethodID = ID_SERIES_METHOD_VALUES
            .SeriesNominalQuantity = PQDIF_NULL
        End With
        With .SeriesDefinition(MY_FILE_SERIES_VALUES)
            .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
            .QuantityUnitsID = ID_QU_VOLTS
            .ValueTypeID = ID_SERIES_VALUE_TYPE_VAL
```

```
        .StorageMethodID = ID_SERIES_METHOD_VALUES
        .SeriesNominalQuantity = PQDIF_NULL
    End With
End With ' .ChannelDefinition(MY_FILE_CHANNEL_VN)


With .ChannelDefinition(MY_FILE_CHANNEL_IA)
    .channelName = "I Waveform A"
    .QuantityMeasuredID = ID_QM_CURRENT
    .PhaseID = ID_PHASE_AN
    .QuantityTypeID = ID_QT_WAVEFORM
    .SeriesDefinitionCount = 2
    ReDim .SeriesDefinition(0 To .SeriesDefinitionCount - 1) As PQDIF_SeriesDefinition
    With .SeriesDefinition(MY_FILE_SERIES_TIME)
        .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
        .QuantityUnitsID = ID_QU_SECONDS
        .ValueTypeID = ID_SERIES_VALUE_TYPE_TIME
        .StorageMethodID = ID_SERIES_METHOD_VALUES
        .SeriesNominalQuantity = PQDIF_NULL
    End With
    With .SeriesDefinition(MY_FILE_SERIES_VALUES)
        .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
        .QuantityUnitsID = ID_QU_AMPS
        .ValueTypeID = ID_SERIES_VALUE_TYPE_VAL
        .StorageMethodID = ID_SERIES_METHOD_VALUES
        .SeriesNominalQuantity = PQDIF_NULL
    End With
End With ' .ChannelDefinition(MY_FILE_CHANNEL_IA)

With .ChannelDefinition(MY_FILE_CHANNEL_IB)
    .channelName = "I Waveform B"
    .QuantityMeasuredID = ID_QM_CURRENT
    .PhaseID = ID_PHASE_BN
    .QuantityTypeID = ID_QT_WAVEFORM
    .SeriesDefinitionCount = 2
    ReDim .SeriesDefinition(0 To .SeriesDefinitionCount - 1) As PQDIF_SeriesDefinition
    With .SeriesDefinition(MY_FILE_SERIES_TIME)
        .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
        .QuantityUnitsID = ID_QU_SECONDS
        .ValueTypeID = ID_SERIES_VALUE_TYPE_TIME
        .StorageMethodID = ID_SERIES_METHOD_VALUES
        .SeriesNominalQuantity = PQDIF_NULL
    End With
    With .SeriesDefinition(MY_FILE_SERIES_VALUES)
        .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
        .QuantityUnitsID = ID_QU_AMPS
        .ValueTypeID = ID_SERIES_VALUE_TYPE_VAL
        .StorageMethodID = ID_SERIES_METHOD_VALUES
        .SeriesNominalQuantity = PQDIF_NULL
    End With
End With ' .ChannelDefinition(MY_FILE_CHANNEL_IB)
```

```
        With .ChannelDefinition(MY_FILE_CHANNEL_IC)
            .channelName = "I Waveform C"
            .QuantityMeasuredID = ID_QM_CURRENT
            .PhaseID = ID_PHASE_CN
            .QuantityTypeID = ID_QT_WAVEFORM
            .SeriesDefinitionCount = 2
            ReDim .SeriesDefinition(0 To .SeriesDefinitionCount - 1) As PQDIF_SeriesDefinition
            With .SeriesDefinition(MY_FILE_SERIES_TIME)
                .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
                .QuantityUnitsID = ID_QU_SECONDS
                .ValueTypeID = ID_SERIES_VALUE_TYPE_TIME
                .StorageMethodID = ID_SERIES_METHOD_VALUES
                .SeriesNominalQuantity = PQDIF_NULL
            End With
            With .SeriesDefinition(MY_FILE_SERIES_VALUES)
                .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
                .QuantityUnitsID = ID_QU_AMPS
                .ValueTypeID = ID_SERIES_VALUE_TYPE_VAL
                .StorageMethodID = ID_SERIES_METHOD_VALUES
                .SeriesNominalQuantity = PQDIF_NULL
            End With
        End With ' .ChannelDefinition(MY_FILE_CHANNEL_IC)

        With .ChannelDefinition(MY_FILE_CHANNEL_IN)
            .channelName = "I Waveform N"
            .QuantityMeasuredID = ID_QM_CURRENT
            .PhaseID = ID_PHASE_NG
            .QuantityTypeID = ID_QT_WAVEFORM
            .SeriesDefinitionCount = 2
            ReDim .SeriesDefinition(0 To .SeriesDefinitionCount - 1) As PQDIF_SeriesDefinition
            With .SeriesDefinition(MY_FILE_SERIES_TIME)
                .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
                .QuantityUnitsID = ID_QU_SECONDS
                .ValueTypeID = ID_SERIES_VALUE_TYPE_TIME
                .StorageMethodID = ID_SERIES_METHOD_VALUES
                .SeriesNominalQuantity = PQDIF_NULL
            End With
            With .SeriesDefinition(MY_FILE_SERIES_VALUES)
                .QuantityCharacteristicID = ID_QC_INSTANTANEOUS
                .QuantityUnitsID = ID_QU_AMPS
                .ValueTypeID = ID_SERIES_VALUE_TYPE_VAL
                .StorageMethodID = ID_SERIES_METHOD_VALUES
                .SeriesNominalQuantity = PQDIF_NULL
            End With
        End With ' .ChannelDefinition(MY_FILE_CHANNEL_IN)

    End With ' .RecordDataSource(0)


    ' We only need one monitor settings record
```

```
.RecordMonitorSettingsCount = 1
ReDim .RecordMonitorSetting(0 To .RecordMonitorSettingsCount - 1) As PQDIF_RecordMonitorSettings
With .RecordMonitorSetting(0)

    ' This time stamp should be the date when the settings for this meter become effective
    ' (e.g., when the meter is installed or when the setups last changed).  The date itself
    ' is not important as long as it is at or before the earliest observation record time stamp.
    .Effective.TimeStamp = datWhenStart
    .Effective.Subseconds = 0

    ' This time stamp should when the meter is installed.  The date itself is not important
    ' as long as it is at or before the earliest observation record time stamp.
    .TimeInstalled.TimeStamp = datWhenStart
    .TimeInstalled.Subseconds = 0

    ' This is the time stamp when the meter is removed.  The date itself is not important
    ' as long as it is after the latest observation record time stamp.
    .TimeRemoved.TimeStamp = Now() ' Do not set time removed to be greater than 2030
    .TimeRemoved.Subseconds = 0

    ' We are storing measurements with no calibration or transucer settings
    .UseCalibration = 0
    .UseTransducer = 0

    ' This should be 50, 60, or 400 Hertz
    .NominalFrequency = dblFundFreq

    ' We need one channel setting for each channel definition
    With .ChannelSettingsArray

        ' We need one channel definition index for each of the six channel definitions.
        .ChannelSettingsCount = MY_FILE_CHANNEL_COUNT
        ReDim .ChannelDefinitionIndex(0 To .ChannelSettingsCount - 1) As Long

        .ChannelDefinitionIndex(MY_FILE_CHANNEL_VA) = MY_FILE_CHANNEL_VA
        .ChannelDefinitionIndex(MY_FILE_CHANNEL_VB) = MY_FILE_CHANNEL_VB
        .ChannelDefinitionIndex(MY_FILE_CHANNEL_VC) = MY_FILE_CHANNEL_VC
        .ChannelDefinitionIndex(MY_FILE_CHANNEL_VN) = MY_FILE_CHANNEL_VN
        .ChannelDefinitionIndex(MY_FILE_CHANNEL_IA) = MY_FILE_CHANNEL_IA
        .ChannelDefinitionIndex(MY_FILE_CHANNEL_IB) = MY_FILE_CHANNEL_IB
        .ChannelDefinitionIndex(MY_FILE_CHANNEL_IC) = MY_FILE_CHANNEL_IC
        .ChannelDefinitionIndex(MY_FILE_CHANNEL_IN) = MY_FILE_CHANNEL_IN

    End With

End With ' .RecordMonitorSetting(0)

' We will store one event in this PQDIF file
.RecordObservationCount = 1
ReDim usr_PQDIF_File.RecordObservation(0 To .RecordObservationCount - 1) As PQDIF_RecordObservation
```

```
' Add the event
With usr_PQDIF_File.RecordObservation(0)

    .ObservationName = "Waveform Samples"
    .TimeCreate.TimeStamp = datWhenStart
    .TimeCreate.Subseconds = dblStartTime
    .TimeStart.TimeStamp = datWhenStart
    .TimeStart.Subseconds = dblStartTime
    .TriggerMethodID = ID_TRIGGER_METH_CHANNEL
    .TimeTriggered.TimeStamp = datWhenStart
    .TimeTriggered.Subseconds = dblStartTime
    .ChannelTriggerIdx = MY_FILE_CHANNEL_VA

    ' We need one channel instance for each channel definition
    .ChannelInstanceCount = MY_FILE_CHANNEL_COUNT
    ReDim Preserve .ChannelInstance(0 To .ChannelInstanceCount - 1) As PQDIF_ChannelInstance

    With .ChannelInstance(MY_FILE_CHANNEL_VA)

        .ChannelFrequency = PQDIF_NULL ' This is used when storing harmonic samples.
        .ChannelGroupID = PQDIF_NULL ' This also is used when storing harmonic samples.
        .ChannelDefinitionIndex = MY_FILE_CHANNEL_VA

        ' We need one series instance for time and one for values
        .SeriesInstanceCount = 2
        ReDim .SeriesInstance(0 To .SeriesInstanceCount - 1) As PQDIF_SeriesInstance
        With .SeriesInstance(MY_FILE_SERIES_TIME)
            .SeriesBaseQuantity = PQDIF_NULL
            .SeriesOffset = 0
            .SeriesScale = 1
            .ValueType = "REAL8"
            .SeriesValuesCount = lngSampleCount
            ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
            For i = 0 To .SeriesValuesCount - 1
                .SeriesValues(i) = dblTime(i)
            Next i
        End With
        With .SeriesInstance(MY_FILE_SERIES_VALUES)
            .SeriesBaseQuantity = PQDIF_NULL
            .SeriesOffset = 0
            .SeriesScale = 1
            .ValueType = "REAL4"
            .SeriesValuesCount = lngSampleCount
            ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
            For i = 0 To .SeriesValuesCount - 1
                .SeriesValues(i) = CDbl(sngVa(i))
            Next i
        End With

    End With ' .ChannelInstance(MY_FILE_CHANNEL_VA)
```

```
With .ChannelInstance(MY_FILE_CHANNEL_VB)

    .ChannelFrequency = PQDIF_NULL ' This is used when storing harmonic samples.
    .ChannelGroupID = PQDIF_NULL ' This also is used when storing harmonic samples.
    .ChannelDefinitionIndex = MY_FILE_CHANNEL_VB

    ' We need one series instance for time and one for values
    .SeriesInstanceCount = 2
    ReDim .SeriesInstance(0 To .SeriesInstanceCount - 1) As PQDIF_SeriesInstance
    With .SeriesInstance(MY_FILE_SERIES_TIME)
        .SeriesBaseQuantity = PQDIF_NULL
        .SeriesOffset = 0
        .SeriesScale = 1
        .ValueType = "REAL8"
        .SeriesValuesCount = lngSampleCount
        ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
        For i = 0 To .SeriesValuesCount - 1
            .SeriesValues(i) = dblTime(i)
        Next i
    End With
    With .SeriesInstance(MY_FILE_SERIES_VALUES)
        .SeriesBaseQuantity = PQDIF_NULL
        .SeriesOffset = 0
        .SeriesScale = 1
        .ValueType = "REAL4"
        .SeriesValuesCount = lngSampleCount
        ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
        For i = 0 To .SeriesValuesCount - 1
            .SeriesValues(i) = CDbl(sngVb(i))
        Next i
    End With

End With ' .ChannelInstance(MY_FILE_CHANNEL_VB)

With .ChannelInstance(MY_FILE_CHANNEL_VC)

    .ChannelFrequency = PQDIF_NULL ' This is used when storing harmonic samples.
    .ChannelGroupID = PQDIF_NULL ' This also is used when storing harmonic samples.
    .ChannelDefinitionIndex = MY_FILE_CHANNEL_VC

    ' We need one series instance for time and one for values
    .SeriesInstanceCount = 2
    ReDim .SeriesInstance(0 To .SeriesInstanceCount - 1) As PQDIF_SeriesInstance
    With .SeriesInstance(MY_FILE_SERIES_TIME)
        .SeriesBaseQuantity = PQDIF_NULL
        .SeriesOffset = 0
        .SeriesScale = 1
        .ValueType = "REAL8"
        .SeriesValuesCount = lngSampleCount
        ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
        For i = 0 To .SeriesValuesCount - 1
```

```
                .SeriesValues(i) = dblTime(i)
            Next i
        End With
        With .SeriesInstance(MY_FILE_SERIES_VALUES)
            .SeriesBaseQuantity = PQDIF_NULL
            .SeriesOffset = 0
            .SeriesScale = 1
            .ValueType = "REAL4"
            .SeriesValuesCount = lngSampleCount
            ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
            For i = 0 To .SeriesValuesCount - 1
                .SeriesValues(i) = CDbl(sngVc(i))
            Next i
        End With

    End With ' .ChannelInstance(MY_FILE_CHANNEL_VC)

    With .ChannelInstance(MY_FILE_CHANNEL_VN)

        .ChannelFrequency = PQDIF_NULL ' This is used when storing harmonic samples.
        .ChannelGroupID = PQDIF_NULL ' This also is used when storing harmonic samples.
        .ChannelDefinitionIndex = MY_FILE_CHANNEL_VN

        ' We need one series instance for time and one for values
        .SeriesInstanceCount = 2
        ReDim .SeriesInstance(0 To .SeriesInstanceCount - 1) As PQDIF_SeriesInstance
        With .SeriesInstance(MY_FILE_SERIES_TIME)
            .SeriesBaseQuantity = PQDIF_NULL
            .SeriesOffset = 0
            .SeriesScale = 1
            .ValueType = "REAL8"
            .SeriesValuesCount = lngSampleCount
            ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
            For i = 0 To .SeriesValuesCount - 1
                .SeriesValues(i) = dblTime(i)
            Next i
        End With
        With .SeriesInstance(MY_FILE_SERIES_VALUES)
            .SeriesBaseQuantity = PQDIF_NULL
            .SeriesOffset = 0
            .SeriesScale = 1
            .ValueType = "REAL4"
            .SeriesValuesCount = lngSampleCount
            ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
            For i = 0 To .SeriesValuesCount - 1
                .SeriesValues(i) = CDbl(sngVn(i))
            Next i
        End With

    End With ' .ChannelInstance(MY_FILE_CHANNEL_VN)
```

```
With .ChannelInstance(MY_FILE_CHANNEL_IA)

    .ChannelFrequency = PQDIF_NULL ' This is used when storing harmonic samples.
    .ChannelGroupID = PQDIF_NULL ' This also is used when storing harmonic samples.
    .ChannelDefinitionIndex = MY_FILE_CHANNEL_IA

    ' We need one series instance for time and one for values
    .SeriesInstanceCount = 2
    ReDim .SeriesInstance(0 To .SeriesInstanceCount - 1) As PQDIF_SeriesInstance
    With .SeriesInstance(MY_FILE_SERIES_TIME)
        .SeriesBaseQuantity = PQDIF_NULL
        .SeriesOffset = 0
        .SeriesScale = 1
        .ValueType = "REAL8"
        .SeriesValuesCount = lngSampleCount
        ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
        For i = 0 To .SeriesValuesCount - 1
            .SeriesValues(i) = dblTime(i)
        Next i
    End With
    With .SeriesInstance(MY_FILE_SERIES_VALUES)
        .SeriesBaseQuantity = PQDIF_NULL
        .SeriesOffset = 0
        .SeriesScale = 1
        .ValueType = "REAL4"
        .SeriesValuesCount = lngSampleCount
        ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
        For i = 0 To .SeriesValuesCount - 1
            .SeriesValues(i) = CDbl(sngIa(i))
        Next i
    End With

End With ' .ChannelInstance(MY_FILE_CHANNEL_IA)

With .ChannelInstance(MY_FILE_CHANNEL_IB)

    .ChannelFrequency = PQDIF_NULL ' This is used when storing harmonic samples.
    .ChannelGroupID = PQDIF_NULL ' This also is used when storing harmonic samples.
    .ChannelDefinitionIndex = MY_FILE_CHANNEL_IB

    ' We need one series instance for time and one for values
    .SeriesInstanceCount = 2
    ReDim .SeriesInstance(0 To .SeriesInstanceCount - 1) As PQDIF_SeriesInstance
    With .SeriesInstance(MY_FILE_SERIES_TIME)
        .SeriesBaseQuantity = PQDIF_NULL
        .SeriesOffset = 0
        .SeriesScale = 1
        .ValueType = "REAL8"
        .SeriesValuesCount = lngSampleCount
        ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
        For i = 0 To .SeriesValuesCount - 1
```

```
            .SeriesValues(i) = dblTime(i)
        Next i
    End With
    With .SeriesInstance(MY_FILE_SERIES_VALUES)
        .SeriesBaseQuantity = PQDIF_NULL
        .SeriesOffset = 0
        .SeriesScale = 1
        .ValueType = "REAL4"
        .SeriesValuesCount = lngSampleCount
        ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
        For i = 0 To .SeriesValuesCount - 1
            .SeriesValues(i) = CDbl(sngIc(i))
        Next i
    End With

End With ' .ChannelInstance(MY_FILE_CHANNEL_IB)

With .ChannelInstance(MY_FILE_CHANNEL_IC)

    .ChannelFrequency = PQDIF_NULL ' This is used when storing harmonic samples.
    .ChannelGroupID = PQDIF_NULL ' This also is used when storing harmonic samples.
    .ChannelDefinitionIndex = MY_FILE_CHANNEL_IC

    ' We need one series instance for time and one for values
    .SeriesInstanceCount = 2
    ReDim .SeriesInstance(0 To .SeriesInstanceCount - 1) As PQDIF_SeriesInstance
    With .SeriesInstance(MY_FILE_SERIES_TIME)
        .SeriesBaseQuantity = PQDIF_NULL
        .SeriesOffset = 0
        .SeriesScale = 1
        .ValueType = "REAL8"
        .SeriesValuesCount = lngSampleCount
        ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
        For i = 0 To .SeriesValuesCount - 1
            .SeriesValues(i) = dblTime(i)
        Next i
    End With
    With .SeriesInstance(MY_FILE_SERIES_VALUES)
        .SeriesBaseQuantity = PQDIF_NULL
        .SeriesOffset = 0
        .SeriesScale = 1
        .ValueType = "REAL4"
        .SeriesValuesCount = lngSampleCount
        ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
        For i = 0 To .SeriesValuesCount - 1
            .SeriesValues(i) = CDbl(sngIc(i))
        Next i
    End With

End With ' .ChannelInstance(MY_FILE_CHANNEL_IC)
```

```
            With .ChannelInstance(MY_FILE_CHANNEL_IN)

                .ChannelFrequency = PQDIF_NULL ' This is used when storing harmonic samples.
                .ChannelGroupID = PQDIF_NULL ' This also is used when storing harmonic samples.
                .ChannelDefinitionIndex = MY_FILE_CHANNEL_IN

                ' We need one series instance for time and one for values
                .SeriesInstanceCount = 2
                ReDim .SeriesInstance(0 To .SeriesInstanceCount - 1) As PQDIF_SeriesInstance
                With .SeriesInstance(MY_FILE_SERIES_TIME)
                    .SeriesBaseQuantity = PQDIF_NULL
                    .SeriesOffset = 0
                    .SeriesScale = 1
                    .ValueType = "REAL8"
                    .SeriesValuesCount = lngSampleCount
                    ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
                    For i = 0 To .SeriesValuesCount - 1
                        .SeriesValues(i) = dblTime(i)
                    Next i
                End With
                With .SeriesInstance(MY_FILE_SERIES_VALUES)
                    .SeriesBaseQuantity = PQDIF_NULL
                    .SeriesOffset = 0
                    .SeriesScale = 1
                    .ValueType = "REAL4"
                    .SeriesValuesCount = lngSampleCount
                    ReDim .SeriesValues(0 To .SeriesValuesCount - 1) As Double
                    For i = 0 To .SeriesValuesCount - 1
                        .SeriesValues(i) = CDbl(sngIn(i))
                    Next i
                End With

            End With ' .ChannelInstance(MY_FILE_CHANNEL_IN)

        End With ' usr_PQDIF_File.RecordObservation(0)

    End With ' usr_PQDIF_File

    ' Save the observations to a PQDIF file
    SavePQDIFUsingPQDCOM4 usr_PQDIF_File

End Sub
```

Example Function to Export Voltage and Current Waveforms

```
Public Sub ExportWaveformExample()

    Dim dblTime() As Double
    Dim sngVa() As Single
    Dim sngVb() As Single
    Dim sngVc() As Single
    Dim sngVn() As Single
    Dim sngIa() As Single
    Dim sngIb() As Single
    Dim sngIc() As Single
    Dim sngIn() As Single

    Dim i As Long
    Dim dblVMag As Double
    Dim dblIMag As Double

    Const PI As Double = 3.14159265358979
    Const DEGREES_120 As Double = 2 * PI / 3
    Const DEGREES_10 As Double = 2 * PI / 36
    Const SQRT2 = 1.4142135623731

    Const MY_FILE_NOMINAL_VOLTAGE As Double = 12000#
    Const MY_FILE_NOMINAL_FREQUENCY As Double = 60#
    Const MY_FILE_POINTS_PER_CYCLE As Long = 128
    Const MY_FILE_SAMPLE_COUNT As Long = MY_FILE_POINTS_PER_CYCLE * 10 ' cycles

    ' Allocate memory for the 10 cycles
    ReDim dblTime(0 To MY_FILE_SAMPLE_COUNT - 1) As Double
    ReDim sngVa(0 To MY_FILE_SAMPLE_COUNT - 1) As Single
    ReDim sngVb(0 To MY_FILE_SAMPLE_COUNT - 1) As Single
    ReDim sngVc(0 To MY_FILE_SAMPLE_COUNT - 1) As Single
    ReDim sngVn(0 To MY_FILE_SAMPLE_COUNT - 1) As Single
    ReDim sngIa(0 To MY_FILE_SAMPLE_COUNT - 1) As Single
    ReDim sngIb(0 To MY_FILE_SAMPLE_COUNT - 1) As Single
    ReDim sngIc(0 To MY_FILE_SAMPLE_COUNT - 1) As Single
    ReDim sngIn(0 To MY_FILE_SAMPLE_COUNT - 1) As Single

    ' Derive the values for an idealized three-phase voltage sag observation record
    ' with a minimum voltage of 0.7 per unit and a duration of 2 cycles.
    For i = 0 To MY_FILE_SAMPLE_COUNT - 1

        If i >= MY_FILE_POINTS_PER_CYCLE * 2 And i < MY_FILE_POINTS_PER_CYCLE * 4 Then
            dblVMag = 0.7 * MY_FILE_NOMINAL_VOLTAGE * SQRT2
            dblIMag = 500 * SQRT2
        Else
            dblVMag = MY_FILE_NOMINAL_VOLTAGE * SQRT2
            dblIMag = 300 * SQRT2
```

```
        End If

        dblTime(i) = i / MY_FILE_NOMINAL_FREQUENCY / MY_FILE_POINTS_PER_CYCLE
        sngVa(i) = dblVMag * Sin(2 * PI * i / MY_FILE_POINTS_PER_CYCLE)
        sngVb(i) = dblVMag * Sin(2 * PI * i / MY_FILE_POINTS_PER_CYCLE + DEGREES_120)
        sngVc(i) = dblVMag * Sin(2 * PI * i / MY_FILE_POINTS_PER_CYCLE - DEGREES_120)
        sngVn(i) = dblVMag * Rnd() * 0.01
        sngIa(i) = dblIMag * Sin(2 * PI * i / MY_FILE_POINTS_PER_CYCLE - DEGREES_10)
        sngIb(i) = dblIMag * Sin(2 * PI * i / MY_FILE_POINTS_PER_CYCLE + DEGREES_120 - DEGREES_10)
        sngIc(i) = dblIMag * Sin(2 * PI * i / MY_FILE_POINTS_PER_CYCLE - DEGREES_120 - DEGREES_10)
        sngIn(i) = dblIMag * Rnd() * 0.02

    Next i

    ExportWaveformsToPQDIF "c:\temp\myfile.pqd", "My Site", "Description of My Site", #10/14/2006 2:20:13 PM#, 0.07161975, _
                           MY_FILE_NOMINAL_VOLTAGE * SQRT2, MY_FILE_NOMINAL_FREQUENCY, _
                           MY_FILE_SAMPLE_COUNT, dblTime(), _
                           sngVa(), sngVb(), sngVc(), sngVn(), _
                           sngIa(), sngIb(), sngIc(), sngIn()

End Sub
```

4
REPRESENTING IEEE PQDIF FILES IN XML

The IEEE Std 1159.3-2002 PQDIF binary file format provides a compact, flexible, extensible means to exchange these diverse measurements between software applications. However, for applications where the ease of data manipulation is more important than file size, an alternate easily-parsed, human-readable, text-based representation of PQDIF is highly desirable. This paper proposes the methods to be used when representing a PQDIF file in Extensible Markup Language (XML), a popular file format that meets these requirements. An example of expressing an IEEE PQDIF file in XML is presented as well.

PQDIF is a binary format that is optimized to minimum disk storage and transfer time. As such, parsing PQDIF files requires low-level software tools capable of byte-level data manipulation. The need for such parsing tools limits the usefulness of PQDIF. Conversely, XML is well supported on a diverse set of high-level, platform-independent, programming environments. Consider a monitoring system that employs a web server to deliver power quality data to a web browser client. Parsing power quality data encoded in XML could be performed with the high-level, platform-independent XML scripting tools built into the browser running on the client computer. Measurements could also be edited if need be using a number of XML editors freely available on the Internet. Clearly any XML representation of PQDIF provides the same level of flexibility and extensibility. Adhering as closely as possible to the structure and concepts of PQDIF also minimizes the effort of porting applications to use the XML representation.

As of February 2007, the IEEE P1159.3 Task Force was engaged in creating an annex to the IEEE Std 1159.2-2002 recommended practice that would recommend a procedure for representing PQDIF records in XML format. This chapter presents a method that closely aligns with work of the task force.

Overview of XML

Extensible Markup Language (XML) is a simple markup language for documents that contain structured information. It is a standard, self-describing way of encoding both text and data. A primary purpose of XML is to allow content to be exchanged across a wide range of hardware, software, and operating system. Both Hypertext Markup Language (HTML), which is the markup language used by World Wide Web browsers [13], and XML have their roots in Standard Generalized Markup Language (SGML), which is defined by ISO 8879 [14]. XML was originally developed as a tool in large-scale electronic publishing. However, it is now playing an increasingly important role in the exchange of data via the World Wide Web.

An XML file appears very similar in format to an HTML file. This resemblance is due to their common origin in SGML However, there are two important differences:

- HTML for the most part consists of “tags” that define the appearance and placement of text, images, and hyperlinks to other documents. On the other hand, in XML the tags are generally used to define the structure and content of data. In XML the appearance of the data is specified by the application that is displaying the file or by an associated style sheet file.
- HTML has a standard set of tags that is defined by the World Wide Web Consortium (W3C). Users are free to create custom tags, but they will be ignored by web browsers. On the other hand, XML is extensible. In other words, tags can be defined by the individual users for some specific application. This feature lends XML very well to the purpose of representing IEEE PQDIF files.

Representing PQDIF Records in XML

The hierarchical, tag-based, extensible structure of XML is a good match for the structure of PQDIF. The task of defining a XML representation of PQDIF is essentially that of defining the XML representation of the PQDIF physical structure. The logical structure of our XML representation is identical to that of the binary PQDIF file.

XML elements are of the following form:

```
<tag p1="v1" p2="v2" p3="v3"…>value</tag>
```

where “tag” is the element’s tag name, “p1”, “p2”, “p3”, etc. are optional properties of the element, “v1”, “v2”, “v3”, etc. are the respective property values, and “value” is the value of the element, which can in fact be a collection of XML elements.

The PQDIF specification defines names for tags and ids. For consistency and readability, our XML representation uses these names for tag and values respectively. The IEEE P1159.3 task force recommends that an accompanying Extensible Stylesheet Language (XSL) file would be the means to match up the tag name used in an XML file with its true IEEE 1159.3 GUID or numeric ID. At present this XSL format has not been specified by the IEEE P1159.3 Task Force but it is expected to be completed in 2007.

PQDIF collection elements map as simple XML elements with no properties. The value of a collection is the set of elements contained in the collection. For example:

```
<tagRecObservation>
        …
</tagRecObservation>
```

This example denotes an observation record. The elements of the record would be included between the opening and closing tags.

Scalar elements have a type and single value. For many applications the type implied by the value encoding is sufficient. For example 1 is an integer; 1.2 is a real value, 2003-12-31 is a date, etc. Further, for many elements, their tags imply the data type. However, the physical type is useful in determining the optimal decoding method for data and so is included as an attribute.

Dictionary

PQDIF is structure is defined by tags and IDs. Tags are globally unique identifiers (GUIDs) and IDs are integers defined in the IEEE 1159.3 standard. The standard assigns names to these tags and IDs to make the standard easier to read. To facilitate ease of decoding and to maintain the ability for a human to read and interpret an 1159.3 XML file, the concept of a tag dictionary is being defined in the IEEE P1159.3 Task Force. The task force recommends a separate XML file containing a mapping of human readable tag names to their respective ID or GUID is used. This file has the format as shown in XML Source 4-1.

XML Source 4-1: Example PQDIF XML Dictionary

```
<Dictionary>
  <Standard>
    <tags>
      <tagRecObservation value="8973861a-f1c3-11cf-9d89-0080c72e70a3" />
    </tags>
    <ids>
      <ID_QU_NONE value="0" />
      <ID_PHYS_TYPE_BOOLEAN1 value="1" />
    </ids>
  </Standard>
  <Extensions>
    <tags>
      <tagRecPrivate value="7973861b-e1c2-21ce-8d88-1080c72e70a4" />
    </tags>
    <ids>
      <ID_QU_FAHRENHEIT value="9001" />
      <BOOLEAN1 value="1" />
      <BOOL1 value="1" />
      <B1 value="1" />
    </ids>
  </Extensions>
</Dictionary>
```

The <Standard> section is meant to specify the GUIDs and IDs from the current version of the IEEE 1159.3 standard. Note that a dictionary is not required since an application can assume that the standard name mappings are used. If a tag or ID is not found in the <Standard> or <Extensions> sections, then a client application should ignore the invalid tag or ID and continue processing.

This approach allows names to be used instead of GUIDs and IDs in the main PQDIF file while allowing for nonstandard GUIDs and IDs to be specified in the dictionary to facilitate extension of the standard. If no dictionary file is available, client programs are free to assume that the implicit mapping of tags to GUIDs and IDs to integers are defined in the IEEE 1159.3 document's Annex A and Annex B.

The current draft of IEEE P1159.3 task force also allows the dictionary file to be embedded in XML PQDIF file itself.

PQView 3.42 exports a PQDIF dictionary to a file named pqdif-dictionary.xml each time that a PQDIF XML file is generated.

Record Mapping

PQDIF files consist of a collection of records. In the binary representation, records consist of a record header and a record body. The record header contains a tag indicating the record type, a binary signature, the size of the record header and the size of the record body. All but the first of these elements are needed in the binary format to ensure that it is valid and can be read properly from a file stream. The XML mapping only requires the tag indicating the record type. The XML version of the record header therefore is represented by an XML tag representing the PQDIF record type and the body is simply the content enclosed by the tag.

PQDIF has a special record called the container record. The container record is used only once in a binary PQDIF file and is always the first record in the file. The same is true for the XML mapping. In the XML case, the container record is the required, single top level XML tag that encloses all of the XML content in the file. All other PQDIF records are therefore contained within this top level record as shown in the example below (all contents of the individual records – the record body - have been removed). The record body is simply the content between the opening and closing tags of each record.

The tagContainer element has a required version attribute which specifies the version of the XML PQDIF Schema used. The container record also contains the Dictionary object or reference, if included in the data file.

XML Source 4-2: Simple Example of a PQDIF XML File Structure

```
<?xml version="1.0"?>
<tagContainer version=”1.0”>
  <Dictionary>
  </Dictionary>
  <tagRecDataSource>
  </tagRecDataSource>
  <tagRecMonitorSettings>
  </tagRecMonitorSettings>
  <tagRecObservation>
  </tagRecObservation>
  <tagRecObservation>
  </tagRecObservation>
  <tagRecProprietary>
  </tagRecProprietary>
</tagContainer>
```

Element Mappings

As defined in IEEE 1159.3, the record body consists of a collection of elements. Each element is one of three types; a scalar (a single value), a vector (a series of values), or another collection of elements. Since an element can be a collection, this forms a hierarchy that is easily represented in XML as nested collections of XML tags and their contents. This simple logical format allows us to easily map the PQDIF structure to an XML representation.

An element is represented in XML as follows:

```
<tagElementName VT=value-type-code" ET="element-type-code" NP="vector-length" BL="block-
length">Value</tagElementName>
```

Where:

- *tagElementName* is the element tag name as defined in 1159.3 and associated with its GUID in the PQDIF dictionary.
- *value-type-code* is the value of the VT (Value Type) attribute that is one of the predefined IDs defined in 1159.3 Annex A. These IDs are mapped to their defined values in the PQDIF dictionary XML file. Note that for brevity, the shorter "typedef" versions of the names are used by default.
- *element-type-code* is the value of the ET (Element Type) attribute which can be S (for Scalar), V (for Vector), or C (for Collection). If a VT attribute is present, the ET attribute value may only be S or V. If the VT attribute is not present, then the ET attribute may only have a value of C. The ET attribute must always be present.
- *vector-length* is the number of data points for the vector Element Type. This attribute should only be present for ET="V".
- *block-length* is the number of data points for each <d> element within the main element. All<d> elements must contain exactly this many white-space delimited floating-point values, except possibly the last one. (All examples in this report use a block length of 1.)
- *value* is the value of the element itself and is formatted in a manner depending upon the value of the ET attribute. If the ET attribute value is "S" then value is the text formatted value of the scalar. If the ET attribute has a value of "C", then value is actually one or more nested element tags which form a PQDIF collection. If the ET attribute value is "V", then value consists of one or more instances of <d>data</d> elements that contain the values of the vector elements. In order to break up long vector sequences into manageable chunks, the vector points are divided into fixed-size blocks, with each block represented by a <d> element. Each <d> element contains one block of points from the vector data. Values in the <d> element are delimited by one white space character. Any block size may be used, but must be fixed for all <d> elements in this vector except the last, which may contain a partial block of data. An empty <d> element is not allowed. The degenerate cases of block-size=1 or block-size=vector-length are allowed, although a value between 100 and 300 is suggested for maximum throughput with existing XML and XSL tools.

In the binary version of PQDIF, a collection of elements is preceded by a count. This information is not necessary in the XML mapping. In XML, a collection is simply the set of individual scalar, vector, and collection elements which are contained between the opening and closing record tags or are enclosed within the opening and closing tags of a collection element. XML parsers are able to provide the client program with the element count if needed.

Locale Concerns

To ease worldwide compatibility, it is recommend use a period as a decimal separator when writing text files. This requires special handling on computers that are configured to use a comma as a decimal separator when reading and writing XML PQDIF files.

It is recommended to format dates using the unambiguous format *yyyy-mm-dd* in order to prevent confusion between month, day, and year. For example, June 5, 2007 would be represented as 2007-06-05.

PQDIF XML Examples

Examples in this section were created using PQView 3.42 with the demonstration database downloadable to PQView users from www.mypq.net.

PQDIF Dictionary File

This example presents a complete XML dictionary file. This is the file that maps the tags and IDs used in other PQDIF XML files to the current version of IEEE Std 1159.3.

XML Source 4-3: PQDIF Dictionary File

```
<Dictionary>
  <Standard>
    <tags>
      <Blank value="89738618-11CF-F1C3-8000-899DA3702EC7" />
      <Container value="89738606-11CF-F1C3-8000-899DA3702EC7" />
      <RecDataSource value="89738619-11CF-F1C3-8000-899DA3702EC7" />
      <RecMonitorSettings value="B48D858C-11CF-F5F5-8000-899DA3702EC7" />
      <RecObservation value="8973861A-11CF-F1C3-8000-899DA3702EC7" />
      <VersionInfo value="89738607-11CF-F1C3-8000-899DA3702EC7" />
      <FileName value="89738608-11CF-F1C3-8000-899DA3702EC7" />
      <Creation value="89738609-11CF-F1C3-8000-899DA3702EC7" />
      <LastSaved value="8973860A-11CF-F1C3-8000-899DA3702EC7" />
      <TimesSaved value="8973860B-11CF-F1C3-8000-899DA3702EC7" />
      <Language value="8973860C-11CF-F1C3-8000-899DA3702EC7" />
      <Title value="8973860D-11CF-F1C3-8000-899DA3702EC7" />
      <Subject value="8973860E-11CF-F1C3-8000-899DA3702EC7" />
      <Author value="8973860F-11CF-F1C3-8000-899DA3702EC7" />
      <Keywords value="89738610-11CF-F1C3-8000-899DA3702EC7" />
      <Comments value="89738611-11CF-F1C3-8000-899DA3702EC7" />
      <LastSavedBy value="89738612-11CF-F1C3-8000-899DA3702EC7" />
      <Application value="89738623-11CF-F1C3-8000-899DA3702EC7" />
      <Security value="89738613-11CF-F1C3-8000-899DA3702EC7" />
      <Owner value="89738614-11CF-F1C3-8000-899DA3702EC7" />
      <Copyright value="89738615-11CF-F1C3-8000-899DA3702EC7" />
      <Trademarks value="89738616-11CF-F1C3-8000-899DA3702EC7" />
      <Notes value="89738617-11CF-F1C3-8000-899DA3702EC7" />
      <CompressionStyleID value="8973861B-11CF-F1C3-8000-899DA3702EC7" />
      <CompressionAlgorithmID value="8973861C-11CF-F1C3-8000-899DA3702EC7" />
      <CompressionChecksum value="8973861D-11CF-F1C3-8000-899DA3702EC7" />
      <Name value="B48D85A2-11CF-F5F5-8000-899DA3702EC7" />
      <Address1 value="B48D85A3-11CF-F5F5-8000-899DA3702EC7" />
      <Address2 value="B48D85A4-11CF-F5F5-8000-899DA3702EC7" />
      <City value="B48D85A5-11CF-F5F5-8000-899DA3702EC7" />
      <State value="B48D85A6-11CF-F5F5-8000-899DA3702EC7" />
      <PostalCode value="B48D85A7-11CF-F5F5-8000-899DA3702EC7" />
      <Country value="B48D85A8-11CF-F5F5-8000-899DA3702EC7" />
      <PhoneVoice value="B48D85A9-11CF-F5F5-8000-899DA3702EC7" />
      <PhoneFAX value="3D786F80-11CF-F76E-8000-899DA3702EC7" />
      <EMail value="3D786F81-11CF-F76E-8000-899DA3702EC7" />
      <DataSourceTypeID value="B48D8581-11CF-F5F5-8000-899DA3702EC7" />
      <VendorID value="B48D8582-11CF-F5F5-8000-899DA3702EC7" />
      <EquipmentID value="B48D8583-11CF-F5F5-8000-899DA3702EC7" />
      <CustomSourceInfo value="B48D8584-11CF-F5F5-8000-899DA3702EC7" />
      <SerialNumberDS value="B48D8585-11CF-F5F5-8000-899DA3702EC7" />
      <VersionDS value="B48D8586-11CF-F5F5-8000-899DA3702EC7" />
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<ID_QC_S_ARITH_FUND value="1C39FB03-11D4-A6AA-4544-B3A45453" />
<ID_QC_S_PEAK_DEMAND value="72E82A43-11D5-336C-4544-B3A45453" />
<ID_QC_Q_PEAK_DEMAND value="72E82A42-11D5-336C-4544-B3A45453" />
<ID_QC_P_PEAK_DEMAND value="72E82A41-11D5-336C-4544-B3A45453" />
<ID_QC_P_HARMONIC value="B82B5C80-11D5-55C7-4544-B3A45453" />
<ID_QC_P_HARMONIC_UNSIGNED value="B82B5C81-11D5-55C7-4544-B3A45453" />
<ID_QC_P_FUND value="1CDDA475-42D8-1EBB-1BD0-878097FA5C0B" />
<ID_QC_P_INTG value="7EF68A6-11D2-9FF5-6000-0BB38371B308" />
<ID_QC_P_INTG_POS value="7EF68A7-11D2-9FF5-6000-0BB38371B308" />
<ID_QC_P_INTG_POS_FUND value="672D0300-11D4-7810-4544-B3A45453" />
```

```
    <ID_QC_P_INTG_NEG value="7EF68A8-11D2-9FF5-6000-0BB38371B308" />
    <ID_QC_P_INTG_NEG_FUND value="672D0301-11D4-7810-4544-B3A45453" />
    <ID_QC_Q_INTG value="7EF68A9-11D2-9FF5-6000-0BB38371B308" />
    <ID_QC_Q_INTG_POS value="7EF68AA-11D2-9FF5-6000-0BB38371B308" />
    <ID_QC_Q_INTG_POS_FUND value="672D0303-11D4-7810-4544-B3A45453" />
    <ID_QC_Q_INTG_NEG_FUND value="672D0304-11D4-7810-4544-B3A45453" />
    <ID_QC_Q_INTG_NEG value="7EF68AB-11D2-9FF5-6000-0BB38371B308" />
    <ID_QC_S_INTG value="7EF68AC-11D2-9FF5-6000-0BB38371B308" />
    <ID_QC_S_INTG_FUND value="672D0313-11D4-7810-4544-B3A45453" />
    <ID_QC_P_IVL_INTG value="F098A9A0-11D5-3EE4-4544-B3A45453" />
    <ID_QC_P_IVL_INTG_POS value="F098A9A1-11D5-3EE4-4544-B3A45453" />
    <ID_QC_P_IVL_INTG_POS_FUND value="F098A9A2-11D5-3EE4-4544-B3A45453" />
    <ID_QC_P_IVL_INTG_NEG value="F098A9A3-11D5-3EE4-4544-B3A45453" />
    <ID_QC_P_IVL_INTG_NEG_FUND value="F098A9A4-11D5-3EE4-4544-B3A45453" />
    <ID_QC_Q_IVL_INTG value="F098A9A5-11D5-3EE4-4544-B3A45453" />
    <ID_QC_Q_IVL_INTG_POS value="F098A9A6-11D5-3EE4-4544-B3A45453" />
    <ID_QC_Q_IVL_INTG_POS_FUND value="F098A9A7-11D5-3EE4-4544-B3A45453" />
    <ID_QC_Q_IVL_INTG_NEG_FUND value="F098A9A8-11D5-3EE4-4544-B3A45453" />
    <ID_QC_Q_IVL_INTG_NEG value="F098A9A9-11D5-3EE4-4544-B3A45453" />
    <ID_QC_S_IVL_INTG value="F098A9AA-11D5-3EE4-4544-B3A45453" />
    <ID_QC_S_IVL_INTG_FUND value="F098A9AB-11D5-3EE4-4544-B3A45453" />
    <ID_QC_DAXISFIELD value="D347BA65-11D4-E34C-E000-D98294A07298" />
    <ID_QC_QAXIS value="D347BA64-11D4-E34C-E000-D98294A07298" />
    <ID_QC_ROTATIONAL value="D347BA62-11D4-E34C-E000-D98294A07298" />
    <ID_QC_DAXIS value="D347BA63-11D4-E34C-E000-D98294A07298" />
    <ID_QC_LINEAR value="D347BA61-11D4-E34C-E000-D98294A07298" />
    <ID_QC_TRANSFERFUNC value="5202BD07-11D5-245C-4544-B3A45453" />
    <ID_QC_STATUS value="B82B5C83-11D5-55C7-4544-B3A45453" />
  </tags>
  <ids>
    <ID_COMP_STYLE_NONE value="0" />
    <ID_COMP_STYLE_RECORDLEVEL value="2" />
    <ID_COMP_STYLE_TOTALFILE value="1" />
    <ID_COMP_STYLE_NONE value="0" />
    <ID_COMP_ALG_ZLIB value="1" />
    <ID_COMP_ALG_PKZIPCL value="64" />
    <ID_PHASE_NONE value="0" />
    <ID_PHASE_AN value="1" />
    <ID_PHASE_BN value="2" />
    <ID_PHASE_CN value="3" />
    <ID_PHASE_NG value="4" />
    <ID_PHASE_AB value="5" />
    <ID_PHASE_BC value="6" />
    <ID_PHASE_CA value="7" />
    <ID_PHASE_RES value="8" />
    <ID_PHASE_NET value="9" />
    <ID_PHASE_TOTAL value="13" />
    <ID_PHASE_LN_AVE value="14" />
    <ID_PHASE_LL_AVE value="15" />
    <ID_PHASE_WORST value="16" />
    <ID_PHASE_PLUS value="17" />
    <ID_PHASE_MINUS value="18" />
    <ID_PHASE_GENERAL_1 value="19" />
    <ID_PHASE_GENERAL_2 value="20" />
    <ID_PHASE_GENERAL_3 value="21" />
    <ID_PHASE_GENERAL_4 value="22" />
    <ID_PHASE_GENERAL_5 value="23" />
    <ID_PHASE_GENERAL_6 value="24" />
    <ID_PHASE_GENERAL_7 value="25" />
    <ID_PHASE_GENERAL_8 value="26" />
    <ID_PHASE_GENERAL_9 value="27" />
    <ID_PHASE_GENERAL_10 value="28" />
    <ID_PHASE_GENERAL_11 value="29" />
    <ID_PHASE_GENERAL_12 value="30" />
    <ID_PHASE_GENERAL_13 value="31" />
    <ID_PHASE_GENERAL_14 value="32" />
    <ID_PHASE_GENERAL_15 value="33" />
    <ID_PHASE_GENERAL_16 value="34" />
    <ID_QU_NONE value="0" />
    <ID_QU_SECONDS value="2" />
    <ID_QU_TIMESTAMP value="1" />
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<ID_QU_CYCLES value="3" />
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<ID_QU_AMPS value="7" />
<ID_QU_VA value="8" />
<ID_QU_WATTS value="9" />
<ID_QU_VARS value="10" />
<ID_QU_OHMS value="11" />
<ID_QU_SIEMENS value="12" />
<ID_QU_VOLTSPERAMP value="13" />
<ID_QU_JOULES value="14" />
<ID_QU_HERTZ value="15" />
<ID_QU_CELCIUS value="16" />
<ID_QU_DEGREES value="17" />
<ID_QU_DB value="18" />
<ID_QU_PERCENT value="19" />
<ID_QU_PERUNIT value="20" />
<ID_QU_SAMPLES value="21" />
<ID_QU_VARHOURS value="22" />
<ID_QU_WATTHOURS value="23" />
<ID_QU_VAHOURS value="24" />
<ID_QU_MPS value="25" />
<ID_QU_MPH value="26" />
<ID_QU_BARS value="27" />
<ID_QU_PASCALS value="28" />
<ID_QU_NEWTONS value="29" />
<ID_QU_NEWTONMETERS value="30" />
<ID_QU_RPM value="31" />
<ID_QU_RADPERSEC value="32" />
<ID_QU_METERS value="33" />
<ID_QU_WEBERTURNS value="34" />
<ID_QU_TESLAS value="35" />
<ID_QU_WEBERS value="36" />
<ID_QU_VOLTSPERVOLT value="37" />
<ID_QU_AMPSPERAMP value="38" />
<ID_QU_AMPSPERVOLT value="39" />
<ID_SERIES_METHOD_VALUES value="1" />
<ID_SERIES_METHOD_SCALED value="2" />
<ID_SERIES_METHOD_INCREMENT value="4" />
<ID_GREEK_DONTCARE value="0" />
<ID_GREEK_FEMTO value="1" />
<ID_GREEK_PICO value="2" />
<ID_GREEK_NANO value="3" />
<ID_GREEK_MICRO value="4" />
<ID_GREEK_MILLI value="5" />
<ID_GREEK_NONE value="6" />
<ID_GREEK_KILO value="7" />
<ID_GREEK_MEGA value="8" />
<ID_GREEK_TERA value="10" />
<ID_GREEK_GIGA value="9" />
<ID_PREFER_ENG value="1" />
<ID_PREFER_PCT value="2" />
<ID_PREFER_PU value="3" />
<ID_DEFAULT_DONTCARE value="0" />
<ID_DEFAULT_MAG value="1" />
<ID_DEFAULT_ANG value="2" />
<ID_DEFAULT_REAL value="3" />
<ID_DEFAULT_IMAG value="4" />
<ID_DEFAULT_RX value="5" />
<ID_TRIG_NONE value="0" />
<ID_TRIG_LOW value="1" />
<ID_TRIG_HIGH value="2" />
<ID_TRIG_RATE value="4" />
<ID_TRIG_SHAPE value="8" />
<ID_TRIG_OTHER value="16" />
<ID_XFORMER_TYPE_CT value="2" />
<ID_XFORMER_TYPE_PT value="1" />
<ID_TRIGGER_METH_NONE value="0" />
<ID_TRIGGER_METH_CHANNEL value="1" />
<ID_TRIGGER_METH_PERIODIC value="2" />
<ID_TRIGGER_METH_EXTERNAL value="3" />
<ID_TRIGGER_METH_PERIODIC_STATS value="4" />
```

```
        <ID_QM_NONE value="0" />
        <ID_QM_VOLTAGE value="1" />
        <ID_QM_CURRENT value="2" />
        <ID_QM_POWER value="3" />
        <ID_QM_ENERGY value="4" />
        <ID_QM_TEMPERATURE value="5" />
        <ID_QM_PRESSURE value="6" />
        <ID_QM_CHARGE value="7" />
        <ID_QM_EFIELD value="8" />
        <ID_QM_MFIELD value="9" />
        <ID_QM_VELOCITY value="10" />
        <ID_QM_BEARING value="11" />
        <ID_QM_FORCE value="12" />
        <ID_QM_TORQUE value="13" />
        <ID_QM_POSITION value="14" />
        <ID_QM_FLUXLINKAGE value="15" />
        <ID_QM_FLUXDENSITY value="16" />
        <ID_QM_STATUS value="17" />
        <ID_CTT_NONE value="0" />
        <ID_CTT_NORMAL_TO_LO value="1" />
        <ID_CTT_NORMAL_TO_LO_LO value="2" />
        <ID_CTT_NORMAL_TO_HI value="3" />
        <ID_CTT_NORMAL_TO_HI_HI value="4" />
        <ID_CTT_LO_LO_TO_LO value="5" />
        <ID_CTT_LO_LO_TO_NORMAL value="6" />
        <ID_CTT_LO_LO_TO_HI value="7" />
        <ID_CTT_LO_LO_TO_HI_HI value="8" />
        <ID_CTT_LO_TO_LO_LO value="9" />
        <ID_CTT_LO_TO_NORMAL value="10" />
        <ID_CTT_LO_TO_HI value="11" />
        <ID_CTT_LO_TO_HI_HI value="12" />
        <ID_CTT_HI_TO_LO_LO value="13" />
        <ID_CTT_HI_TO_LO value="14" />
        <ID_CTT_HI_TO_NORMAL value="15" />
        <ID_CTT_HI_TO_HI_HI value="16" />
        <ID_CTT_HI_HI_TO_LO_LO value="17" />
        <ID_CTT_HI_HI_TO_LO value="18" />
        <ID_CTT_HI_HI_TO_NORMAL value="19" />
        <ID_CTT_HI_HI_TO_HI value="20" />
        <ID_CTT_DB_LO value="21" />
        <ID_CTT_DB_HI value="22" />
        <ID_CTT_PERIODIC value="23" />
        <ID_CTT_MANUAL value="24" />
        <ID_CTT_INT_CROSS_TRIG value="25" />
        <ID_CTT_EXT_CROSS_TRIG value="26" />
        <ID_CTT_MODULE value="27" />
        <ID_CTT_RATE value="28" />
        <ID_SINGLE_PHASE value="1" />
        <ID_2ELEMENT_DELTA value="2" />
        <ID_2_5ELEMENT_WYE value="3" />
        <ID_3ELMENT_WYE value="4" />
        <ID_3ELEMENT_DELTA value="5" />
        <ID_SPLIT_PHASE value="6" />
        <ID_2ELEMENT_2PHASE value="7" />
      </ids>
    </Standard>
    <Extensions>
    </Extensions>
  </Dictionary>
```

Value Log of Voltage THD for One Phase

This example presents a series of values of voltage THD recorded by a meter at periodic intervals. Note how THD is stored in per unit – not in percent. This is the best way to store measurements because it is the assumed unit for voltage THD is the PQDIF reader does not find a tag otherwise identifying the THD units.

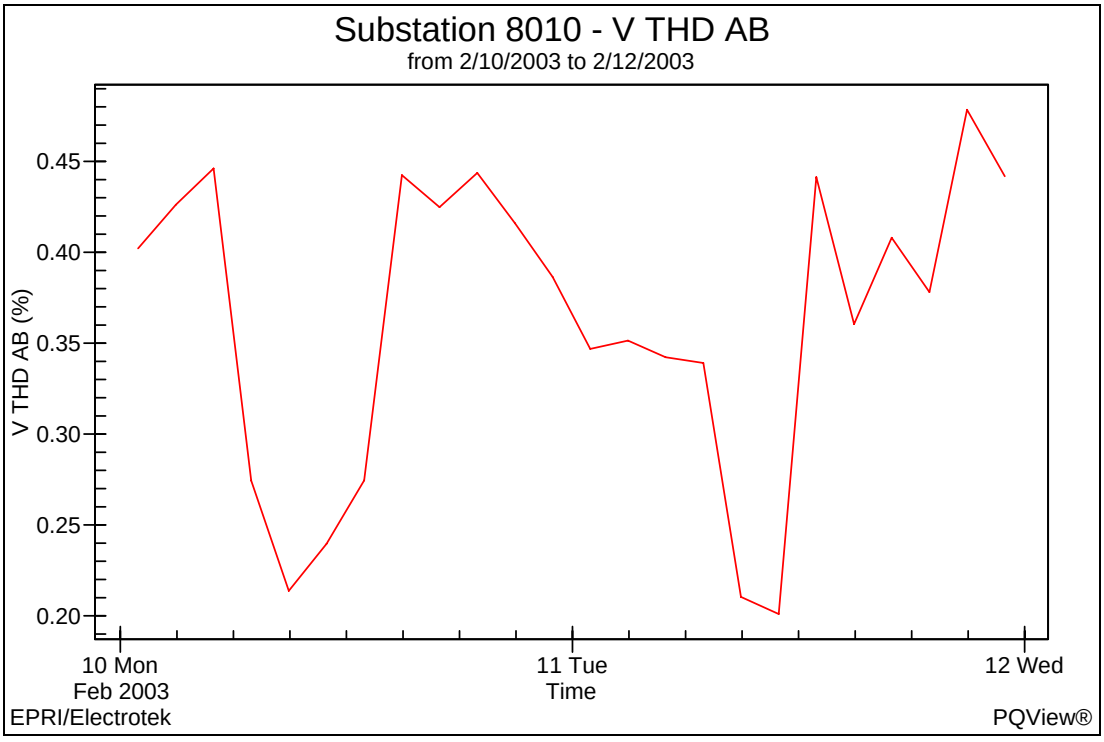

Figure 4-1
Value Log of a Voltage THD for One Phase

XML Source 4-4: Value Log of Voltage THD for One Phase

```
<?xml version="1.0"?>
<records>
  <tagContainer>
    <tagFileName VT="CHAR1" ET="T"> c:\projects\EPRI P001.003-2006\XML Examples\Value Log
of Voltage THD for One Phase.xml</tagFileName>
    <tagCreation VT="DT">2007-02-27T23:28:49.875000</tagCreation>
    <tagVersionInfo VT="UINT4" ET="V" NP="4"><d>1 5 1 5</d></tagVersionInfo>
    <tagLanguage VT="CHAR1" ET="T">US English</tagLanguage>
    <tagTitle VT="CHAR1" ET="T">PQView</tagTitle>
    <tagSubject VT="CHAR1" ET="T">N/A</tagSubject>
    <tagAuthor VT="CHAR1" ET="T">dsabin</tagAuthor>
    <tagKeywords VT="CHAR1" ET="T">N/A</tagKeywords>
    <tagComments VT="CHAR1" ET="T">Exported from ODBC;DATABASE=PQVIEW_DEMO</tagComments>
    <tagLastSavedBy VT="CHAR1" ET="T">SABINPORT</tagLastSavedBy>
    <tagApplication VT="CHAR1" ET="T">PQView Power Quality Data Manager</tagApplication>
    <tagSecurity VT="CHAR1" ET="T">No Security</tagSecurity>
    <tagOwner VT="CHAR1" ET="T">N/A</tagOwner>
    <tagCopyright VT="CHAR1" ET="T">N/A</tagCopyright>
    <tagTrademarks VT="CHAR1" ET="T">PQView is a registered trademark of Electrotek
Concepts, Inc.  EPRI is a registered service mark of the Electric Power Research
Institute.</tagTrademarks>
```

```
      <tagNotes VT="CHAR1" ET="T">N/A</tagNotes>
      <tagCompressionStyleID VT="GUID">ID_COMP_STYLE_NONE</tagCompressionStyleID>
      <tagCompressionAlgorithmID VT="GUID">ID_COMP_ALG_NONE</tagCompressionAlgorithmID>
    </tagContainer>
    <tagRecDataSource>
      <tagDataSourceTypeID VT="GUID">ID_DS_TYPE_MEASURE</tagDataSourceTypeID>
      <tagVendorID VT="GUID">ID_VENDOR_EPRI</tagVendorID>
      <tagEquipmentID VT="GUID">ID_EQUIP_ETK_PQVIEW</tagEquipmentID>
      <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
      <tagNameDS VT="CHAR1" ET="T">Substation 8010</tagNameDS>
      <tagOwnerDS VT="CHAR1" ET="T">dsabin</tagOwnerDS>
      <tagLocationDS VT="CHAR1" ET="T">N/A</tagLocationDS>
      <tagTimeZoneDS VT="CHAR1" ET="T">UTC</tagTimeZoneDS>
      <tagSerialNumberDS VT="CHAR1" ET="T">Dranetz-BMI PQNode&#174;
  8010</tagSerialNumberDS>
      <tagVersionDS VT="CHAR1" ET="T">3.42</tagVersionDS>
      <tagChannelDefns>
        <tagOneChannelDefn>
          <tagQuantityMeasuredID VT="UINT4">ID_QM_VOLTAGE</tagQuantityMeasuredID>
          <tagChannelName VT="CHAR1" ET="T">V THD AB</tagChannelName>
          <tagPhaseID VT="UINT4">ID_PHASE_AB</tagPhaseID>
          <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
          <tagSeriesDefns>
            <tagQuantityUnitsID VT="UINT4">ID_QU_SECONDS</tagQuantityUnitsID>
            <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_TIME</tagValueTypeID>
            <tagQuantityCharacteristicID
  VT="GUID">ID_QC_INSTANTANEOUS</tagQuantityCharacteristicID>
            <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
          </tagSeriesDefns>
          <tagSeriesDefns>
            <tagQuantityUnitsID VT="UINT4">ID_QU_NONE</tagQuantityUnitsID>
            <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_VAL</tagValueTypeID>
            <tagQuantityCharacteristicID
  VT="GUID">ID_QC_TOTAL_THD</tagQuantityCharacteristicID>
            <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
          </tagSeriesDefns>
        </tagOneChannelDefn>
      </tagChannelDefns>
    </tagRecDataSource>
    <tagRecMonitorSettings>
      <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
      <tagTimeInstalled VT="DT">2003-02-10T00:00:00.000</tagTimeInstalled>
      <tagTimeRemoved VT="DT">2003-02-12T00:00:00.000</tagTimeRemoved>
      <tagUseCalibration VT="BOOLEAN4">0</tagUseCalibration>
      <tagUseTransducer VT="BOOLEAN4">0</tagUseTransducer>
      <tagNominalFrequency VT="REAL8">60</tagNominalFrequency>
      <tagChannelSettingsArray>
        <tagOneChannelSetting>
          <tagChannelDefnIdx VT="UINT4">0</tagChannelDefnIdx>
        </tagOneChannelSetting>
      </tagChannelSettingsArray>
    </tagRecMonitorSettings>
    <tagRecObservation>
      <tagObservationName VT="CHAR1" ET="T">Data Log</tagObservationName>
      <tagTimeCreate VT="DT">2007-02-27T18:28:49.937000</tagTimeCreate>
      <tagTimeStart VT="DT">2003-02-10T00:00:00.000</tagTimeStart>
      <tagTimeTriggered VT="DT">2003-02-10T00:00:00.000</tagTimeTriggered>
      <tagTriggerMethodID VT="UINT4">ID_TRIGGER_METH_PERIODIC</tagTriggerMethodID>
      <tagChannelInstances>
        <tagSeriesInstances>
          <tagOneSeriesInstance>
            <tagSeriesScale VT="REAL8">1</tagSeriesScale>
            <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
            <tagSeriesValues VT="REAL8" ET="V" NP="24" BL="1">
              <d>3392.00400025584</d>
              <d>10592.0039998367</d>
              <d>17792.0040000463</d>
              <d>24993.003999861</d>
              <d>32193.0040000705</d>
              <d>39393.0040002801</d>
              <d>46593.003999861</d>
```

```
            <d>53794.0040003043</d>
            <d>60994.0039998852</d>
            <d>68194.0040000947</d>
            <d>75394.0040003043</d>
            <d>82595.0040001189</d>
            <d>89795.0039996998</d>
            <d>96995.0039999094</d>
            <d>104195.004000119</d>
            <d>111396.003999934</d>
            <d>118596.004000143</d>
            <d>125796.003999724</d>
            <d>132996.003999934</d>
            <d>140197.003999748</d>
            <d>147397.003999958</d>
            <d>154597.004000167</d>
            <d>161798.003999982</d>
            <d>168998.004000192</d>
          </tagSeriesValues>
      </tagOneSeriesInstance>
        <tagOneSeriesInstance>
          <tagSeriesScale VT="REAL8">1</tagSeriesScale>
          <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
          <tagSeriesValues VT="REAL4" ET="V" NP="24" BL="1">
            <d>0.00402157893404365</d>
            <d>0.00426152208819985</d>
            <d>0.00446209451183677</d>
            <d>0.00274413963779807</d>
            <d>0.00213735830038786</d>
            <d>0.00239621987566352</d>
            <d>0.00274464394897223</d>
            <d>0.00442485231906176</d>
            <d>0.00424853805452585</d>
            <d>0.00443652179092169</d>
            <d>0.00415920093655586</d>
            <d>0.00386433699168265</d>
            <d>0.00346871255896986</d>
            <d>0.00351415388286114</d>
            <d>0.00342280045151711</d>
            <d>0.00339089217595756</d>
            <d>0.00210384884849191</d>
            <d>0.00200964161194861</d>
            <d>0.00441365595906973</d>
            <d>0.00360459974035621</d>
            <d>0.00408052373677492</d>
            <d>0.00378110283054411</d>
            <d>0.00478457473218441</d>
            <d>0.0044181807897985</d>
          </tagSeriesValues>
      </tagOneSeriesInstance>
      </tagSeriesInstances>
    </tagChannelInstances>
  </tagRecObservation>
</records>
```

Value Log of Voltage THD for Three Phases

This example presents a series of values of voltage THD recorded by a meter at periodic intervals for three channels.

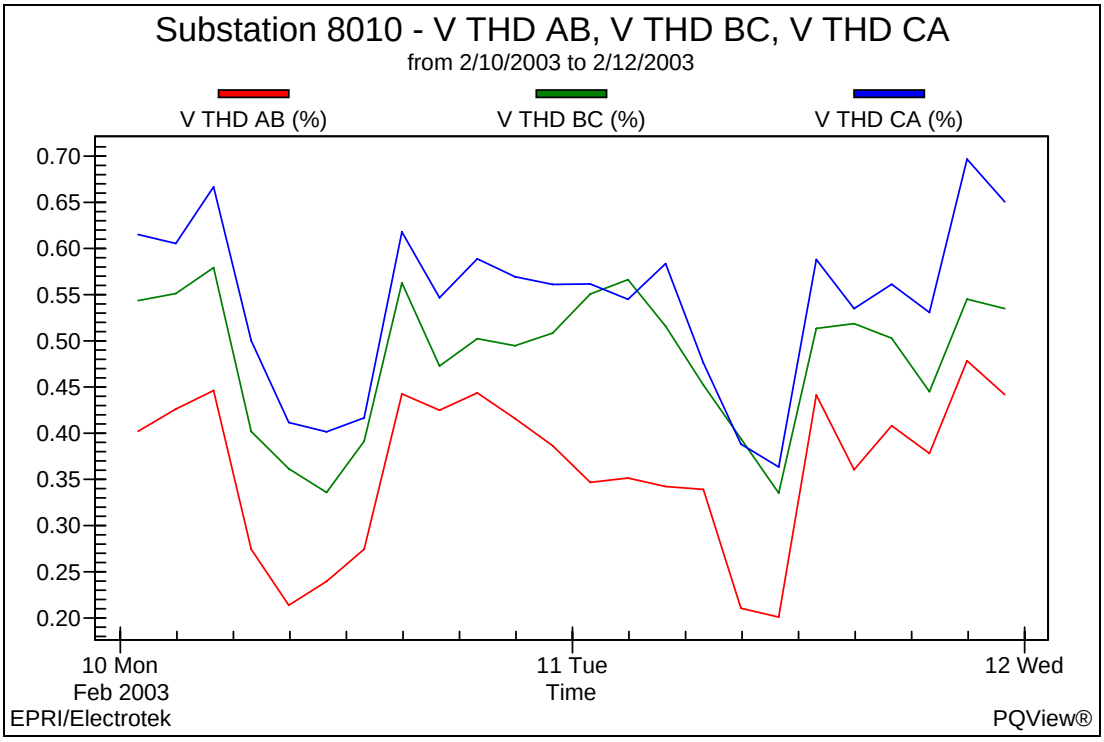

Figure 4-2
Value Log of a Voltage THD for Three Phases

XML Source 4-5: Value Log of a Voltage THD for Three Phases

```
<?xml version="1.0"?>
<records>
  <tagContainer>
    <tagFileName VT="CHAR1" ET="T">C:\projects\EPRI P001.003-2006\XML Examples\Value Log
of Voltage THD for Three Phases.xml</tagFileName>
    <tagCreation VT="DT">2007-02-27T23:42:50.062000</tagCreation>
    <tagVersionInfo VT="UINT4" ET="V" NP="4"><d>1 5 1 5</d></tagVersionInfo>
    <tagLanguage VT="CHAR1" ET="T">US English</tagLanguage>
    <tagTitle VT="CHAR1" ET="T">PQView</tagTitle>
    <tagSubject VT="CHAR1" ET="T">N/A</tagSubject>
    <tagAuthor VT="CHAR1" ET="T">dsabin</tagAuthor>
    <tagKeywords VT="CHAR1" ET="T">N/A</tagKeywords>
    <tagComments VT="CHAR1" ET="T">Exported from ODBC;DATABASE=PQVIEW_DEMO</tagComments>
    <tagLastSavedBy VT="CHAR1" ET="T">SABINPORT</tagLastSavedBy>
    <tagApplication VT="CHAR1" ET="T">PQView Power Quality Data Manager</tagApplication>
    <tagSecurity VT="CHAR1" ET="T">No Security</tagSecurity>
    <tagOwner VT="CHAR1" ET="T">N/A</tagOwner>
    <tagCopyright VT="CHAR1" ET="T">N/A</tagCopyright>
    <tagTrademarks VT="CHAR1" ET="T">PQView is a registered trademark of Electrotek
Concepts, Inc.  EPRI is a registered service mark of the Electric Power Research
Institute.</tagTrademarks>
    <tagNotes VT="CHAR1" ET="T">N/A</tagNotes>
    <tagCompressionStyleID VT="GUID">ID_COMP_STYLE_NONE</tagCompressionStyleID>
    <tagCompressionAlgorithmID VT="GUID">ID_COMP_ALG_NONE</tagCompressionAlgorithmID>
```

```
  </tagContainer>
  <tagRecDataSource>
    <tagDataSourceTypeID VT="GUID">ID_DS_TYPE_MEASURE</tagDataSourceTypeID>
    <tagVendorID VT="GUID">ID_VENDOR_EPRI</tagVendorID>
    <tagEquipmentID VT="GUID">ID_EQUIP_ETK_PQVIEW</tagEquipmentID>
    <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
    <tagNameDS VT="CHAR1" ET="T">Substation 8010</tagNameDS>
    <tagOwnerDS VT="CHAR1" ET="T">dsabin</tagOwnerDS>
    <tagLocationDS VT="CHAR1" ET="T">N/A</tagLocationDS>
    <tagTimeZoneDS VT="CHAR1" ET="T">UTC</tagTimeZoneDS>
    <tagSerialNumberDS VT="CHAR1" ET="T">Dranetz-BMI PQNode&#174;
8010</tagSerialNumberDS>
    <tagVersionDS VT="CHAR1" ET="T">3.42</tagVersionDS>
    <tagChannelDefns>
      <tagOneChannelDefn>
        <tagQuantityMeasuredID VT="UINT4">ID_QM_VOLTAGE</tagQuantityMeasuredID>
        <tagChannelName VT="CHAR1" ET="T">V THD AB</tagChannelName>
        <tagPhaseID VT="UINT4">ID_PHASE_AB</tagPhaseID>
        <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_SECONDS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_TIME</tagValueTypeID>
          <tagQuantityCharacteristicID
VT="GUID">ID_QC_INSTANTANEOUS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_NONE</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_VAL</tagValueTypeID>
          <tagQuantityCharacteristicID
VT="GUID">ID_QC_TOTAL_THD</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
      </tagOneChannelDefn>
      <tagOneChannelDefn>
        <tagQuantityMeasuredID VT="UINT4">ID_QM_VOLTAGE</tagQuantityMeasuredID>
        <tagChannelName VT="CHAR1" ET="T">V THD BC</tagChannelName>
        <tagPhaseID VT="UINT4">ID_PHASE_BC</tagPhaseID>
        <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_SECONDS</tagQuantityUnitsID>
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          <tagQuantityCharacteristicID
VT="GUID">ID_QC_INSTANTANEOUS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_NONE</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_VAL</tagValueTypeID>
          <tagQuantityCharacteristicID
VT="GUID">ID_QC_TOTAL_THD</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
      </tagOneChannelDefn>
      <tagOneChannelDefn>
        <tagQuantityMeasuredID VT="UINT4">ID_QM_VOLTAGE</tagQuantityMeasuredID>
        <tagChannelName VT="CHAR1" ET="T">V THD CA</tagChannelName>
        <tagPhaseID VT="UINT4">ID_PHASE_CA</tagPhaseID>
        <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_SECONDS</tagQuantityUnitsID>
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          <tagQuantityCharacteristicID
VT="GUID">ID_QC_INSTANTANEOUS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_NONE</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_VAL</tagValueTypeID>
          <tagQuantityCharacteristicID
VT="GUID">ID_QC_TOTAL_THD</tagQuantityCharacteristicID>
```

```
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
      </tagOneChannelDefn>
    </tagChannelDefns>
  </tagRecDataSource>
  <tagRecMonitorSettings>
    <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
    <tagTimeInstalled VT="DT">2003-02-10T00:00:00.000</tagTimeInstalled>
    <tagTimeRemoved VT="DT">2003-02-12T00:00:00.000</tagTimeRemoved>
    <tagUseCalibration VT="BOOLEAN4">0</tagUseCalibration>
    <tagUseTransducer VT="BOOLEAN4">0</tagUseTransducer>
    <tagNominalFrequency VT="REAL8">60</tagNominalFrequency>
    <tagChannelSettingsArray>
      <tagOneChannelSetting>
        <tagChannelDefnIdx VT="UINT4">0</tagChannelDefnIdx>
      </tagOneChannelSetting>
      <tagOneChannelSetting>
        <tagChannelDefnIdx VT="UINT4">1</tagChannelDefnIdx>
      </tagOneChannelSetting>
      <tagOneChannelSetting>
        <tagChannelDefnIdx VT="UINT4">2</tagChannelDefnIdx>
      </tagOneChannelSetting>
    </tagChannelSettingsArray>
  </tagRecMonitorSettings>
  <tagRecObservation>
    <tagObservationName VT="CHAR1" ET="T">Data Log</tagObservationName>
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    <tagTimeStart VT="DT">2003-02-10T00:00:00.000</tagTimeStart>
    <tagTimeTriggered VT="DT">2003-02-10T00:00:00.000</tagTimeTriggered>
    <tagTriggerMethodID VT="UINT4">ID_TRIGGER_METH_PERIODIC</tagTriggerMethodID>
    <tagChannelInstances>
      <tagSeriesInstances>
        <tagOneSeriesInstance>
          <tagSeriesScale VT="REAL8">1</tagSeriesScale>
          <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
          <tagSeriesValues VT="REAL8" ET="V" NP="24" BL="1">
            <d>3392.00400025584</d>
            <d>10592.0039998367</d>
            <d>17792.0040000463</d>
            <d>24993.003999861</d>
            <d>32193.0040000705</d>
            <d>39393.0040002801</d>
            <d>46593.003999861</d>
            <d>53794.0040003043</d>
            <d>60994.0039998852</d>
            <d>68194.0040000947</d>
            <d>75394.0040003043</d>
            <d>82595.0040001189</d>
            <d>89795.0039996998</d>
            <d>96995.0039999094</d>
            <d>104195.004000119</d>
            <d>111396.003999934</d>
            <d>118596.004000143</d>
            <d>125796.003999724</d>
            <d>132996.003999934</d>
            <d>140197.003999748</d>
            <d>147397.003999958</d>
            <d>154597.004000167</d>
            <d>161798.003999982</d>
            <d>168998.004000192</d>
          </tagSeriesValues>
      </tagOneSeriesInstance>
        <tagOneSeriesInstance>
          <tagSeriesScale VT="REAL8">1</tagSeriesScale>
          <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
          <tagSeriesValues VT="REAL4" ET="V" NP="24" BL="1">
            <d>0.00402157893404365</d>
            <d>0.00426152208819985</d>
            <d>0.00446209451183677</d>
            <d>0.00274413963779807</d>
            <d>0.00213735830038786</d>
```

```
      <d>0.00239621987566352</d>
      <d>0.00274464394897223</d>
      <d>0.00442485231906176</d>
      <d>0.00424853805452585</d>
      <d>0.00443652179092169</d>
      <d>0.00415920093655586</d>
      <d>0.00386433699168265</d>
      <d>0.00346871255896986</d>
      <d>0.00351415388286114</d>
      <d>0.00342280045151711</d>
      <d>0.00339089217595756</d>
      <d>0.00210384884849191</d>
      <d>0.00200964161194861</d>
      <d>0.00441365595906973</d>
      <d>0.00360459974035621</d>
      <d>0.00408052373677492</d>
      <d>0.00378110283054411</d>
      <d>0.00478457473218441</d>
      <d>0.0044181807897985</d>
    </tagSeriesValues>
</tagOneSeriesInstance>
</tagSeriesInstances>
<tagSeriesInstances>
  <tagOneSeriesInstance>
    <tagSeriesScale VT="REAL8">1</tagSeriesScale>
    <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
    <tagSeriesValues VT="REAL8" ET="V" NP="24" BL="1">
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      <d>10592.0039998367</d>
      <d>17792.0040000463</d>
      <d>24993.003999861</d>
      <d>32193.0040000705</d>
      <d>39393.0040002801</d>
      <d>46593.003999861</d>
      <d>53794.0040003043</d>
      <d>60994.0039998852</d>
      <d>68194.0040000947</d>
      <d>75394.0040003043</d>
      <d>82595.0040001189</d>
      <d>89795.0039996998</d>
      <d>96995.0039999094</d>
      <d>104195.004000119</d>
      <d>111396.003999934</d>
      <d>118596.004000143</d>
      <d>125796.003999724</d>
      <d>132996.003999934</d>
      <d>140197.003999748</d>
      <d>147397.003999958</d>
      <d>154597.004000167</d>
      <d>161798.003999982</d>
      <d>168998.004000192</d>
    </tagSeriesValues>
</tagOneSeriesInstance>
  <tagOneSeriesInstance>
    <tagSeriesScale VT="REAL8">1</tagSeriesScale>
    <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
    <tagSeriesValues VT="REAL4" ET="V" NP="24" BL="1">
      <d>0.00543655175715685</d>
      <d>0.00551323592662811</d>
      <d>0.00579189695417881</d>
      <d>0.00401930185034871</d>
      <d>0.0036143793258816</d>
      <d>0.00335888750851154</d>
      <d>0.00391327030956745</d>
      <d>0.00562870688736439</d>
      <d>0.00472811283543706</d>
      <d>0.00502322940155864</d>
      <d>0.00494667515158653</d>
      <d>0.00508378399536014</d>
      <d>0.00550762284547091</d>
      <d>0.00566286640241742</d>
```

```
        <d>0.0051581896841526</d>
        <d>0.00452276645228267</d>
        <d>0.00394118065014482</d>
        <d>0.00335165509022772</d>
        <d>0.00513329962268472</d>
        <d>0.00518643856048584</d>
        <d>0.00502875866368413</d>
        <d>0.00444941315799952</d>
        <d>0.00545153208076954</d>
        <d>0.00534956995397806</d>
      </tagSeriesValues>
  </tagOneSeriesInstance>
  </tagSeriesInstances>
  <tagSeriesInstances>
    <tagOneSeriesInstance>
      <tagSeriesScale VT="REAL8">1</tagSeriesScale>
      <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
      <tagSeriesValues VT="REAL8" ET="V" NP="24" BL="1">
        <d>3392.00400025584</d>
        <d>10592.0039998367</d>
        <d>17792.0040000463</d>
        <d>24993.003999861</d>
        <d>32193.0040000705</d>
        <d>39393.0040002801</d>
        <d>46593.003999861</d>
        <d>53794.0040003043</d>
        <d>60994.0039998852</d>
        <d>68194.0040000947</d>
        <d>75394.0040003043</d>
        <d>82595.0040001189</d>
        <d>89795.0039996998</d>
        <d>96995.0039999094</d>
        <d>104195.004000119</d>
        <d>111396.003999934</d>
        <d>118596.004000143</d>
        <d>125796.003999724</d>
        <d>132996.003999934</d>
        <d>140197.003999748</d>
        <d>147397.003999958</d>
        <d>154597.004000167</d>
        <d>161798.003999982</d>
        <d>168998.004000192</d>
      </tagSeriesValues>
  </tagOneSeriesInstance>
    <tagOneSeriesInstance>
      <tagSeriesScale VT="REAL8">1</tagSeriesScale>
      <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
      <tagSeriesValues VT="REAL4" ET="V" NP="24" BL="1">
        <d>0.00615084916353226</d>
        <d>0.00605485122650862</d>
        <d>0.00666701467707753</d>
        <d>0.0050021973438561</d>
        <d>0.00411579757928848</d>
        <d>0.00401447992771864</d>
        <d>0.00416702544316649</d>
        <d>0.00617942726239562</d>
        <d>0.00546707445755601</d>
        <d>0.00588811840862036</d>
        <d>0.00569496210664511</d>
        <d>0.00561014609411359</d>
        <d>0.00561602273955941</d>
        <d>0.0054502016864717</d>
        <d>0.00583647005259991</d>
        <d>0.004761369433254</d>
        <d>0.00388110894709826</d>
        <d>0.00363466748967767</d>
        <d>0.00588115025311708</d>
        <d>0.00535034015774727</d>
        <d>0.00561300618574023</d>
        <d>0.00530798360705376</d>
        <d>0.0069678770378232</d>
```

```
            <d>0.00650429492816329</d>
          </tagSeriesValues>
        </tagOneSeriesInstance>
        </tagSeriesInstances>
      </tagChannelInstances>
    </tagRecObservation>
  </records>
```

Value Log for Min Avg Max RMS Voltage for One Phase

This examples presents rms voltage samples that represent the minimum, average, and maximum value recorded at a substation location once every 15 minutes. Note that measurements are stored in volts – not in kilovolts. This is the recommended unit in which to store rms voltages.

Only the first three samples for each series channel instance are shown in the printed version of this report in the interest of limiting page count.

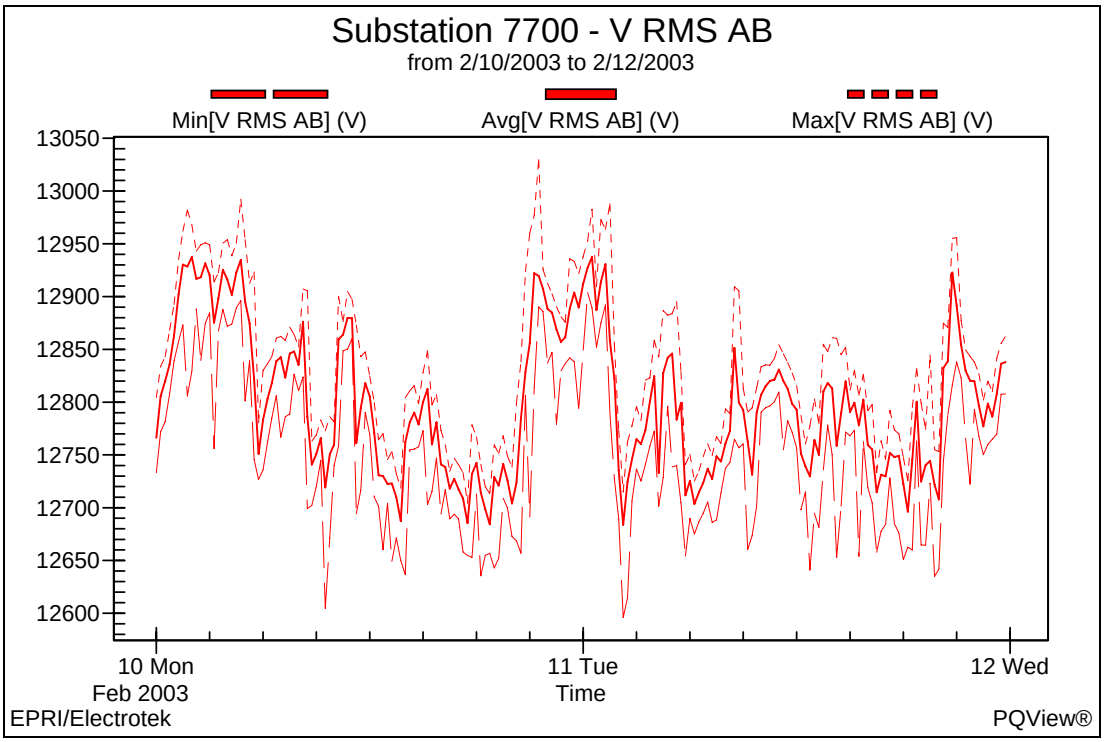

Figure 4-3
Value Log of Min Avg Max RMS Voltage for One Phase

XML Source 4-6: Value Log of Min Avg Max RMS Voltage for One Phase[1]

```
<?xml version="1.0"?>
<records>
  <tagContainer>
    <tagFileName VT="CHAR1" ET="T">C:\projects\EPRI P001.003-2006\XML Examples\Min Avg
Max RMS Voltage for One Phase.xml</tagFileName>
    <tagCreation VT="DT">2007-02-28T00:02:10.250000</tagCreation>
    <tagVersionInfo VT="UINT4" ET="V" NP="4"><d>1 5 1 5</d></tagVersionInfo>
    <tagLanguage VT="CHAR1" ET="T">US English</tagLanguage>
    <tagTitle VT="CHAR1" ET="T">PQView</tagTitle>
    <tagSubject VT="CHAR1" ET="T">N/A</tagSubject>
    <tagAuthor VT="CHAR1" ET="T">dsabin</tagAuthor>
    <tagKeywords VT="CHAR1" ET="T">N/A</tagKeywords>
    <tagComments VT="CHAR1" ET="T">Exported from ODBC;DATABASE=PQVIEW_DEMO</tagComments>
    <tagLastSavedBy VT="CHAR1" ET="T">SABINPORT</tagLastSavedBy>
```

[1] Data limited to three samples per series instance to save space in written report

```
    <tagApplication VT="CHAR1" ET="T">PQView Power Quality Data Manager</tagApplication>
    <tagSecurity VT="CHAR1" ET="T">No Security</tagSecurity>
    <tagOwner VT="CHAR1" ET="T">N/A</tagOwner>
    <tagCopyright VT="CHAR1" ET="T">N/A</tagCopyright>
    <tagTrademarks VT="CHAR1" ET="T">PQView is a registered trademark of Electrotek
Concepts, Inc.  EPRI is a registered service mark of the Electric Power Research
Institute.</tagTrademarks>
    <tagNotes VT="CHAR1" ET="T">N/A</tagNotes>
    <tagCompressionStyleID VT="GUID">ID_COMP_STYLE_NONE</tagCompressionStyleID>
    <tagCompressionAlgorithmID VT="GUID">ID_COMP_ALG_NONE</tagCompressionAlgorithmID>
  </tagContainer>
  <tagRecDataSource>
    <tagDataSourceTypeID VT="GUID">ID_DS_TYPE_MEASURE</tagDataSourceTypeID>
    <tagVendorID VT="GUID">ID_VENDOR_EPRI</tagVendorID>
    <tagEquipmentID VT="GUID">ID_EQUIP_ETK_PQVIEW</tagEquipmentID>
    <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
    <tagNameDS VT="CHAR1" ET="T">Substation 7700</tagNameDS>
    <tagOwnerDS VT="CHAR1" ET="T">dsabin</tagOwnerDS>
    <tagLocationDS VT="CHAR1" ET="T">N/A</tagLocationDS>
    <tagTimeZoneDS VT="CHAR1" ET="T">UTC</tagTimeZoneDS>
    <tagSerialNumberDS VT="CHAR1" ET="T">Power Measurement&#153; ION&#174;
7700</tagSerialNumberDS>
    <tagVersionDS VT="CHAR1" ET="T">3.42</tagVersionDS>
    <tagChannelDefns>
      <tagOneChannelDefn>
        <tagQuantityMeasuredID VT="UINT4">ID_QM_VOLTAGE</tagQuantityMeasuredID>
        <tagChannelName VT="CHAR1" ET="T">V RMS AB</tagChannelName>
        <tagPhaseID VT="UINT4">ID_PHASE_AB</tagPhaseID>
        <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_SECONDS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_TIME</tagValueTypeID>
          <tagQuantityCharacteristicID
VT="GUID">ID_QC_INSTANTANEOUS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_MIN</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_AVG</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_MAX</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
      </tagOneChannelDefn>
    </tagChannelDefns>
  </tagRecDataSource>
  <tagRecMonitorSettings>
    <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
    <tagTimeInstalled VT="DT">2003-02-10T00:00:00.000</tagTimeInstalled>
    <tagTimeRemoved VT="DT">2003-02-12T00:00:00.000</tagTimeRemoved>
    <tagUseCalibration VT="BOOLEAN4">0</tagUseCalibration>
    <tagUseTransducer VT="BOOLEAN4">0</tagUseTransducer>
    <tagNominalFrequency VT="REAL8">60</tagNominalFrequency>
    <tagChannelSettingsArray>
      <tagOneChannelSetting>
        <tagChannelDefnIdx VT="UINT4">0</tagChannelDefnIdx>
      </tagOneChannelSetting>
    </tagChannelSettingsArray>
  </tagRecMonitorSettings>
  <tagRecObservation>
```

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      <tagObservationName VT="CHAR1" ET="T">Data Log</tagObservationName>
      <tagTimeCreate VT="DT">2007-02-27T19:02:10.281000</tagTimeCreate>
      <tagTimeStart VT="DT">2003-02-10T00:00:00.000</tagTimeStart>
      <tagTimeTriggered VT="DT">2003-02-10T00:00:00.000</tagTimeTriggered>
      <tagTriggerMethodID VT="UINT4">ID_TRIGGER_METH_PERIODIC</tagTriggerMethodID>
      <tagChannelInstances>
        <tagSeriesInstances>
          <tagOneSeriesInstance>
            <tagSeriesScale VT="REAL8">1</tagSeriesScale>
            <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
            <tagSeriesValues VT="REAL8" ET="V" NP="3" BL="1">
              <d>0.00000125728547573O9</d>
              <d>900.000001047738</d>
              <d>1800.00000083819</d>
            </tagSeriesValues>
        </tagOneSeriesInstance>
          <tagOneSeriesInstance>
            <tagSeriesScale VT="REAL8">1</tagSeriesScale>
            <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
            <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
              <d>12733.1083984375</d>
              <d>12771.876953125</d>
              <d>12781.568359375</d>
            </tagSeriesValues>
        </tagOneSeriesInstance>
          <tagOneSeriesInstance>
            <tagSeriesScale VT="REAL8">1</tagSeriesScale>
            <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
            <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
              <d>12766.203125</d>
              <d>12805.6708984375</d>
              <d>12819.90625</d>
            </tagSeriesValues>
        </tagOneSeriesInstance>
          <tagOneSeriesInstance>
            <tagSeriesScale VT="REAL8">1</tagSeriesScale>
            <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
            <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
              <d>12804.3564453125</d>
              <d>12833.775390625</d>
              <d>12843.0244140625</d>
            </tagSeriesValues>
        </tagOneSeriesInstance>
        </tagSeriesInstances>
      </tagChannelInstances>
    </tagRecObservation>
  </records>
```

Value Log Min Avg Max RMS Voltage for Three Phases

This examples presents rms voltage samples for three phases that represent the minimum, average, and maximum value recorded at a substation location once every 15 minutes.

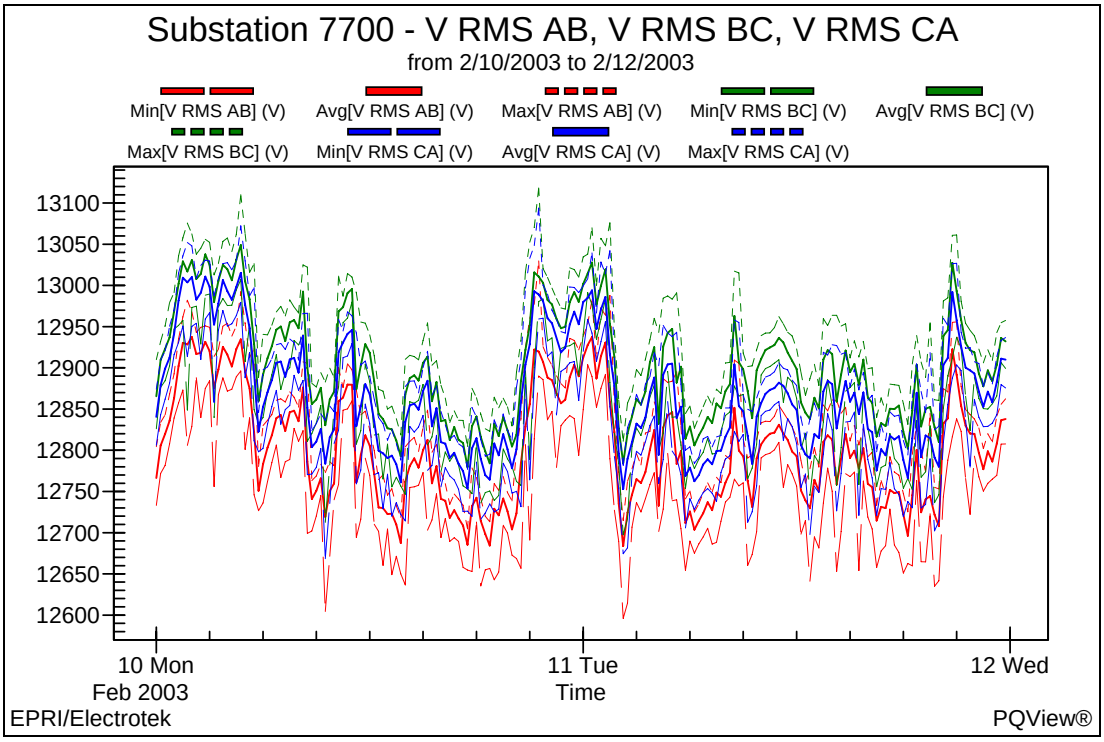

Figure 4-4
Value Log of Min Avg Max RMS Voltage for One Phase

XML Source 4-7: Value Log of Min Avg Max RMS Voltage for One Phase[2]

```
<?xml version="1.0"?>
<records>
  <tagContainer>
    <tagFileName VT="CHAR1" ET="T">C:\projects\EPRI P001.003-2006\XML Examples\Min Avg
Max RMS Voltage for Three Phases.xml</tagFileName>
    <tagCreation VT="DT">2007-02-28T00:06:37.625000</tagCreation>
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    <tagSubject VT="CHAR1" ET="T">N/A</tagSubject>
    <tagAuthor VT="CHAR1" ET="T">dsabin</tagAuthor>
    <tagKeywords VT="CHAR1" ET="T">N/A</tagKeywords>
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    <tagApplication VT="CHAR1" ET="T">PQView Power Quality Data Manager</tagApplication>
    <tagSecurity VT="CHAR1" ET="T">No Security</tagSecurity>
    <tagOwner VT="CHAR1" ET="T">N/A</tagOwner>
    <tagCopyright VT="CHAR1" ET="T">N/A</tagCopyright>
```

[2] Data limited to three samples per series instance to save space in written report

```
    <tagTrademarks VT="CHAR1" ET="T">PQView is a registered trademark of Electrotek
Concepts, Inc.  EPRI is a registered service mark of the Electric Power Research
Institute.</tagTrademarks>
    <tagNotes VT="CHAR1" ET="T">N/A</tagNotes>
    <tagCompressionStyleID VT="GUID">ID_COMP_STYLE_NONE</tagCompressionStyleID>
    <tagCompressionAlgorithmID VT="GUID">ID_COMP_ALG_NONE</tagCompressionAlgorithmID>
  </tagContainer>
  <tagRecDataSource>
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    <tagEquipmentID VT="GUID">ID_EQUIP_ETK_PQVIEW</tagEquipmentID>
    <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
    <tagNameDS VT="CHAR1" ET="T">Substation 7700</tagNameDS>
    <tagOwnerDS VT="CHAR1" ET="T">dsabin</tagOwnerDS>
    <tagLocationDS VT="CHAR1" ET="T">N/A</tagLocationDS>
    <tagTimeZoneDS VT="CHAR1" ET="T">UTC</tagTimeZoneDS>
    <tagSerialNumberDS VT="CHAR1" ET="T">Power Measurement&#153; ION&#174;
7700</tagSerialNumberDS>
    <tagVersionDS VT="CHAR1" ET="T">3.42</tagVersionDS>
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        <tagSeriesDefns>
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        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_MIN</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_AVG</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
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        <tagSeriesDefns>
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          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_MAX</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
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      </tagOneChannelDefn>
      <tagOneChannelDefn>
        <tagQuantityMeasuredID VT="UINT4">ID_QM_VOLTAGE</tagQuantityMeasuredID>
        <tagChannelName VT="CHAR1" ET="T">V RMS BC</tagChannelName>
        <tagPhaseID VT="UINT4">ID_PHASE_BC</tagPhaseID>
        <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_SECONDS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_TIME</tagValueTypeID>
          <tagQuantityCharacteristicID
VT="GUID">ID_QC_INSTANTANEOUS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
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          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_MIN</tagValueTypeID>
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        <tagSeriesDefns>
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          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_MAX</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
      </tagOneChannelDefn>
      <tagOneChannelDefn>
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        <tagChannelName VT="CHAR1" ET="T">V RMS CA</tagChannelName>
        <tagPhaseID VT="UINT4">ID_PHASE_CA</tagPhaseID>
        <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_SECONDS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_TIME</tagValueTypeID>
          <tagQuantityCharacteristicID
VT="GUID">ID_QC_INSTANTANEOUS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_MIN</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_AVG</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_MAX</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
      </tagOneChannelDefn>
    </tagChannelDefns>
  </tagRecDataSource>
  <tagRecMonitorSettings>
    <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
    <tagTimeInstalled VT="DT">2003-02-10T00:00:00.000</tagTimeInstalled>
    <tagTimeRemoved VT="DT">2003-02-12T00:00:00.000</tagTimeRemoved>
    <tagUseCalibration VT="BOOLEAN4">0</tagUseCalibration>
    <tagUseTransducer VT="BOOLEAN4">0</tagUseTransducer>
    <tagNominalFrequency VT="REAL8">60</tagNominalFrequency>
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      <tagOneChannelSetting>
        <tagChannelDefnIdx VT="UINT4">0</tagChannelDefnIdx>
      </tagOneChannelSetting>
      <tagOneChannelSetting>
        <tagChannelDefnIdx VT="UINT4">1</tagChannelDefnIdx>
      </tagOneChannelSetting>
      <tagOneChannelSetting>
        <tagChannelDefnIdx VT="UINT4">2</tagChannelDefnIdx>
      </tagOneChannelSetting>
    </tagChannelSettingsArray>
  </tagRecMonitorSettings>
  <tagRecObservation>
    <tagObservationName VT="CHAR1" ET="T">Data Log</tagObservationName>
    <tagTimeCreate VT="DT">2007-02-27T19:06:37.640000</tagTimeCreate>
    <tagTimeStart VT="DT">2003-02-10T00:00:00.000</tagTimeStart>
    <tagTimeTriggered VT="DT">2003-02-10T00:00:00.000</tagTimeTriggered>
    <tagTriggerMethodID VT="UINT4">ID_TRIGGER_METH_PERIODIC</tagTriggerMethodID>
    <tagChannelInstances>
      <tagSeriesInstances>
```

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  <tagOneSeriesInstance>
    <tagSeriesScale VT="REAL8">1</tagSeriesScale>
    <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
    <tagSeriesValues VT="REAL8" ET="V" NP="3" BL="1">
      <d>0.00000125728547573O9</d>
      <d>900.000001047738</d>
      <d>1800.00000083819</d>
    </tagSeriesValues>
</tagOneSeriesInstance>
  <tagOneSeriesInstance>
    <tagSeriesScale VT="REAL8">1</tagSeriesScale>
    <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
    <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
      <d>12733.1083984375</d>
      <d>12771.876953125</d>
      <d>12781.568359375</d>
    </tagSeriesValues>
</tagOneSeriesInstance>
  <tagOneSeriesInstance>
    <tagSeriesScale VT="REAL8">1</tagSeriesScale>
    <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
    <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
      <d>12766.203125</d>
      <d>12805.6708984375</d>
      <d>12819.90625</d>
    </tagSeriesValues>
</tagOneSeriesInstance>
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    <tagSeriesScale VT="REAL8">1</tagSeriesScale>
    <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
    <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
      <d>12804.3564453125</d>
      <d>12833.775390625</d>
      <d>12843.0244140625</d>
    </tagSeriesValues>
</tagOneSeriesInstance>
</tagSeriesInstances>
<tagSeriesInstances>
  <tagOneSeriesInstance>
    <tagSeriesScale VT="REAL8">1</tagSeriesScale>
    <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
    <tagSeriesValues VT="REAL8" ET="V" NP="3" BL="1">
      <d>0.00000125728547573O9</d>
      <d>900.000001047738</d>
      <d>1800.00000083819</d>
    </tagSeriesValues>
</tagOneSeriesInstance>
  <tagOneSeriesInstance>
    <tagSeriesScale VT="REAL8">1</tagSeriesScale>
    <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
    <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
      <d>12826.11328125</d>
      <d>12876.4130859375</d>
      <d>12884.35546875</d>
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</tagOneSeriesInstance>
  <tagOneSeriesInstance>
    <tagSeriesScale VT="REAL8">1</tagSeriesScale>
    <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
    <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
      <d>12865.5078125</d>
      <d>12909.84765625</d>
      <d>12923.111328125</d>
    </tagSeriesValues>
</tagOneSeriesInstance>
  <tagOneSeriesInstance>
    <tagSeriesScale VT="REAL8">1</tagSeriesScale>
    <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
    <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
      <d>12910.0029296875</d>
      <d>12932.0517578125</d>
```

```
            <d>12951.0029296875</d>
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        </tagSeriesInstances>
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          <tagOneSeriesInstance>
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            <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
            <tagSeriesValues VT="REAL8" ET="V" NP="3" BL="1">
              <d>0.00000125728547573O9</d>
              <d>900.000001047738</d>
              <d>1800.00000083819</d>
            </tagSeriesValues>
        </tagOneSeriesInstance>
          <tagOneSeriesInstance>
            <tagSeriesScale VT="REAL8">1</tagSeriesScale>
            <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
            <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
              <d>12806.0234375</d>
              <d>12842.9765625</d>
              <d>12861.970703125</d>
            </tagSeriesValues>
        </tagOneSeriesInstance>
          <tagOneSeriesInstance>
            <tagSeriesScale VT="REAL8">1</tagSeriesScale>
            <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
            <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
              <d>12840.35546875</d>
              <d>12879.0625</d>
              <d>12898.9755859375</d>
            </tagSeriesValues>
        </tagOneSeriesInstance>
          <tagOneSeriesInstance>
            <tagSeriesScale VT="REAL8">1</tagSeriesScale>
            <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
            <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
              <d>12874.1875</d>
              <d>12909.3271484375</d>
              <d>12920.5517578125</d>
            </tagSeriesValues>
        </tagOneSeriesInstance>
        </tagSeriesInstances>
      </tagChannelInstances>
    </tagRecObservation>
  </records>
```

Value Log of Val RMS Voltage for One Phase

In example, we export periodic samples of rms voltage that were recorded at a single site on a single phase.

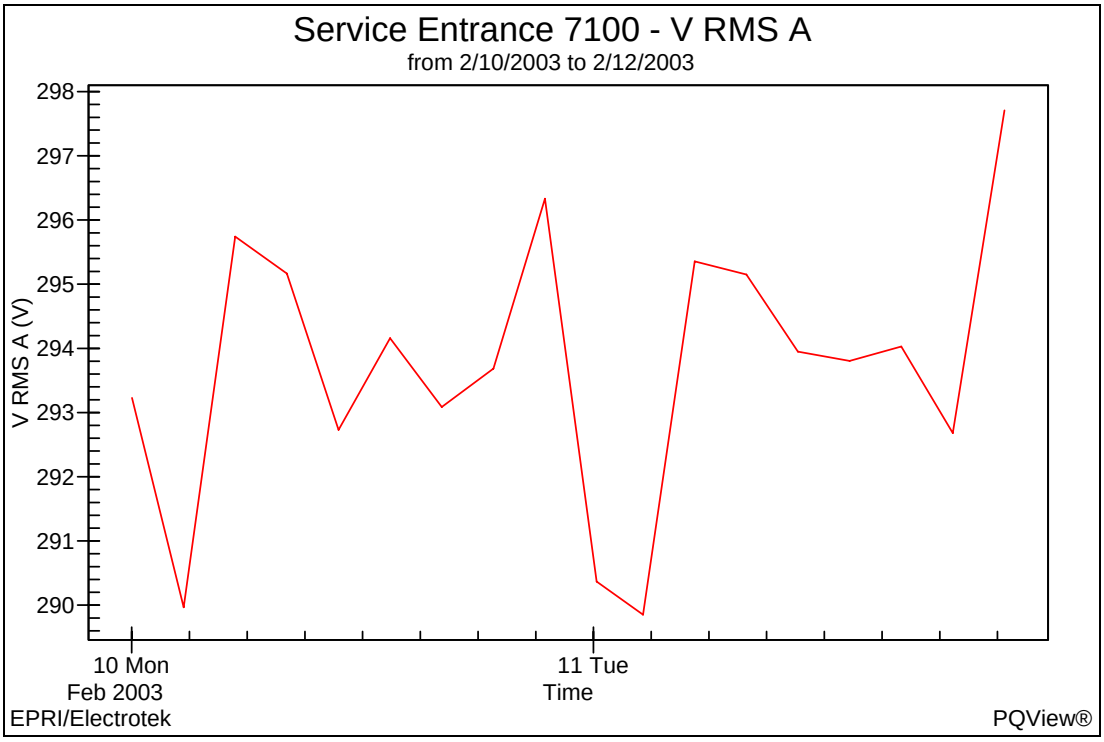

Figure 4-5
Value Log of Val RMS Voltage for One Phase

XML Source 4-8: Value Log of Val RMS Voltage for One Phase

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<records>
  <tagContainer>
    <tagFileName VT="CHAR1" ET="T">C:\projects\EPRI P001.003-2006\XML Examples\Value Log
of Val RMS Voltage for One Phase.xml</tagFileName>
    <tagCreation VT="DT">2007-02-28T00:17:58.968000</tagCreation>
    <tagVersionInfo VT="UINT4" ET="V" NP="4"><d>1 5 1 5</d></tagVersionInfo>
    <tagLanguage VT="CHAR1" ET="T">US English</tagLanguage>
    <tagTitle VT="CHAR1" ET="T">PQView</tagTitle>
    <tagSubject VT="CHAR1" ET="T">N/A</tagSubject>
    <tagAuthor VT="CHAR1" ET="T">dsabin</tagAuthor>
    <tagKeywords VT="CHAR1" ET="T">N/A</tagKeywords>
    <tagComments VT="CHAR1" ET="T">Exported from ODBC;DATABASE=PQVIEW_DEMO</tagComments>
    <tagLastSavedBy VT="CHAR1" ET="T">SABINPORT</tagLastSavedBy>
    <tagApplication VT="CHAR1" ET="T">PQView Power Quality Data Manager</tagApplication>
    <tagSecurity VT="CHAR1" ET="T">No Security</tagSecurity>
    <tagOwner VT="CHAR1" ET="T">N/A</tagOwner>
    <tagCopyright VT="CHAR1" ET="T">N/A</tagCopyright>
    <tagTrademarks VT="CHAR1" ET="T">PQView is a registered trademark of Electrotek
Concepts, Inc.  EPRI is a registered service mark of the Electric Power Research
Institute.</tagTrademarks>
    <tagNotes VT="CHAR1" ET="T">N/A</tagNotes>
    <tagCompressionStyleID VT="GUID">ID_COMP_STYLE_NONE</tagCompressionStyleID>
    <tagCompressionAlgorithmID VT="GUID">ID_COMP_ALG_NONE</tagCompressionAlgorithmID>
```

```
  </tagContainer>
  <tagRecDataSource>
    <tagDataSourceTypeID VT="GUID">ID_DS_TYPE_MEASURE</tagDataSourceTypeID>
    <tagVendorID VT="GUID">ID_VENDOR_EPRI</tagVendorID>
    <tagEquipmentID VT="GUID">ID_EQUIP_ETK_PQVIEW</tagEquipmentID>
    <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
    <tagNameDS VT="CHAR1" ET="T">Service Entrance 7100</tagNameDS>
    <tagOwnerDS VT="CHAR1" ET="T">dsabin</tagOwnerDS>
    <tagLocationDS VT="CHAR1" ET="T">N/A</tagLocationDS>
    <tagTimeZoneDS VT="CHAR1" ET="T">UTC</tagTimeZoneDS>
    <tagSerialNumberDS VT="CHAR1" ET="T">Dranetz-BMI PQNode&#174;
7100</tagSerialNumberDS>
    <tagVersionDS VT="CHAR1" ET="T">3.42</tagVersionDS>
    <tagChannelDefns>
      <tagOneChannelDefn>
        <tagQuantityMeasuredID VT="UINT4">ID_QM_VOLTAGE</tagQuantityMeasuredID>
        <tagChannelName VT="CHAR1" ET="T">V RMS A</tagChannelName>
        <tagPhaseID VT="UINT4">ID_PHASE_AN</tagPhaseID>
        <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_SECONDS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_TIME</tagValueTypeID>
          <tagQuantityCharacteristicID
VT="GUID">ID_QC_INSTANTANEOUS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_VAL</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
      </tagOneChannelDefn>
    </tagChannelDefns>
  </tagRecDataSource>
  <tagRecMonitorSettings>
    <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
    <tagTimeInstalled VT="DT">2003-02-10T00:00:00.000</tagTimeInstalled>
    <tagTimeRemoved VT="DT">2003-02-12T00:00:00.000</tagTimeRemoved>
    <tagUseCalibration VT="BOOLEAN4">0</tagUseCalibration>
    <tagUseTransducer VT="BOOLEAN4">0</tagUseTransducer>
    <tagNominalFrequency VT="REAL8">60</tagNominalFrequency>
    <tagChannelSettingsArray>
      <tagOneChannelSetting>
        <tagChannelDefnIdx VT="UINT4">0</tagChannelDefnIdx>
      </tagOneChannelSetting>
    </tagChannelSettingsArray>
  </tagRecMonitorSettings>
  <tagRecObservation>
    <tagObservationName VT="CHAR1" ET="T">Data Log</tagObservationName>
    <tagTimeCreate VT="DT">2007-02-27T19:17:58.968000</tagTimeCreate>
    <tagTimeStart VT="DT">2003-02-10T00:00:00.000</tagTimeStart>
    <tagTimeTriggered VT="DT">2003-02-10T00:00:00.000</tagTimeTriggered>
    <tagTriggerMethodID VT="UINT4">ID_TRIGGER_METH_PERIODIC</tagTriggerMethodID>
    <tagChannelInstances>
      <tagSeriesInstances>
        <tagOneSeriesInstance>
          <tagSeriesScale VT="REAL8">1</tagSeriesScale>
          <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
          <tagSeriesValues VT="REAL8" ET="V" NP="18" BL="1">
            <d>9537.62399980333</d>
            <d>19197.6239998592</d>
            <d>28857.6140000951</d>
            <d>38517.6140001509</d>
            <d>48177.6140002068</d>
            <d>57837.6140002627</d>
            <d>67497.6139996899</d>
            <d>77157.6139997458</d>
            <d>86817.6139998017</d>
            <d>96477.6240003062</d>
            <d>106137.623999733</d>
```

```
              <d>115797.623999789</d>
              <d>124481.633999711</d>
              <d>134141.623999947</d>
              <d>143801.624000003</d>
              <d>153461.624000059</d>
              <d>163121.624000114</d>
              <d>172781.62400017</d>
            </tagSeriesValues>
          </tagOneSeriesInstance>
            <tagOneSeriesInstance>
              <tagSeriesScale VT="REAL8">1</tagSeriesScale>
              <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
              <tagSeriesValues VT="REAL4" ET="V" NP="18" BL="1">
                <d>294.281768798828</d>
                <d>295.924652099609</d>
                <d>293.228118896484</d>
                <d>289.966461181641</d>
                <d>295.7431640625</d>
                <d>295.167236328125</d>
                <d>292.731597900391</d>
                <d>294.157562255859</d>
                <d>293.086791992188</d>
                <d>293.684814453125</d>
                <d>296.331573486328</d>
                <d>290.367248535156</d>
                <d>289.850830078125</d>
                <d>295.355865478516</d>
                <d>295.149688720703</d>
                <d>293.950347900391</d>
                <d>293.806365966797</d>
                <d>294.028411865234</d>
              </tagSeriesValues>
          </tagOneSeriesInstance>
          </tagSeriesInstances>
        </tagChannelInstances>
      </tagRecObservation>
    </records>
```

Value Log of Val Min Avg Max RMS Voltage for One Phase

In this example, we show how to represent data from four different value types in a single file: min, avg, max, and value. The min, avg, and max data were recorded using a different method, so in this case it makes sense to use two channel instances. One is used to store the periodic values and one is used to store the minimum, average, and maximum values.

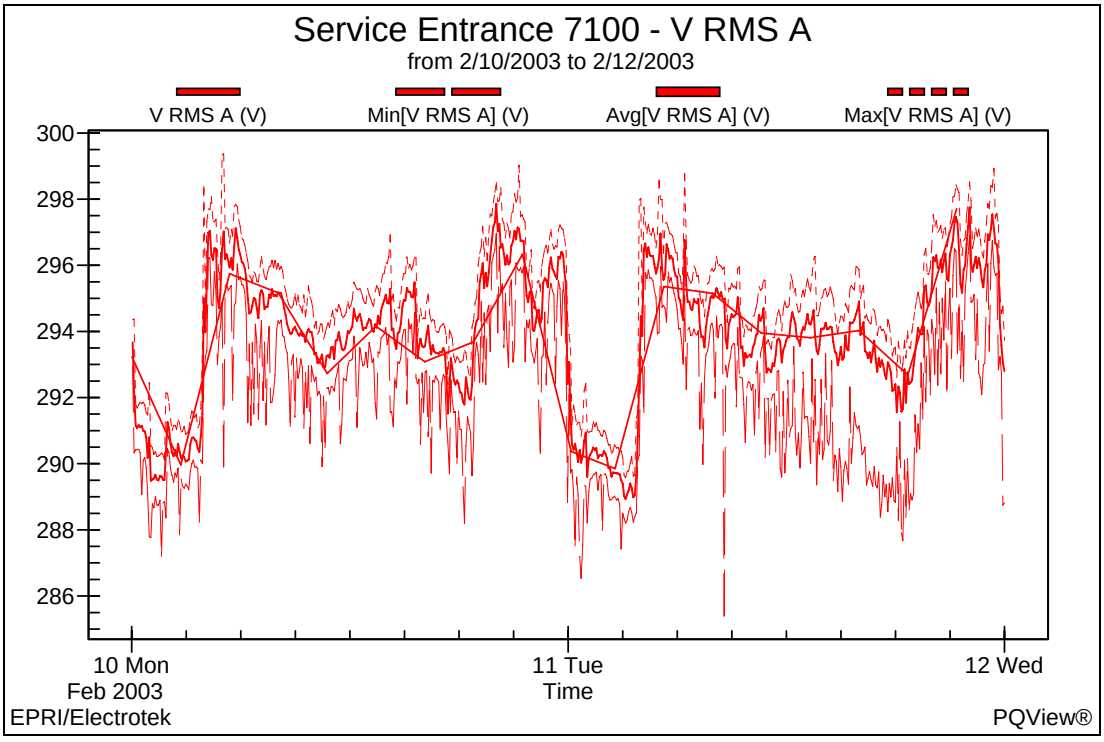

Figure 4-6
Value Log of Val Min Avg Max RMS Voltage for One Phase

XML Source 4-9: Value Log of Val Min Avg Max RMS Voltage for One Phase[3]

```
<?xml version="1.0"?>
<records>
  <tagContainer>
    <tagFileName VT="CHAR1" ET="T">C:\projects\EPRI P001.003-2006\XML Examples\Value Log
of Val Min Avg Max RMS Voltage for One Phase.xml</tagFileName>
    <tagCreation VT="DT">2007-02-28T00:21:06.453000</tagCreation>
    <tagVersionInfo VT="UINT4" ET="V" NP="4"><d>1 5 1 5</d></tagVersionInfo>
    <tagLanguage VT="CHAR1" ET="T">US English</tagLanguage>
    <tagTitle VT="CHAR1" ET="T">PQView</tagTitle>
    <tagSubject VT="CHAR1" ET="T">N/A</tagSubject>
    <tagAuthor VT="CHAR1" ET="T">dsabin</tagAuthor>
    <tagKeywords VT="CHAR1" ET="T">N/A</tagKeywords>
    <tagComments VT="CHAR1" ET="T">Exported from ODBC;DATABASE=PQVIEW_DEMO</tagComments>
    <tagLastSavedBy VT="CHAR1" ET="T">SABINPORT</tagLastSavedBy>
    <tagApplication VT="CHAR1" ET="T">PQView Power Quality Data Manager</tagApplication>
    <tagSecurity VT="CHAR1" ET="T">No Security</tagSecurity>
    <tagOwner VT="CHAR1" ET="T">N/A</tagOwner>
```

[3] Data limited to three samples per series instance to save space in written report.

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    <tagCopyright VT="CHAR1" ET="T">N/A</tagCopyright>
    <tagTrademarks VT="CHAR1" ET="T">PQView is a registered trademark of Electrotek
Concepts, Inc.  EPRI is a registered service mark of the Electric Power Research
Institute.</tagTrademarks>
    <tagNotes VT="CHAR1" ET="T">N/A</tagNotes>
    <tagCompressionStyleID VT="GUID">ID_COMP_STYLE_NONE</tagCompressionStyleID>
    <tagCompressionAlgorithmID VT="GUID">ID_COMP_ALG_NONE</tagCompressionAlgorithmID>
  </tagContainer>
  <tagRecDataSource>
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    <tagVendorID VT="GUID">ID_VENDOR_EPRI</tagVendorID>
    <tagEquipmentID VT="GUID">ID_EQUIP_ETK_PQVIEW</tagEquipmentID>
    <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
    <tagNameDS VT="CHAR1" ET="T">Service Entrance 7100</tagNameDS>
    <tagOwnerDS VT="CHAR1" ET="T">dsabin</tagOwnerDS>
    <tagLocationDS VT="CHAR1" ET="T">N/A</tagLocationDS>
    <tagTimeZoneDS VT="CHAR1" ET="T">UTC</tagTimeZoneDS>
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7100</tagSerialNumberDS>
    <tagVersionDS VT="CHAR1" ET="T">3.42</tagVersionDS>
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      <tagOneChannelDefn>
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        <tagChannelName VT="CHAR1" ET="T">V RMS A</tagChannelName>
        <tagPhaseID VT="UINT4">ID_PHASE_AN</tagPhaseID>
        <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_SECONDS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_TIME</tagValueTypeID>
          <tagQuantityCharacteristicID
VT="GUID">ID_QC_INSTANTANEOUS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_MIN</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_MAX</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_VOLTS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_AVG</tagValueTypeID>
          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
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      </tagOneChannelDefn>
      <tagOneChannelDefn>
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        <tagPhaseID VT="UINT4">ID_PHASE_AN</tagPhaseID>
        <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
        <tagSeriesDefns>
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        </tagSeriesDefns>
        <tagSeriesDefns>
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          <tagQuantityCharacteristicID VT="GUID">ID_QC_RMS</tagQuantityCharacteristicID>
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  </tagChannelDefns>
</tagRecDataSource>
<tagRecMonitorSettings>
  <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
  <tagTimeInstalled VT="DT">2003-02-10T00:00:00.000</tagTimeInstalled>
  <tagTimeRemoved VT="DT">2003-02-12T00:00:00.000</tagTimeRemoved>
  <tagUseCalibration VT="BOOLEAN4">0</tagUseCalibration>
  <tagUseTransducer VT="BOOLEAN4">0</tagUseTransducer>
  <tagNominalFrequency VT="REAL8">60</tagNominalFrequency>
  <tagChannelSettingsArray>
    <tagOneChannelSetting>
      <tagChannelDefnIdx VT="UINT4">0</tagChannelDefnIdx>
    </tagOneChannelSetting>
    <tagOneChannelSetting>
      <tagChannelDefnIdx VT="UINT4">1</tagChannelDefnIdx>
    </tagOneChannelSetting>
  </tagChannelSettingsArray>
</tagRecMonitorSettings>
<tagRecObservation>
  <tagObservationName VT="CHAR1" ET="T">Data Log</tagObservationName>
  <tagTimeCreate VT="DT">2007-02-27T19:21:06.468000</tagTimeCreate>
  <tagTimeStart VT="DT">2003-02-10T00:00:00.000</tagTimeStart>
  <tagTimeTriggered VT="DT">2003-02-10T00:00:00.000</tagTimeTriggered>
  <tagTriggerMethodID VT="UINT4">ID_TRIGGER_METH_PERIODIC</tagTriggerMethodID>
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        <tagSeriesScale VT="REAL8">1</tagSeriesScale>
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          <d>177.62500026729</d>
          <d>477.624999987893</d>
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        </tagSeriesValues>
    </tagOneSeriesInstance>
      <tagOneSeriesInstance>
        <tagSeriesScale VT="REAL8">1</tagSeriesScale>
        <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
        <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
          <d>294.294769287109</d>
          <d>291.411224365234</d>
          <d>293.917327880859</d>
        </tagSeriesValues>
    </tagOneSeriesInstance>
      <tagOneSeriesInstance>
        <tagSeriesScale VT="REAL8">1</tagSeriesScale>
        <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
        <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
          <d>296.151916503906</d>
          <d>295.700866699219</d>
          <d>296.184020996094</d>
        </tagSeriesValues>
    </tagOneSeriesInstance>
      <tagOneSeriesInstance>
        <tagSeriesScale VT="REAL8">1</tagSeriesScale>
        <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
        <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
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          <d>294.852661132813</d>
          <d>295.051696777344</d>
        </tagSeriesValues>
    </tagOneSeriesInstance>
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        <tagSeriesScale VT="REAL8">1</tagSeriesScale>
        <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
        <tagSeriesValues VT="REAL8" ET="V" NP="3" BL="1">
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          <d>19197.6239998592</d>
          <d>28857.6140000951</d>
```

```
            </tagSeriesValues>
          </tagOneSeriesInstance>
            <tagOneSeriesInstance>
              <tagSeriesScale VT="REAL8">1</tagSeriesScale>
              <tagSeriesOffset VT="REAL8">0</tagSeriesOffset>
              <tagSeriesValues VT="REAL4" ET="V" NP="3" BL="1">
                <d>294.281768798828</d>
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                <d>293.228118896484</d>
              </tagSeriesValues>
          </tagOneSeriesInstance>
          </tagSeriesInstances>
        </tagChannelInstances>
    </tagRecObservation>
  </records>
```

Value Log of Power Channels

In this example, we show how to represent logs containing value logs for real power, reactive power, apparent power, and power factor. Power is exported in watts, vars, and volt-amperes (not in kW, kvar, or kVA) because that is the default unit for power channels. Power factor is exported in per unit to avoid having to convert the measurements to percent during import or export.

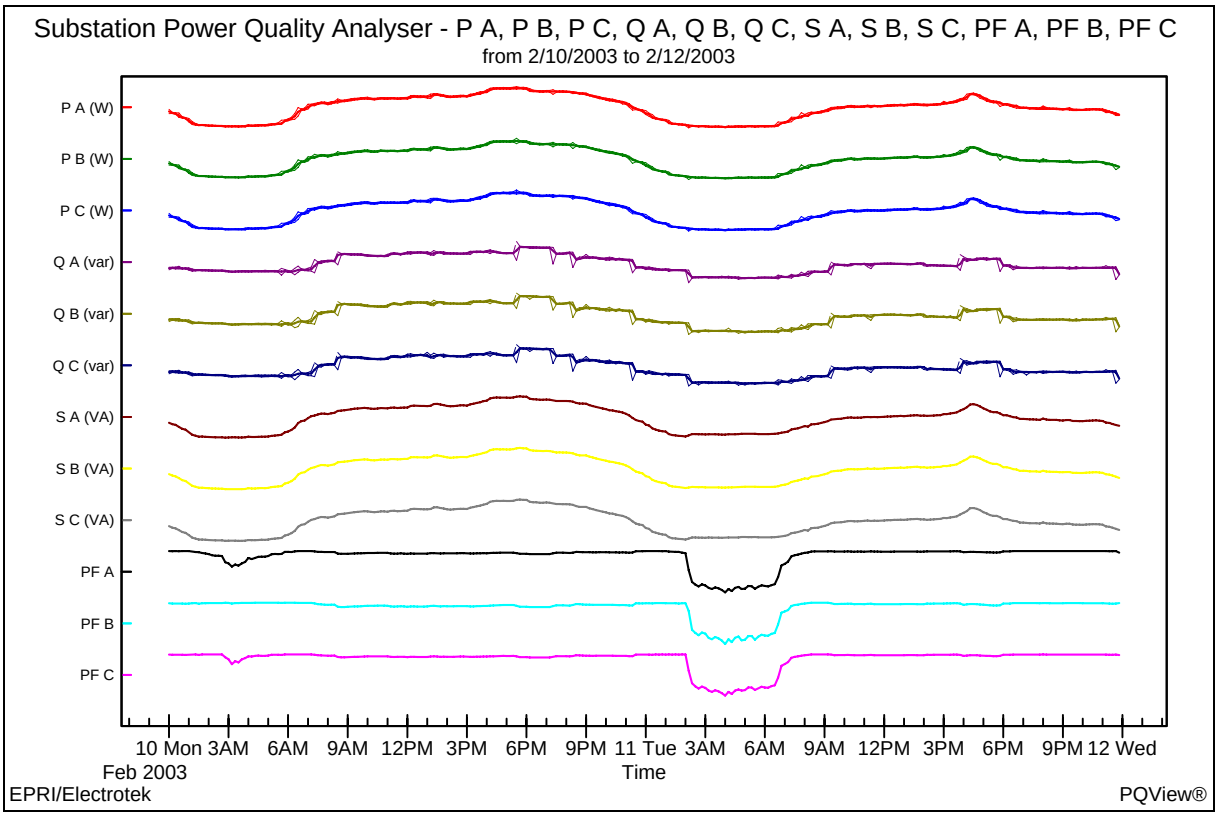

Figure 4-7
Value Log of Power Channels

XML Source 4-10: Value Log of Power Channels[4]

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<?xml version="1.0"?>
<records>
  <tagContainer>
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of Power Channels.xml</tagFileName>
    <tagCreation VT="DT">2007-02-28T00:39:44.390000</tagCreation>
    <tagVersionInfo VT="UINT4" ET="V" NP="4"><d>1 5 1 5</d></tagVersionInfo>
    <tagLanguage VT="CHAR1" ET="T">US English</tagLanguage>
    <tagTitle VT="CHAR1" ET="T">PQView</tagTitle>
    <tagSubject VT="CHAR1" ET="T">N/A</tagSubject>
    <tagAuthor VT="CHAR1" ET="T">dsabin</tagAuthor>
    <tagKeywords VT="CHAR1" ET="T">N/A</tagKeywords>
```

[4] Data limited to three samples per series instance to save space in written report.

```
    <tagComments VT="CHAR1" ET="T">Exported from ODBC;DATABASE=PQVIEW_DEMO</tagComments>
    <tagLastSavedBy VT="CHAR1" ET="T">SABINPORT</tagLastSavedBy>
    <tagApplication VT="CHAR1" ET="T">PQView Power Quality Data Manager</tagApplication>
    <tagSecurity VT="CHAR1" ET="T">No Security</tagSecurity>
    <tagOwner VT="CHAR1" ET="T">N/A</tagOwner>
    <tagCopyright VT="CHAR1" ET="T">N/A</tagCopyright>
    <tagTrademarks VT="CHAR1" ET="T">PQView is a registered trademark of Electrotek
Concepts, Inc.  EPRI is a registered service mark of the Electric Power Research
Institute.</tagTrademarks>
    <tagNotes VT="CHAR1" ET="T">N/A</tagNotes>
    <tagCompressionStyleID VT="GUID">ID_COMP_STYLE_NONE</tagCompressionStyleID>
    <tagCompressionAlgorithmID VT="GUID">ID_COMP_ALG_NONE</tagCompressionAlgorithmID>
  </tagContainer>
  <tagRecDataSource>
    <tagDataSourceTypeID VT="GUID">ID_DS_TYPE_MEASURE</tagDataSourceTypeID>
    <tagVendorID VT="GUID">ID_VENDOR_EPRI</tagVendorID>
    <tagEquipmentID VT="GUID">ID_EQUIP_ETK_PQVIEW</tagEquipmentID>
    <tagEffective VT="DT">2003-02-10T00:00:00.000</tagEffective>
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    <tagOwnerDS VT="CHAR1" ET="T">dsabin</tagOwnerDS>
    <tagLocationDS VT="CHAR1" ET="T">N/A</tagLocationDS>
    <tagTimeZoneDS VT="CHAR1" ET="T">UTC</tagTimeZoneDS>
    <tagSerialNumberDS VT="CHAR1" ET="T">LEM QWave Premium</tagSerialNumberDS>
    <tagVersionDS VT="CHAR1" ET="T">3.42</tagVersionDS>
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        <tagChannelName VT="CHAR1" ET="T">P A</tagChannelName>
        <tagPhaseID VT="UINT4">ID_PHASE_AN</tagPhaseID>
        <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
        <tagSeriesDefns>
          <tagQuantityUnitsID VT="UINT4">ID_QU_SECONDS</tagQuantityUnitsID>
          <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_TIME</tagValueTypeID>
          <tagQuantityCharacteristicID
VT="GUID">ID_QC_INSTANTANEOUS</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
        </tagSeriesDefns>
        <tagSeriesDefns>
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          <tagQuantityCharacteristicID VT="GUID">ID_QC_P</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
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        <tagSeriesDefns>
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          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
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        <tagSeriesDefns>
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      </tagOneChannelDefn>
      <tagOneChannelDefn>
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        <tagSeriesDefns>
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          <tagQuantityCharacteristicID VT="GUID">ID_QC_Q</tagQuantityCharacteristicID>
          <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
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        <tagOneChannelDefn>
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          <tagSeriesDefns>
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          <tagSeriesDefns>
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            <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
          </tagSeriesDefns>
        </tagOneChannelDefn>
        <tagOneChannelDefn>
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          <tagChannelName VT="CHAR1" ET="T">Q C</tagChannelName>
          <tagPhaseID VT="UINT4">ID_PHASE_CN</tagPhaseID>
          <tagQuantityTypeID VT="GUID">ID_QT_VALUELOG</tagQuantityTypeID>
          <tagSeriesDefns>
            <tagQuantityUnitsID VT="UINT4">ID_QU_SECONDS</tagQuantityUnitsID>
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            <tagQuantityCharacteristicID
VT="GUID">ID_QC_INSTANTANEOUS</tagQuantityCharacteristicID>
            <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
          </tagSeriesDefns>
          <tagSeriesDefns>
            <tagQuantityUnitsID VT="UINT4">ID_QU_VARS</tagQuantityUnitsID>
            <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_MIN</tagValueTypeID>
            <tagQuantityCharacteristicID VT="GUID">ID_QC_Q</tagQuantityCharacteristicID>
            <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
          </tagSeriesDefns>
          <tagSeriesDefns>
            <tagQuantityUnitsID VT="UINT4">ID_QU_VARS</tagQuantityUnitsID>
            <tagValueTypeID VT="GUID">ID_SERIES_VALUE_TYPE_AVG</tagValueTypeID>
            <tagQuantityCharacteristicID VT="GUID">ID_QC_Q</tagQuantityCharacteristicID>
            <tagStorageMethodID VT="UINT4">ID_SERIES_METHOD_VALUES</tagStorageMethodID>
          </tagSeriesDefns>
          <tagSeriesDefns>
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        </tagOneChannelDefn>
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```
        <tagChannelName VT="CHAR1" ET="T">S A</tagChannelName>
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Waveform Samples with Voltage and Current Sampled at 4 Points per Cycle

In this example, we display the voltage and current samples recorded by an electronic relay. Note how the voltage and current is exported in volts and amps, which is the default method of storing waveform samples.

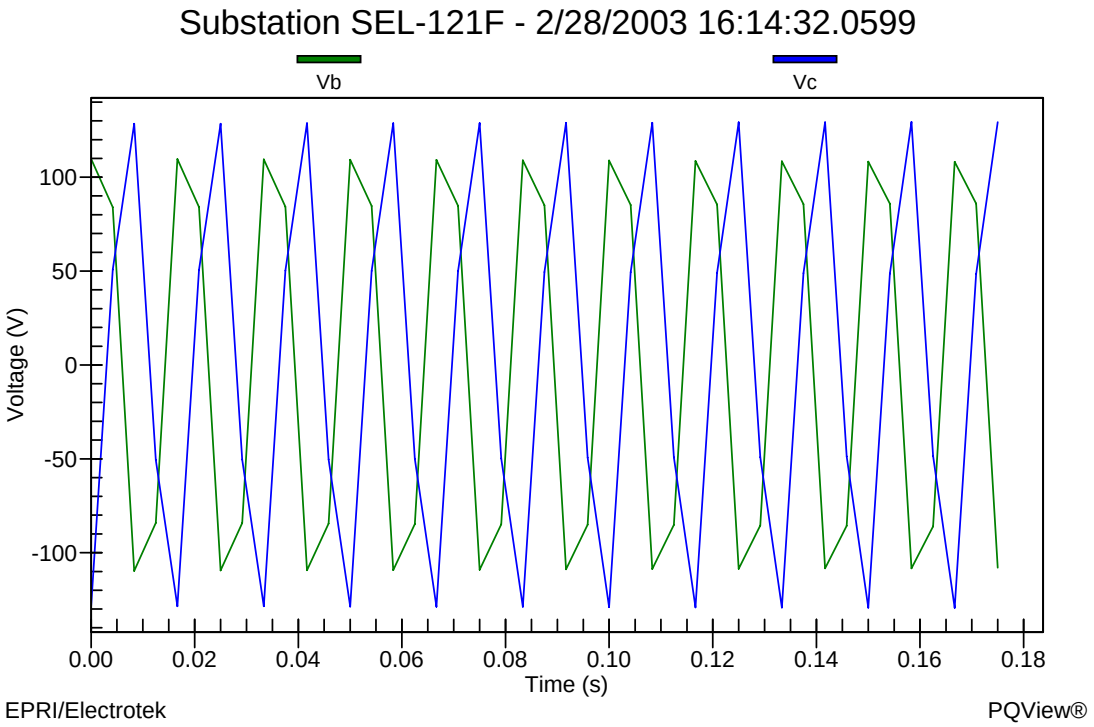

Figure 4-8
Waveform Samples with Voltage and Current Sampled at 4 Points per Cycle

XML Source 4-11: Waveform Samples with Voltage and Current Sampled at 4 Points per Cycle

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    </tagRecObservation>
  </records>
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Waveform Samples with Voltage and Current Sampled at 96 Points per Cycle

In this example, we display the voltage and current samples recorded by an electronic relay. Note how the voltage and current is exported in volts and amps, which is the default method of storing waveform samples.

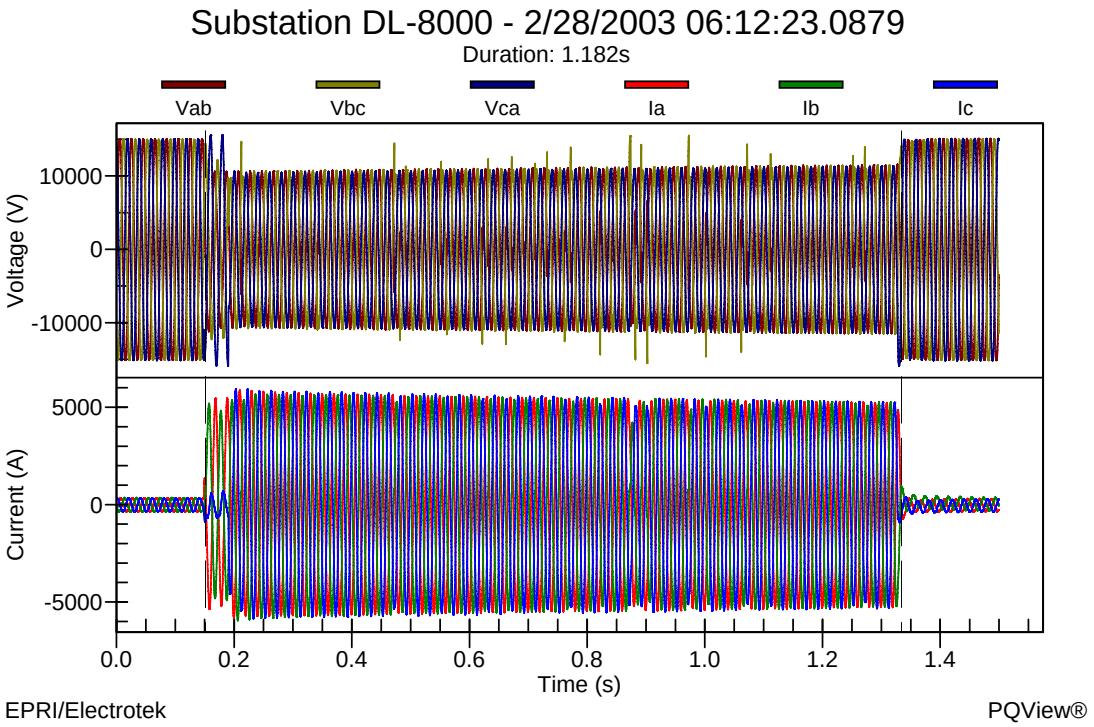

Figure 4-9
Waveform Samples with Voltage and Current Sampled at 96 Points per Cycle

XML Source 4-12: Waveform Samples with Voltage and Current Sampled at 96 Points per Cycle[5]

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Samples with Voltage and Current Sampled at 96 Points per Cycle.xml</tagFileName>
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    <tagTitle VT="CHAR1" ET="T">PQView</tagTitle>
    <tagSubject VT="CHAR1" ET="T">N/A</tagSubject>
    <tagAuthor VT="CHAR1" ET="T">dsabin</tagAuthor>
    <tagKeywords VT="CHAR1" ET="T">N/A</tagKeywords>
    <tagComments VT="CHAR1" ET="T">Exported from ODBC;DATABASE=PQVIEW_DEMO</tagComments>
    <tagLastSavedBy VT="CHAR1" ET="T">SABINPORT</tagLastSavedBy>
    <tagApplication VT="CHAR1" ET="T">PQView Power Quality Data Manager</tagApplication>
    <tagSecurity VT="CHAR1" ET="T">No Security</tagSecurity>
    <tagOwner VT="CHAR1" ET="T">N/A</tagOwner>
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[5] Data limited to three samples per series instance to save space in written report.

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    <tagTrademarks VT="CHAR1" ET="T">PQView is a registered trademark of Electrotek
Concepts, Inc.  EPRI is a registered service mark of the Electric Power Research
Institute.</tagTrademarks>
    <tagNotes VT="CHAR1" ET="T">N/A</tagNotes>
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Digital Fault Recorder</tagSerialNumberDS>
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            <d>5.55616331100464</d>
          </tagSeriesValues>
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    </tagChannelInstances>
  </tagRecObservation>
</records>
```

Waveform Samples with Voltage and Current Sampled at 128 Points per Cycle

In this example, we display the voltage and current samples recorded by a power monitor that stores waveform samples in multiple records. The records have start times relative to the measurement's time stamp (2003-02-25 06:13:09.0062) of -0.001 seconds, 0.014 seconds, and 0.367 seconds. Each waveform record is stored in PQDIF file as a new channel instance. The measurements are stored in volts and amps.

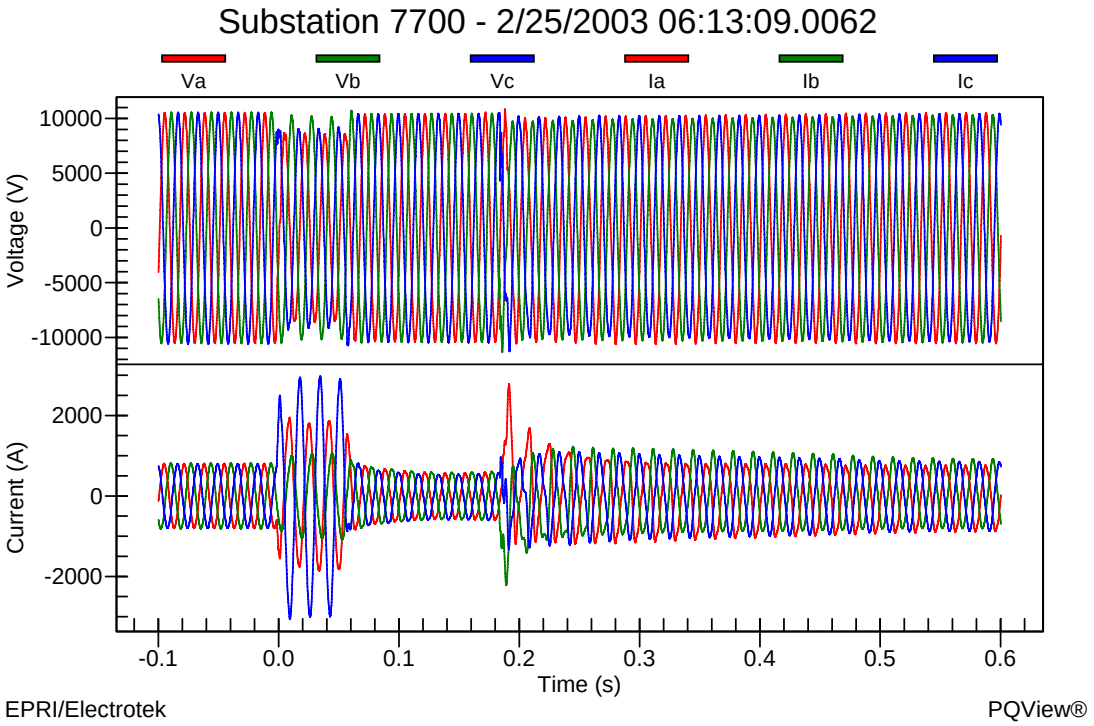

Figure 4-10
Waveform Samples with Voltage and Current Sampled at 128 Points per Cycle

XML Source 4-13: Waveform Samples with Voltage and Current Sampled at 128 Points per Cycle[6]

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<?xml version="1.0"?>
<records>
  <tagContainer>
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Samples with Voltage and Current Sampled at 128 Points per Cycle.xml</tagFileName>
    <tagCreation VT="DT">2007-03-12T21:56:38.500000</tagCreation>
    <tagVersionInfo VT="UINT4" ET="V" NP="4"><d>1 5 1 5</d></tagVersionInfo>
    <tagLanguage VT="CHAR1" ET="T">US English</tagLanguage>
    <tagTitle VT="CHAR1" ET="T">PQView</tagTitle>
    <tagSubject VT="CHAR1" ET="T">N/A</tagSubject>
    <tagAuthor VT="CHAR1" ET="T">dsabin</tagAuthor>
    <tagKeywords VT="CHAR1" ET="T">N/A</tagKeywords>
    <tagComments VT="CHAR1" ET="T">Exported from ODBC;DATABASE=PQVIEW_DEMO</tagComments>
    <tagLastSavedBy VT="CHAR1" ET="T">SABINPORT</tagLastSavedBy>
```

[6] Data limited to three samples per series instance to save space in written report

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    <tagApplication VT="CHAR1" ET="T">PQView Power Quality Data Manager</tagApplication>
    <tagSecurity VT="CHAR1" ET="T">No Security</tagSecurity>
    <tagOwner VT="CHAR1" ET="T">N/A</tagOwner>
    <tagCopyright VT="CHAR1" ET="T">N/A</tagCopyright>
    <tagTrademarks VT="CHAR1" ET="T">PQView is a registered trademark of Electrotek
Concepts, Inc.  EPRI is a registered service mark of the Electric Power Research
Institute.</tagTrademarks>
    <tagNotes VT="CHAR1" ET="T">N/A</tagNotes>
    <tagCompressionStyleID VT="GUID">ID_COMP_STYLE_NONE</tagCompressionStyleID>
    <tagCompressionAlgorithmID VT="GUID">ID_COMP_ALG_NONE</tagCompressionAlgorithmID>
  </tagContainer>
  <tagRecDataSource>
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    <tagEquipmentID VT="GUID">ID_EQUIP_ETK_PQVIEW</tagEquipmentID>
    <tagEffective VT="DT">2003-02-25T06:13:09.000</tagEffective>
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    <tagLocationDS VT="CHAR1" ET="T">N/A</tagLocationDS>
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    <tagSerialNumberDS VT="CHAR1" ET="T">Power Measurement&#153; ION&#174;
7700</tagSerialNumberDS>
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        <tagQuantityTypeID VT="GUID">ID_QT_WAVEFORM</tagQuantityTypeID>
        <tagSeriesDefns>
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    </tagRecObservation>
  </records>
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RMS Samples of Voltage and Current during a Voltage Sag

In this example, we store the rms values computed from the waveform samples stored in XML Source 4-13. Note that the rms values for a voltage sag, swell, or interruption is accomplished using the phasor quantity type (ID_QUANTITY_PHASOR).

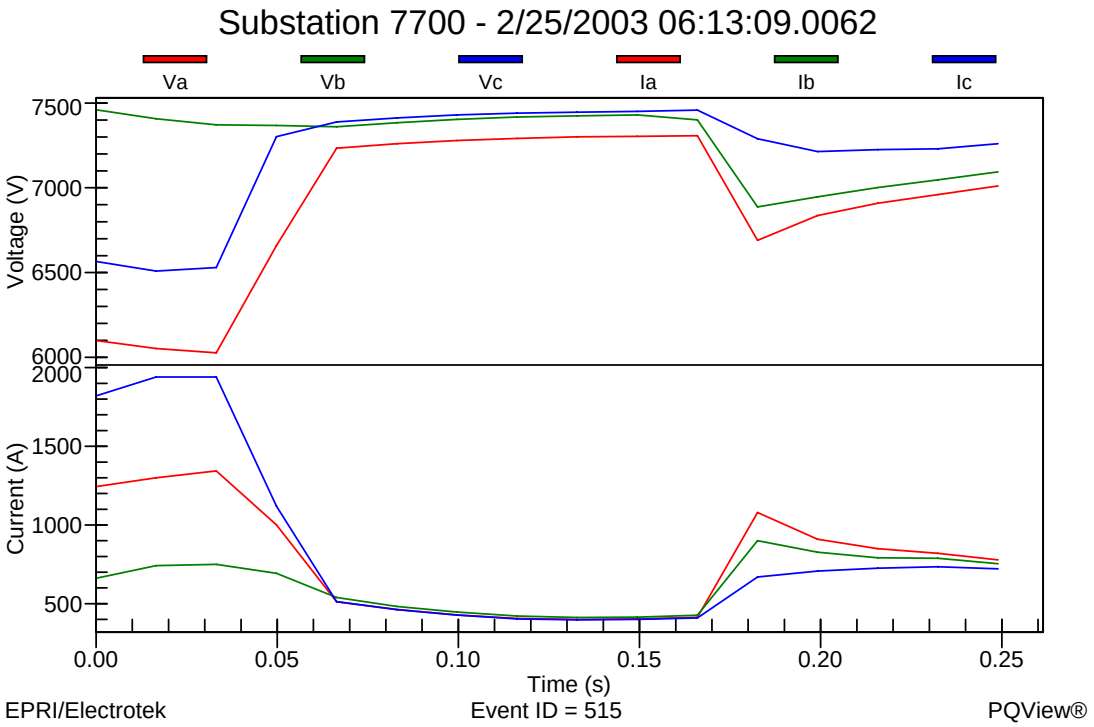

Figure 4-11
RMS Samples of Voltage and Current during a Voltage Sag

XML Source 4-14: RMS Samples of Voltage and Current during a Voltage Sag

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Samples of Voltage and Current during a Voltage Sag.xml</tagFileName>
    <tagCreation VT="DT">2007-03-12T21:58:06.734000</tagCreation>
    <tagVersionInfo VT="UINT4" ET="V" NP="4"><d>1 5 1 5</d></tagVersionInfo>
    <tagLanguage VT="CHAR1" ET="T">US English</tagLanguage>
    <tagTitle VT="CHAR1" ET="T">PQView</tagTitle>
    <tagSubject VT="CHAR1" ET="T">N/A</tagSubject>
    <tagAuthor VT="CHAR1" ET="T">dsabin</tagAuthor>
    <tagKeywords VT="CHAR1" ET="T">N/A</tagKeywords>
    <tagComments VT="CHAR1" ET="T">Exported from ODBC;DATABASE=PQVIEW_DEMO</tagComments>
    <tagLastSavedBy VT="CHAR1" ET="T">SABINPORT</tagLastSavedBy>
    <tagApplication VT="CHAR1" ET="T">PQView Power Quality Data Manager</tagApplication>
    <tagSecurity VT="CHAR1" ET="T">No Security</tagSecurity>
    <tagOwner VT="CHAR1" ET="T">N/A</tagOwner>
    <tagCopyright VT="CHAR1" ET="T">N/A</tagCopyright>
    <tagTrademarks VT="CHAR1" ET="T">PQView is a registered trademark of Electrotek
Concepts, Inc.  EPRI is a registered service mark of the Electric Power Research
Institute.</tagTrademarks>
    <tagNotes VT="CHAR1" ET="T">N/A</tagNotes>
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    <tagEquipmentID VT="GUID">ID_EQUIP_ETK_PQVIEW</tagEquipmentID>
    <tagEffective VT="DT">2003-02-25T06:13:09.000</tagEffective>
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    <tagLocationDS VT="CHAR1" ET="T">N/A</tagLocationDS>
    <tagTimeZoneDS VT="CHAR1" ET="T">UTC</tagTimeZoneDS>
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    </records>
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Waveform and RMS Samples of Voltage and Current during a Voltage Sag

In this example, we store the waveform and rms values stored in XML Source 4-13 and XML Source 4-14. Note that the waveform and rms samples are stored in separate channel instances of the same observation.

XML Source 4-15: Waveform and RMS Samples of Voltage and Current during a Voltage Sag

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5
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A
APPENDIX

Mapping between PQView Steady State Channels and IEEE PQDIF Value Log

The follow table presents the PQDIF GUID and ID values that should be specified in a PQDIF data source channel definition record in order to map value logs to PQView steady-state samples. Additionally, the PQDIF channel definition record should to specify a PQDIF phase ID (e.g., ID_PHASE_AN, ID_PHASE_AB, ID_PHASE_NET, etc.) and a PQDIF value type ID (i.e., ID_SERIES_VALUE_TYPE_MIN, ID_SERIES_VALUE_TYPE_MAX, ID_SERIES_VALUE_TYPE_AVG, or ID_SERIES_VALUE_TYPE_VAL).

Table A-1
Map between PQView Steady-State records and PQDIF Value Log GUID and ID Channel Definition Values

PQView Channel ID	PQView Channel Name	PQDIF Quantity Measured ID	PQDIF Quantity Characteristic ID	Recommend PQDIF Quantity Units
4144	V Peak	ID_QM_VOLTAGE	ID_QC_PEAK	ID_QU_VOLTS
4160	V RMS	ID_QM_VOLTAGE	ID_QC_RMS	ID_QU_VOLTS
4176	V HRMS	ID_QM_VOLTAGE	ID_QC_HRMS	ID_QU_VOLTS
4192	V THD	ID_QM_VOLTAGE	ID_QC_TOTAL_THD	ID_QU_NONE
4208	V ETHD	ID_QM_VOLTAGE	ID_QC_EVEN_THD	ID_QU_NONE
4224	V OTHD	ID_QM_VOLTAGE	ID_QC_ODD_THD	ID_QU_NONE
4256	V CF	ID_QM_VOLTAGE	ID_QC_CREST_FACTOR	ID_QU_NONE
4272	V FF	ID_QM_VOLTAGE	ID_QC_FORM_FACTOR	ID_QU_NONE
4288	V AS	ID_QM_VOLTAGE	ID_QC_ARITH_SUM	ID_QU_VOLTS
4304	V S0/S1	ID_QM_VOLTAGE	ID_QC_S0S1	ID_QU_NONE
4320	V S2/S1	ID_QM_VOLTAGE	ID_QC_S2S1	ID_QU_NONE
4336	V SPOS	ID_QM_VOLTAGE	ID_QC_SPOS	ID_QU_VOLTS
4352	V TIF	ID_QM_VOLTAGE	ID_QC_TIF	ID_QU_NONE
4368	V Flicker RMS	ID_QM_VOLTAGE	ID_QC_FLKR_MAG_AVG	ID_QU_VOLTS
4384	V Flicker dV/V	ID_QM_VOLTAGE	ID_QC_FLKR_MAX_DVV	ID_QU_NONE
4400	V Flicker Frequency	ID_QM_VOLTAGE	ID_QC_FLKR_FREQ_MAX	ID_QU_HERTZ
4416	V Flicker Magnitude	ID_QM_VOLTAGE	ID_QC_FLKR_MAG_MAX	ID_QU_VOLTS
4432	V Flicker SWA	ID_QM_VOLTAGE	ID_QC_FLKR_WGT_AVG	ID_QU_NONE
4448	V Flicker(f)	ID_QM_VOLTAGE	ID_QC_FLKR_SPECTRUM	ID_QU_NONE
4464	V SNEG	ID_QM_VOLTAGE	ID_QC_SNEG	ID_QU_VOLTS
4480	V SZERO	ID_QM_VOLTAGE	ID_QC_SZERO	ID_QU_VOLTS
4496	V Flicker Pst	ID_QM_VOLTAGE	ID_QC_FLKR_PST	ID_QU_NONE
4512	V Flicker Plt	ID_QM_VOLTAGE	ID_QC_FLKR_PLT	ID_QU_NONE
4528	V TIF RMS	ID_QM_VOLTAGE	ID_QC_TIF_RMS	ID_QU_NONE
4544	V Flicker Plt Slide	ID_QM_VOLTAGE	ID_QC_FLKR_PLTSLIDE	ID_QU_NONE
4768	V THD RMS	ID_QM_VOLTAGE	ID_QC_TOTAL_THD_RMS	ID_QU_NONE
4784	V THD RMS Odd	ID_QM_VOLTAGE	ID_QC_ODD_THD_RMS	ID_QU_NONE
4800	V THD RMS Even	ID_QM_VOLTAGE	ID_QC_EVEN_THD_RMS	ID_QU_NONE
4816	V TID	ID_QM_VOLTAGE	ID_QC_TID	ID_QU_NONE
4832	V TID RMS	ID_QM_VOLTAGE	ID_QC_TID_RMS	ID_QU_NONE
4848	V Interharmonic RMS	ID_QM_VOLTAGE	ID_QC_IHRMS	ID_QU_VOLTS
5120	V Imbalance	ID_QM_VOLTAGE	ID_QC_AVG_IMBAL	ID_QU_NONE

Table A-1 (continued)
Map between PQView Steady-State records and PQDIF Value Log GUID and ID Channel Definition Values

PQView Channel ID	PQView Channel Name	PQDIF Quantity Measured ID	PQDIF Quantity Characteristic ID	Recommend PQDIF Quantity Units
5536	V Phase Angle	ID_QM_VOLTAGE	ID_QC_ANGLE_FUND	ID_QU_DEGREES
8240	I Peak	ID_QM_CURRENT	ID_QC_PEAK	ID_QU_AMPS
8256	I RMS	ID_QM_CURRENT	ID_QC_RMS	ID_QU_AMPS
8272	I HRMS	ID_QM_CURRENT	ID_QC_HRMS	ID_QU_AMPS
8288	I THD	ID_QM_CURRENT	ID_QC_TOTAL_THD	ID_QU_NONE
8304	I ETHD	ID_QM_CURRENT	ID_QC_EVEN_THD	ID_QU_NONE
8320	I OTHD	ID_QM_VOLTAGE	ID_QC_ODD_THD	ID_QU_NONE
8352	I CF	ID_QM_CURRENT	ID_QC_CREST_FACTOR	ID_QU_NONE
8368	I FF	ID_QM_CURRENT	ID_QC_FORM_FACTOR	ID_QU_NONE
8384	I AS	ID_QM_CURRENT	ID_QC_ARITH_SUM	ID_QU_AMPS
8400	I S0/S1	ID_QM_CURRENT	ID_QC_S0S1	ID_QU_NONE
8416	I S2/S1	ID_QM_CURRENT	ID_QC_S2S1	ID_QU_NONE
8432	I SPOS	ID_QM_CURRENT	ID_QC_SPOS	ID_QU_AMPS
8448	I TIF	ID_QM_CURRENT	ID_QC_TIF	ID_QU_AMPS
8560	I SNEG	ID_QM_CURRENT	ID_QC_SNEG	ID_QU_AMPS
8576	I ZERO	ID_QM_CURRENT	ID_QC_SZERO	ID_QU_AMPS
8624	I TIF RMS	ID_QM_CURRENT	ID_QC_TIF_RMS	ID_QU_AMPS
8704	IT	ID_QM_CURRENT	ID_QC_IT	ID_QU_NONE
8720	I Demand	ID_QM_CURRENT	ID_QC_RMS_DEMAND	ID_QU_AMPS
8736	ANSI TDF	ID_QM_CURRENT	ID_QC_ANSI_TDF	ID_QU_NONE
8752	K Factor	ID_QM_CURRENT	ID_QC_K_FACTOR	ID_QU_NONE
8768	TDD	ID_QM_CURRENT	ID_QC_TDD	ID_QU_NONE
8784	I RMS Peak Demand	ID_QM_CURRENT	ID_QC_RMS_PEAK_DEMAND	ID_QU_AMPS
8864	I THD RMS	ID_QM_CURRENT	ID_QC_TOTAL_THD_RMS	ID_QU_NONE
8880	I THD RMS Odd	ID_QM_CURRENT	ID_QC_ODD_THD_RMS	ID_QU_NONE
8896	I THD RMS Even	ID_QM_CURRENT	ID_QC_EVEN_THD_RMS	ID_QU_NONE
8912	I TID	ID_QM_CURRENT	ID_QC_TID	ID_QU_NONE
8928	I TID RMS	ID_QM_CURRENT	ID_QC_TID	ID_QU_NONE
8944	I Interharmonic RMS	ID_QM_CURRENT	ID_QC_HRMS	ID_QU_AMPS
9216	I Imbalance	ID_QM_CURRENT	ID_QC_AVG_IMBAL	ID_QU_NONE
9632	I Phase Angle	ID_QM_CURRENT	ID_QC_ANGLE_FUND	ID_QU_DEGREES
13056	P	ID_QM_POWER	ID_QC_P	ID_QU_WATTS
13072	Q	ID_QM_POWER	ID_QC_Q	ID_QU_VARS
13088	S	ID_QM_POWER	ID_QC_S	ID_QU_VA
13104	PF	ID_QM_POWER	ID_QC_PF	ID_QU_NONE
13120	DF	ID_QM_POWER	ID_QC_DF	ID_QU_NONE
13136	P Demand	ID_QM_POWER	ID_QC_P_DEMAND	ID_QU_WATTS
13152	Q Demand	ID_QM_POWER	ID_QC_Q_DEMAND	ID_QU_VARS
13168	S Demand	ID_QM_POWER	ID_QC_S_DEMAND	ID_QU_VA
13184	DF Demand	ID_QM_POWER	ID_QC_DF_DEMAND	ID_QU_NONE
13200	PF Demand	ID_QM_POWER	ID_QC_PF_DEMAND	ID_QU_NONE
13216	P Pred Demand	ID_QM_POWER	ID_QC_P_PRED_DEMAND	ID_QU_WATTS
13232	Q Pred Demand	ID_QM_POWER	ID_QC_Q_PRED_DEMAND	ID_QU_VARS
13248	S Pred Demand	ID_QM_POWER	ID_QC_S_PRED_DEMAND	ID_QU_VA
13568	P Coincident with Q	ID_QM_POWER	ID_QC_P_CO_Q_DEMAND	ID_QU_WATTS
13584	P Coincident with S	ID_QM_POWER	ID_QC_P_CO_S_DEMAND	ID_QU_WATTS
13600	Q Coincident with P	ID_QM_POWER	ID_QC_Q_CO_P_DEMAND	ID_QU_VARS
13616	Q Coincident with S	ID_QM_POWER	ID_QC_Q_CO_S_DEMAND	ID_QU_VARS
13632	PF Coincident with P	ID_QM_POWER	ID_QC_PF_CO_P_DEMAND	ID_QU_NONE
13648	PF Coincident with Q	ID_QM_POWER	ID_QC_PF_CO_Q_DEMAND	ID_QU_NONE
13664	S Coincident with P	ID_QM_POWER	ID_QC_S_CO_P_DEMAND	ID_QU_VA
13680	S Coincident with Q	ID_QM_POWER	ID_QC_S_CO_Q_DEMAND	ID_QU_VA
13696	DF Coincident with S	ID_QM_POWER	ID_QC_DF_CO_S_DEMAND	ID_QU_NONE
13712	PF Coincident with S	ID_QM_POWER	ID_QC_PF_CO_S_DEMAND	ID_QU_NONE
13728	Power Angle Fund	ID_QM_POWER	ID_QC_ANGLE_FUND	ID_QU_DEGREES
13744	Q Fund	ID_QM_POWER	ID_QC_Q_FUND	ID_QU_VARS
13760	S Fund	ID_QM_POWER	ID_QC_S_FUND	ID_QU_VA
13776	PF Vector	ID_QM_POWER	ID_QC_PF_VECTOR	ID_QU_NONE
13792	DF Vector	ID_QM_POWER	ID_QC_DF_VECTOR	ID_QU_NONE

Table A-1 (continued)
Map between PQView Steady-State records and PQDIF Value Log GUID and ID Channel Definition Values

PQView Channel ID	PQView Channel Name	PQDIF Quantity Measured ID	PQDIF Quantity Characteristic ID	Recommend PQDIF Quantity Units
13808	S Vector	ID_QM_POWER	ID_QC_S_VECTOR	ID_QU_VA
13824	S VectorFund	ID_QM_POWER	ID_QC_S_VECTOR_FUND	ID_QU_VA
13840	PF Arith	ID_QM_POWER	ID_QC_PF_ARITH	ID_QU_NONE
13856	DF Arith	ID_QM_POWER	ID_QC_DF_ARITH	ID_QU_NONE
13872	S Arith	ID_QM_POWER	ID_QC_S_ARITH	ID_QU_VA
13888	S ArithFund	ID_QM_POWER	ID_QC_S_ARITH_FUND	ID_QU_VA
13904	P Harmonic	ID_QM_POWER	ID_QC_P_HARMONIC	ID_QU_WATTS
13920	P Harmonic Unsigned	ID_QM_POWER	ID_QC_P_HARMONIC_UNSIGNED	ID_QU_WATTS
14320	P Fund	ID_QM_POWER	ID_QC_P_FUND	ID_QU_WATTS
21520	P Integrated	ID_QM_ENERGY	ID_QC_P_INTG	ID_QU_WATTHOURS
21536	P Integrated Pos	ID_QM_ENERGY	ID_QC_P_INTG_POS	ID_QU_WATTHOURS
21552	P Integrated Neg	ID_QM_ENERGY	ID_QC_P_INTG_NEG	ID_QU_WATTHOURS
21568	Q Integrated	ID_QM_ENERGY	ID_QC_Q_INTG	ID_QU_VARHOURS
21584	Q Integrated Pos	ID_QM_ENERGY	ID_QC_Q_INTG_POS	ID_QU_VARHOURS
21600	Q Integrated Neg	ID_QM_ENERGY	ID_QC_Q_INTG_NEG	ID_QU_VARHOURS
21616	S Integrated	ID_QM_ENERGY	ID_QC_S_INTG	ID_QU_VAHOURS
21632	P Integrated Pos Fund	ID_QM_ENERGY	ID_QC_P_INTG_POS_FUND	ID_QU_WATTHOURS
21648	P Integrated Neg Fund	ID_QM_ENERGY	ID_QC_P_INTG_NEG_FUND	ID_QU_WATTHOURS
21664	Q Integrated Pos Fund	ID_QM_ENERGY	ID_QC_Q_INTG_POS_FUND	ID_QU_VARHOURS
21680	Q Integrated Neg Fund	ID_QM_ENERGY	ID_QC_Q_INTG_NEG_FUND	ID_QU_VARHOURS
21696	S Integrated Fund	ID_QM_ENERGY	ID_QC_S_INTG_FUND	ID_QU_VAHOURS
21712	P Interval Integrated	ID_QM_ENERGY	ID_QC_P_IVL_INTG	ID_QU_WATTHOURS
21728	P Interval Integrated Pos	ID_QM_ENERGY	ID_QC_P_IVL_INTG_POS	ID_QU_WATTHOURS
21744	P Interval Integrated Neg	ID_QM_ENERGY	ID_QC_P_IVL_INTG_NEG	ID_QU_WATTHOURS
22128	Q Interval Integrated	ID_QM_ENERGY	ID_QC_Q_IVL_INTG	ID_QU_VARHOURS
22144	Q Interval Integrated Pos	ID_QM_ENERGY	ID_QC_Q_IVL_INTG_POS	ID_QU_VARHOURS
22160	Q Interval Integrated Neg	ID_QM_ENERGY	ID_QC_Q_IVL_INTG_NEG	ID_QU_VARHOURS
22176	S Interval Integrated	ID_QM_ENERGY	ID_QC_S_IVL_INTG	ID_QU_VAHOURS
22192	P Interval Integrated Pos Fund	ID_QM_ENERGY	ID_QC_P_IVL_INTG_POS_FUND	ID_QU_WATTHOURS
22208	P Interval Integrated Neg Fund	ID_QM_ENERGY	ID_QC_P_IVL_INTG_NEG_FUND	ID_QU_WATTHOURS
22224	Q Interval Integrated Pos Fund	ID_QM_ENERGY	ID_QC_Q_IVL_INTG_POS_FUND	ID_QU_VARHOURS
22240	Q Interval Integrated Neg Fund	ID_QM_ENERGY	ID_QC_Q_IVL_INTG_NEG_FUND	ID_QU_VARHOURS
22256	S Interval Integrated Fund	ID_QM_ENERGY	ID_QC_S_IVL_INTG_FUND	ID_QU_VAHOURS

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