

# **PQDS Software Manual**

*Power Quality Disturbance Sharing*

**Software ID Number 3002017331**



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*Power Quality Disturbance Sharing*

Software Manual, December 2019



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## **ACKNOWLEDGMENTS**

The Grid Protection Alliance (GPA) under contract to the Electric Power Research Institute developed the PQDS software application and prepared this user's manual.

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## SOFTWARE DESCRIPTION

The PQDS software tool is a tool designed to read, write and manage Power Quality Data Sharing (PQDS) files.

### Description

The PQDS software tool can be used to load waveform data and metadata from PQDS files and PQDIF files. It is capable of producing PQDS files with redacted or full meta data sets.

### Benefits and Value

- Convert PQDIF files to PQDS
- Redact meta data from PQDS
- Manage meta data included in PQDS

### Hosting Platform Requirements

PQDS is a MS Windows Forms application designed for installation and use on a Windows workstation or laptop. The recommended hosting platform is:

- Windows 7 or greater
- Processor 2.0Ghz or faster
- Memory 500 MB RAM or greater

### Keywords

Disturbance, Event, Fault, Sag, Swell, Interruption, Power-quality

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# 1 INTRODUCTION

The Power Quality Data Sharing (PQDS) format is a comma-separated value file that enables the easy review, editing and sharing of electric power disturbance waveforms. It is designed to be a simple and extensible human-to-human data format that complements the standard system-to-system waveform data formats of PQDIF.

The PQDS software tool is developed to support the use of the PQDS format. It is designed to facilitate the conversion of PQDIF files into PQDS files and manage the information included in the PQDS format.

The software can be deployed on a desktop computer and should be used to generate PQDS files for sharing waveform data across utilities. By using the redaction tools of the software, it is possible to control what CEII data is included and shared.

This documentation is aimed at the user of the PQDS software tool and describes the various tasks that can be achieved using this tool. The tool is available for download at <https://gridprotectionalliance.org/nightlybuilds/PQDS/Beta/PQdsTool.Installs.zip> Additional documentation is available at <https://gridprotectionalliance.org/nightlybuilds/PQDS/Documentation/manual.pdf>. The remainder of this manual is organized as follows. Section 2 shows an overview of the tool and its interaction with the PQDS file format. Section 3 describes the installation and setup procedure. Finally, Section 4 contains the user manual describing the use of the software tool to convert and manage a PQDS file.

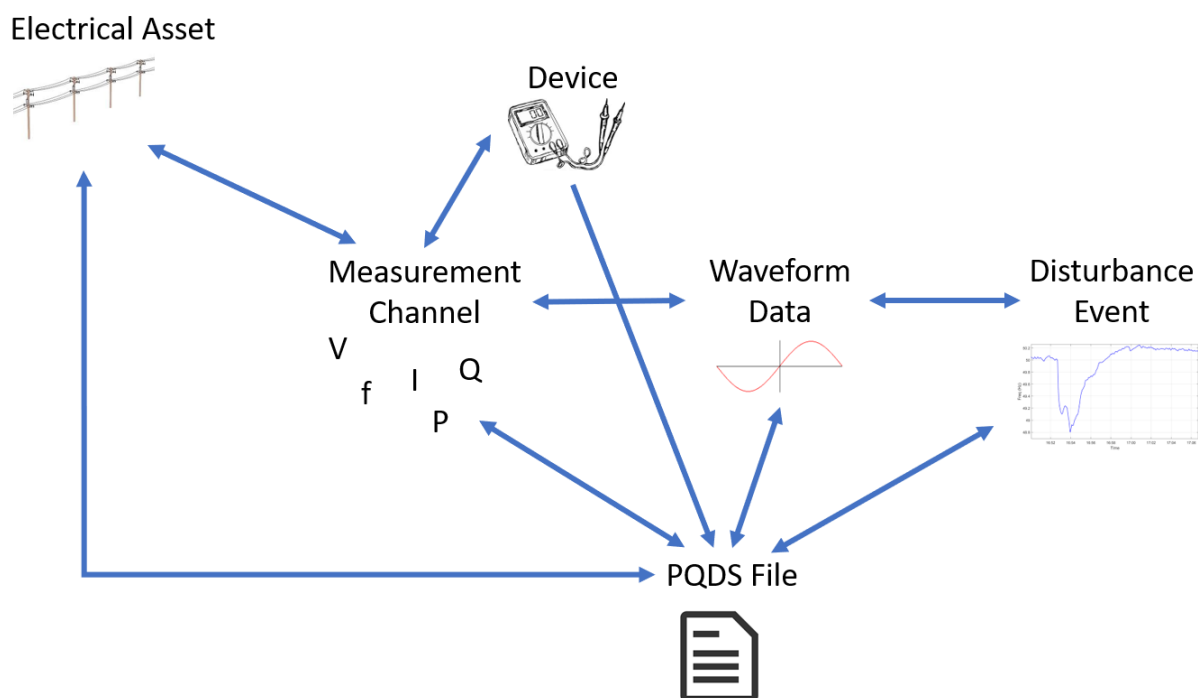


## 2 SYSTEM OVERVIEW

This section describes the PQDS software tool and the PQDS data model which is used to read and write PQDS files into the tool.

### Data Model

Fig. 1 shows an overview of the PQDS tool data model. The lines connecting the various components represent the relationships between them.



**Figure 1 PQDS Data Model**

The following components are present in this model:

- *Electrical Asset*: This represents any electrical asset that is monitored using waveform data.
- *Device*: This represents a device, such as a power quality meter, taking measurements.
- *Measurement Channel*: This represents a collection of data collected by a device for a single physical quantity, such as frequency. Each *Measurement Channel* is associated with a *Device* which is used to record the physical quantity and an *Electrical Asset*.
- *Disturbance Event*: This represents a short window of time during which a disturbance occurred in the power system.
- *Waveform Data*: This represents the data associated with a single *Measurement Channel* taken during a specific *Disturbance Event*. A *Disturbance Event* can have multiple

*Waveform Data* instances associated with it, with one instance for each *Measurement Channel*.

- *PQDS File*: This represents a PQDS file as specified in the PQDS standard. Note that a *PQDS File* can contain multiple sets of *Waveform Data* as long as they are from the same *Disturbance Event*, *Electrical Asset* and *Device*.

Further details of the PQDS file format can be found in Appendix A of this manual.

## PQDS Software Tool Overview

After starting the software tool, the home screen seen in Fig. 2 will open. This screen contains 6 important areas, the function of each area is described in more details throughout Section 4.

1. File Management Area
2. Global Metadata Area
3. Asset and Channel Area
4. Disturbance Event Area
5. Local Metadata Area
6. Waveform Data Area

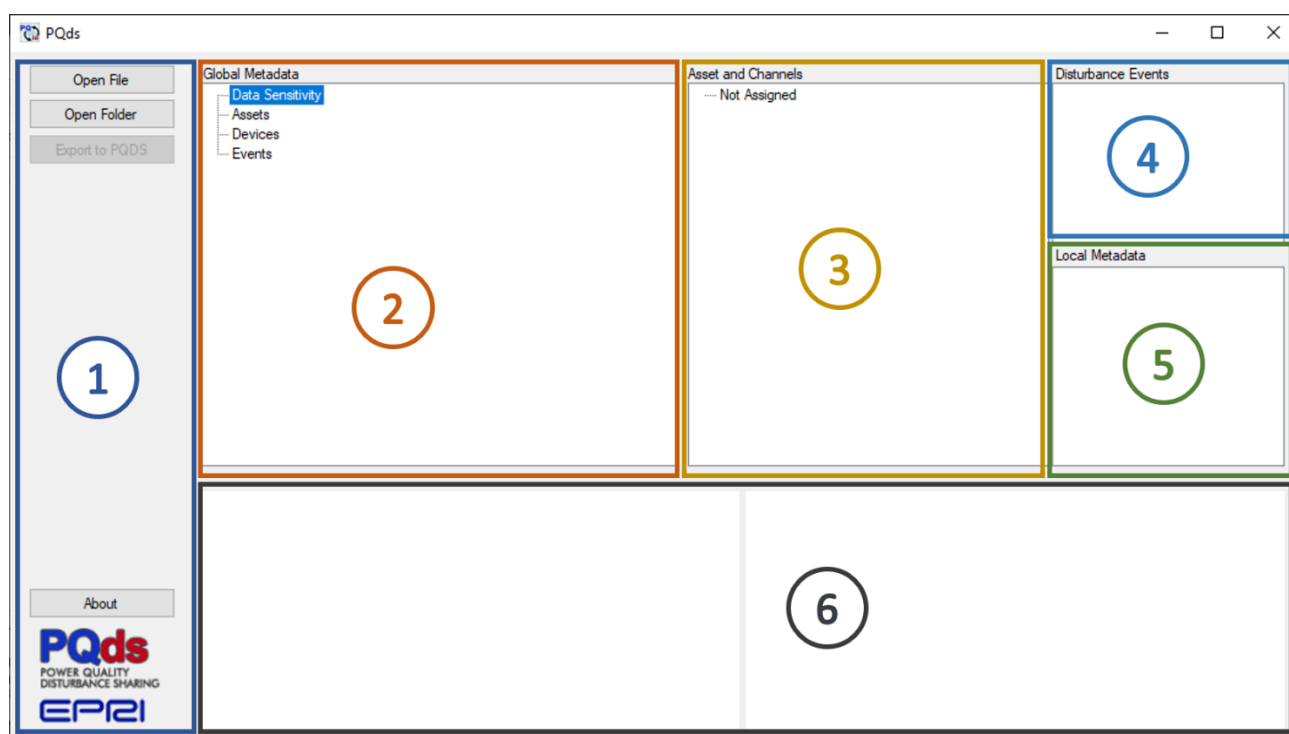


Figure 2 PQDS Software Tool Home Screen

Initially none of these areas contain any data since no files are loaded by default. After loading a disturbance file, as described in Section 4, these areas will populate with the corresponding data.

# 3 GETTING STARTED

The installer for the PQDS software tool can be downloaded from <https://gridprotectionalliance.org/nightlybuilds/PQDS/Beta/PQds.Installs.zip>

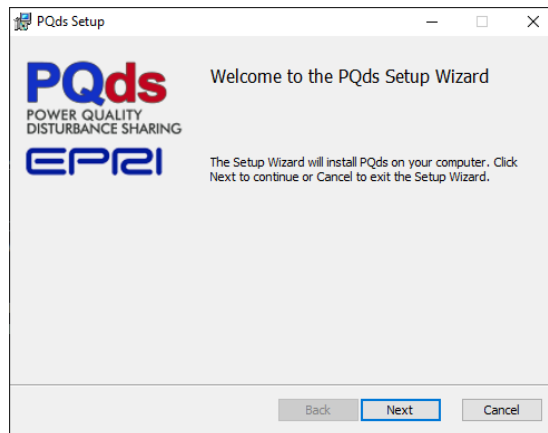
## Hosting Requirements

PQDS is a MS Windows Forms application designed for installation and use on a Windows workstation or laptop. The recommended hosting platform is:

- Windows 7 or greater
- Processor 2.0Ghz or faster
- Memory 500 MB RAM or greater

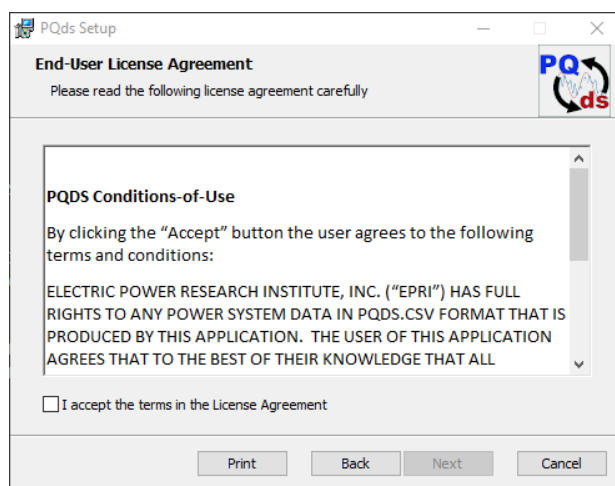
## Installation Guide

The PQDS software tool is installed by running the PQDS installation wizard. The wizard opens with the welcome window in Fig 3.



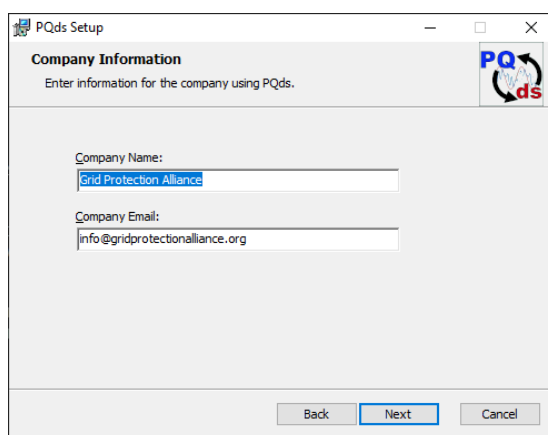
**Figure 3 PQDS Installation Wizard Welcome Window**

After clicking *next* the End-User-License agreement in Fig 4 has to be accepted before the tool can be installed.



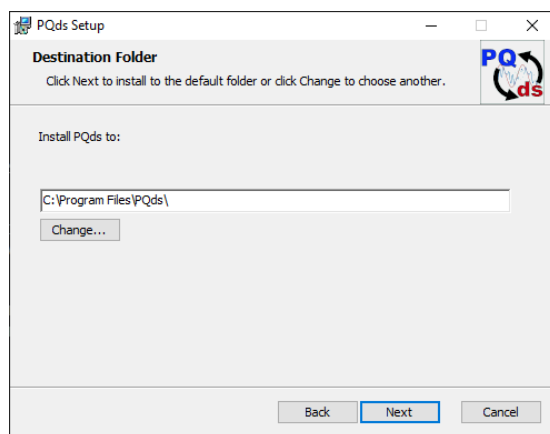
**Figure 4 PQDS Installation Wizard License Agreement**

The company information window in Fig 5 is used to enter the utility name and a contact email for the user. This information is used in all PQDS files generated by the tool as described in Appendix A of this manual.

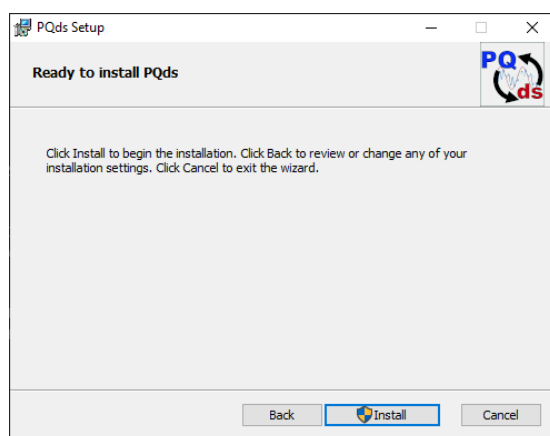


**Figure 5 PQDS Installation Wizard Company Information**

Finally, the installation folder has to be selected before starting the installation as seen in Figs 6-7.

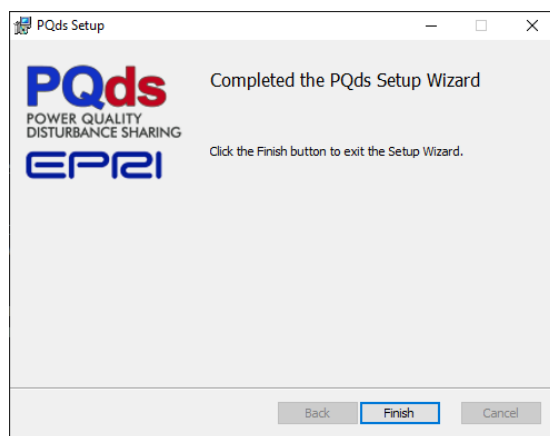


**Figure 6 Installation Folder Selection**



**Figure 7 Installation Wizard Confirmation**

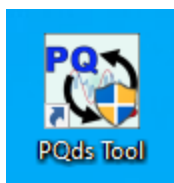
After the installation is complete a success message like the one in Fig 8 is displayed.



**Figure 8 Installation Wizard Success Message**

## Running the PQDS Tool

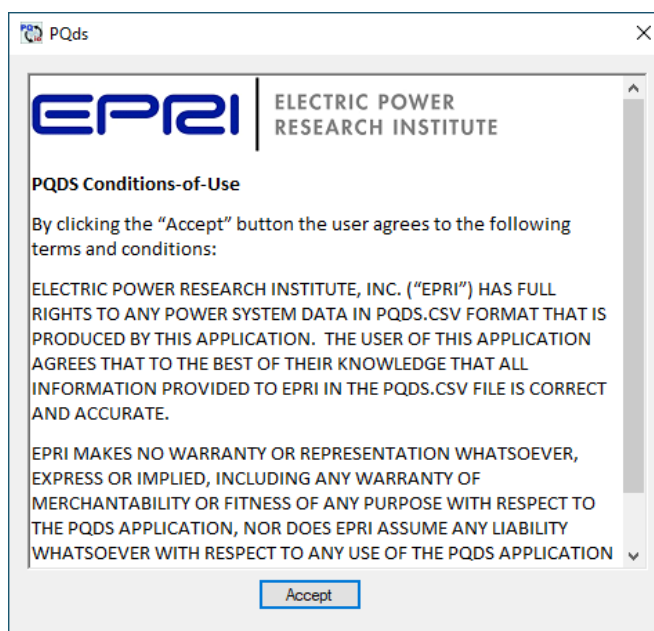
The PQDS tool installer will create an icon on the Desktop similarly to the one in Fig 9. In addition, the tool can be started from the windows start menu by searching for PQds.



**Figure 9 PQDS Desktop Shortcut**

After starting the PQDS software tool, a licensing window will show up. In order to use the software tool it is necessary to confirm that the Conditions-of-Use have been read and are accepted.

To agree click the “*Accept*” button on the bottom center of the window.



**Figure 10 Conditions-of-Use Acceptance Screen**

Accepting the Conditions-of-Use will start the PQDS software tool. Section 4 contains the user manual for further instructions on how to use the tool.

## 4 USER'S GUIDE

This section contains the user manual of the PQDS software tool.

### Loading and Exporting Disturbance Files

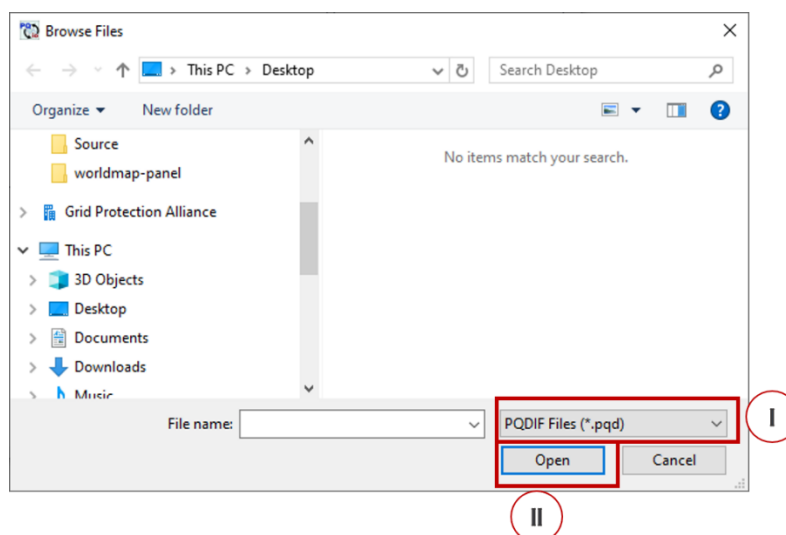
The tool is capable of loading a single PQDS/PQDIF file, as well as loading a whole folder to facilitate batch processing of these files. Both of these actions as well as exporting a PQDS file is started using the buttons in the [File Management Area \(1\)](#) of Fig 2.



Figure 11 File Management Area

### **Loading a single disturbance file**

To load a single disturbance file the “*Open File*” button (a) located on the left upper corner of the home screen is used. This will open a file dialog that allows the user to select the disturbance file.

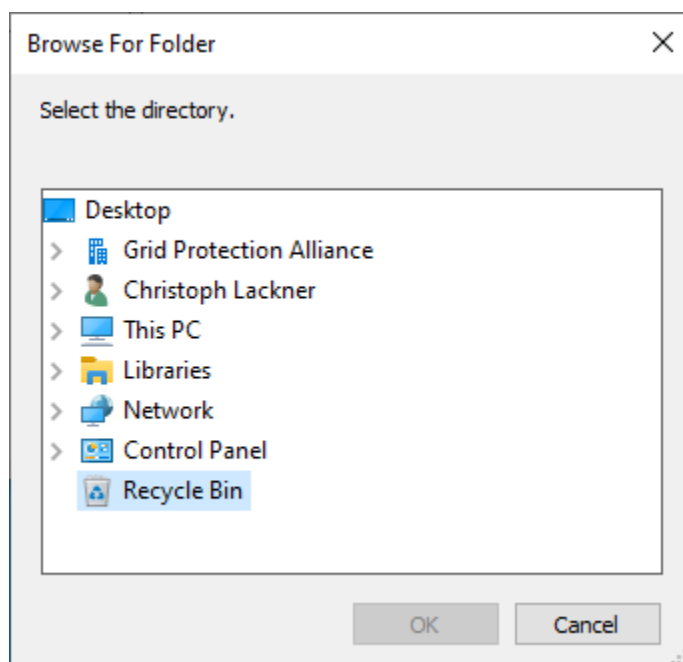


**Figure 12 Load Disturbance File Dialogue**

To change the file extension from PQDIF (.pqd) to PQDS (.csv) or vice versa simply select the desired file extension on the lower right corner of the file dialog (II). To finish loading the file click the “*Open*” button (I).

### **Loading multiple disturbance files**

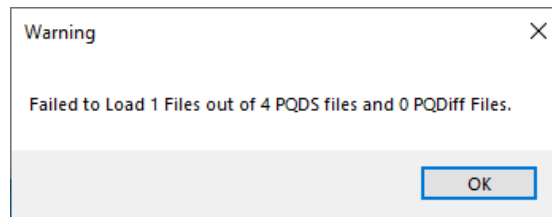
To batch process multiple files the tool is capable of loading all PQDS and PQDIF files in a selected folder and the subfolder contained within. In order to load all files in a folder the “*Open Folder*” button (b) is clicked. This opens a folder selection dialogue that is used to select the desired folder.



**Figure 13 Disturbance File Folder Selection Dialogue**



Note that the tool will attempt to load all PQDS and PQDIF files in the selected folder. Once the tool has completed loading the available files it will display a status message like the one seen in Fig. 14.

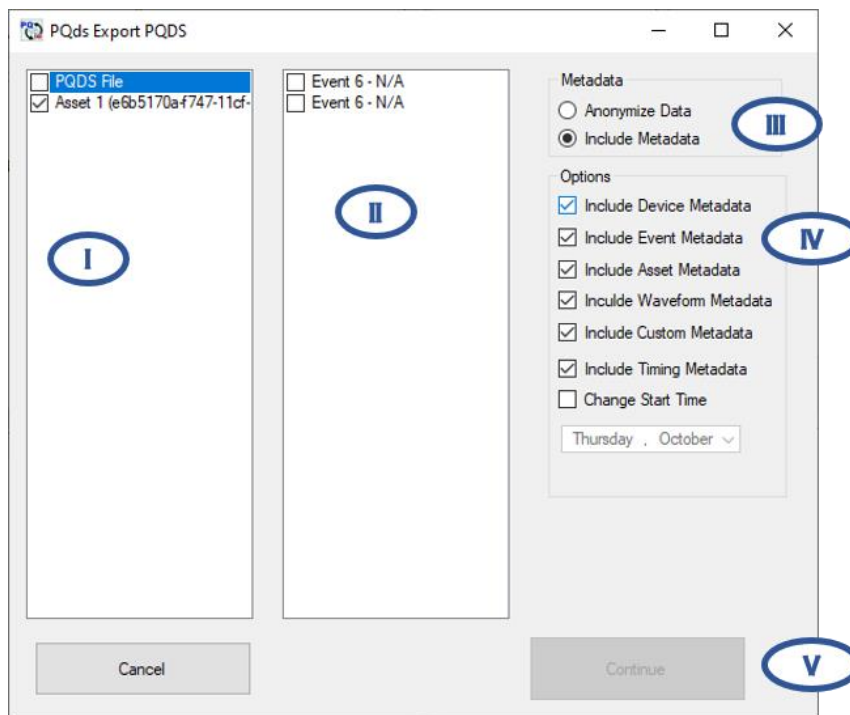


**Figure 14 File Loading Status Message**

This message informs the user how many PQDS and PQDIF files have been loaded and displays any errors that were encountered trying to load the files.

### ***Exporting data as PQDS files***

Once a disturbance file is loaded into the PQDS software tool the data can be exported as PQDS file. To do so the “Export to PQDS” button (c) is clicked. This opens the PQDS export window seen in Fig 15.



**Figure 15 PQDS Export Window**

The asset list (I) and event list (II) in this window are used to select the waveform data that should be exported.

First an asset has to be selected from the asset list (I). If multiple assets are selected the tool will write multiple PQDS files. To select an asset simply click the checkbox next to the asset name.

Similarly, one or multiple events have to be selected from the event list (II). Note that the tool will create a PQDS file for each valid asset and event combination if data is available.

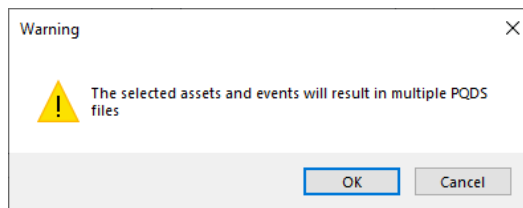
After selecting the waveform data that should be exported the included meta data has to be selected. If “*Anonymize Data*” (III) is selected no meta data will be included and the options (IV) are disabled.

If “*Include Metadata*” (III) is selected the options (IV) are used to determine what meta data should be included. The following options are available:

- *Device Metadata*: All metadata related to the device used to capture the waveform data.
- *Event Metadata*: All metadata related to the disturbance event.
- *Asset Metadata*: All metadata related to the electrical asset.
- *Waveform Metadata*: Metadata related to the waveform data, such as data sensitivity.
- *Custom Metadata*: Any custom metadata fields added.
- *Timing Metadata*: Metadata related to the timing of the disturbance
- *Change Start Time*: This option overrides the *Timing Metadata* option and allows the user to specify a custom start time that is added to the PQDS file instead of the original time of the disturbance.

After selecting the waveform data and the meta data to be exported the files can be generated by clicking the “*Continue*” button (V). If the software tool will generate a single PQDS file, a file selection dialogue will open that allows the user to select a location and a file name for the PQDS file.

If the asset and event selection results in multiple PQDS files a warning dialogue will open to inform the user that there are multiple files.



**Figure 16 Warning for Generating Multiple PQDS Files**

After confirming the warning, a folder selection dialogue will open, which allows the user to select the folder in which the PQDS files should be saved. Note that the PQDS files will be named *PQDS1.csv*, *PQDS2.csv* etc.

### ***Additional information about the PQDS tool***

To obtain additional information about the PQDS software tool the “*About*” button (d) opens the about window in Fig 17.

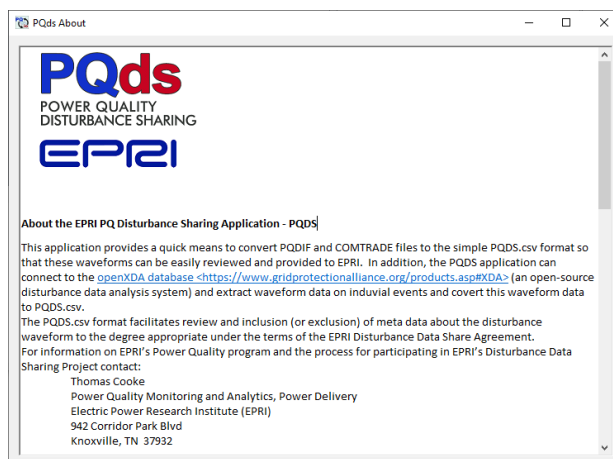


Figure 17 PQDS About Window

## Global Metadata Overview

The **global metadata area (2)** in Fig. 2 shows some of the metadata fields available in the data currently loaded in the software tool. The data is divided in 4 sections as seen in Fig 18.

- *Data Sensitivity*: This section contains metadata that is related to the data sensitivity of all PQDS files generated from this data set. This includes the “*Data Sensitivity*” and “*Data Type*” fields if available, and consistent for all datasets currently loaded.
- *Assets*: This contains the metadata for all assets in the currently loaded datasets.
- *Devices*: This contains the metadata for all measurement devices in the currently loaded datasets.
- *Events*: This contains the metadata for all disturbance events in the currently loaded datasets.

Each section can be expanded by clicking on the “+” symbol next to it. The “*Assets*”, “*Devices*” and “*Events*” sections are further divided by the individual assets, device and events that are available in the currently loaded datasets.

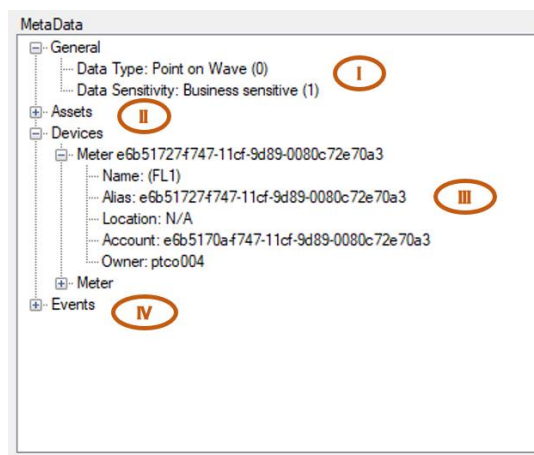


Figure 18 General Metadata Overview

### Editing data sensitivity metadata

The global data sensitivity metadata can be edited, including adding any metadata fields as defined in Appendix A of this manual. First the global metadata context menu has to be opened by right-clicking anywhere in the **global metadata area (2)**. This will open the global metadata context menu seen in Fig 19.

Clicking “Data Sensitivity” will open the data sensitivity metadata window in Fig 18, where the data sensitivity fields can be edited.

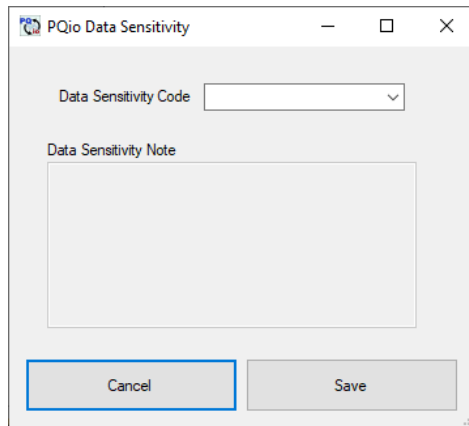


Figure 19 Data Sensitivity Metadata Window

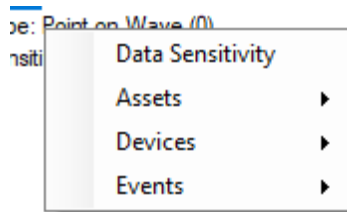


Figure 20 Global Metadata Context Menu

Note that the “Data Sensitivity Code” and “Data Sensitivity Note” setting here will apply to all datasets currently loaded. To change the individual data sensitivity settings of a data-set refer to the “Edit channel and event metadata” Section of this manual.

### Editing metadata of an existing asset

Similar to the general meta data, the metadata related to an asset can be edited by opening the context menu.

Note that clicking anywhere in the **global metadata area (2)** will open the context menu in Fig. 20. From there the “Assets” sub-menu will show an entry to edit each existing asset.

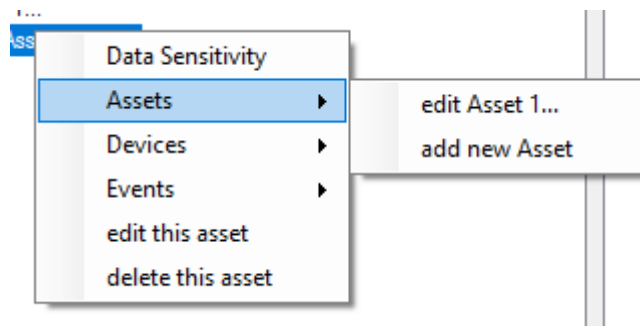
However, when the context menu is opened by right clicking on an asset or any of its sub items the menu will include an additional entry (“edit this asset”) to edit that specific asset directly.

After clicking the edit asset entry for the asset to be changed the asset metadata window in Fig 21 will open and the metadata fields associated with that asset can be edited.

**Figure 21 Asset Metadata Window**

### ***Adding metadata for a new asset***

A new asset can be added by opening the context menu through right-clicking in the **global metadata area (2)** and selecting “*add new Asset*” under the “*Assets*” sub-menu in Fig. 22. This will open the asset metadata window in Fig. 21 and allow the user to enter any metadata associated with the new asset.



**Figure 22 Asset Sub Menu**

### ***Deleting an asset***

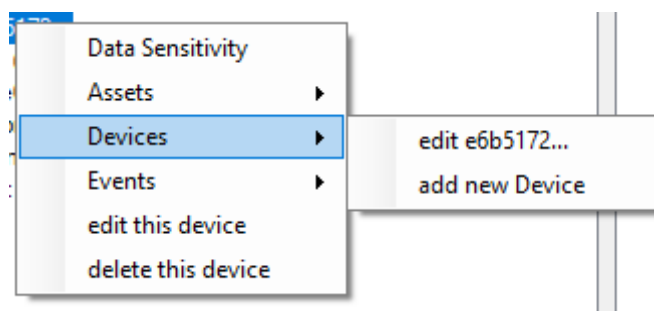
An asset can be deleted by right-clicking on the asset and selecting “*delete this asset*” in the context menu. Note that this option is only available if the user right clicked on an existing asset.

Also note that deleting any asset will change the associated measurement channels to be not assigned which means they cannot be saved to a PQDS file until they have been re-assigned to a different asset as described in the “*Assign channel to an asset*” Section of this manual.

### ***Editing metadata of an existing device***

The device metadata can be edited by opening the context menu and using the “*devices*” sub menu in Fig. 23 and selecting the device to be edited.

Note that similar to editing the asset metadata the context menu will show an option to edit a specific device if it is opened by right-clicking on the device.



**Figure 23 Device Sub Menu**

Selecting the device will open the device metadata window seen in Fig. 24 where the metadata tags defined in Appendix A can be edited.

**Figure 24 Device Metadata Window**

### ***Adding metadata for a new device***

A new device can be added by opening the context menu through right-clicking in the **global metadata area (2)** and selecting “*add new Device*” under the “*Devices*” sub-menu in Fig. 23. This will open the device metadata window in Fig. 24 and allow the user to enter any metadata associated with the new device.

### ***Deleting a device***

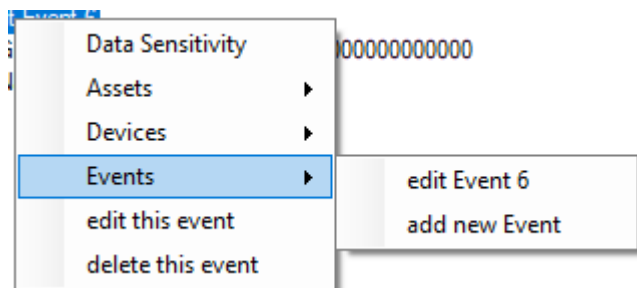
A device can be deleted by right-clicking on the device and selecting “*delete this device*” in the context menu. Note that this option is only available if the user right clicked on an existing device.

Also note that deleting any device will delete any channels associated with that device. For changing the device associated with a channel see the “*editing channel and event metadata*” Section of this manual.

### Editing metadata of an existing event

The event metadata can be edited by opening the context menu and using the “events” sub menu in Fig. 25 and selecting the event to be edited.

Note that similar to editing the asset metadata the context menu will show an option to edit a specific event if it is opened by right-clicking on the event.



**Figure 25 Events Sub Menu**

Selecting the event will open the event metadata window seen in Fig. 26 where the metadata tags defined in Appendix A can be edited.

**Figure 26 Event Metadata Window**

Note that the GUID field cannot be edited since this is a computer-generated unique id.

### Asset and Channel Overview

The **Asset and Channel Area (3)** contains a list of all assets currently loaded and the channels associated with them.

By expanding the assets, the channels associated with this asset are visible. Any channels that are currently not associated with an asset are listed under “*Not Assigned*”. Note that channels that are not assigned to an asset cannot be saved in a PQDS file.

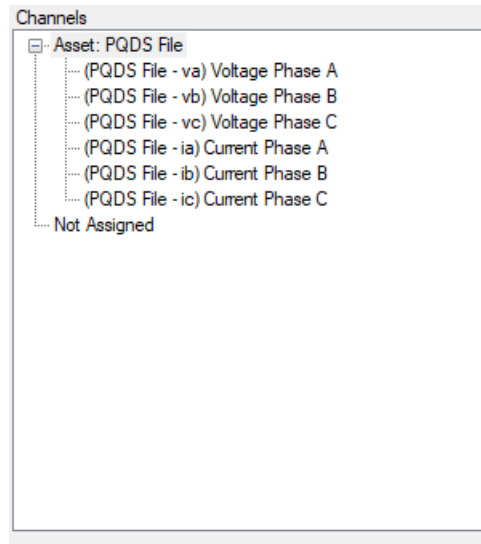


Figure 27 Asset and Channel Overview

### ***Assign channel to an asset***

A channel is selected by clicking on it. Once a channel is selected it is possible to change which asset it is associated with by keeping the left mouse button down and dragging the channel to the asset that should be associated with it and releasing the mouse button.

Note that dragging a channel in this manner and associating it with “*Not Assigned*” will remove the channel from the asset it previously was associated with.

### ***Selecting a channel and event***

After selecting a channel in the **Asset and Channel Area (3)**, the **Disturbance Event Area (4)** in Fig. 28 shows all events associated with the selected channel.

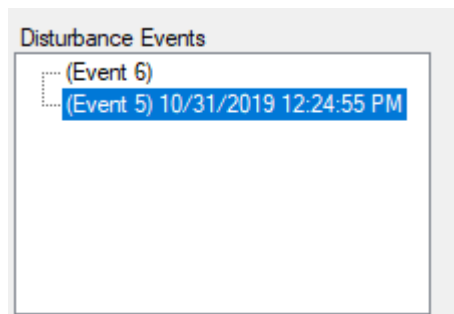
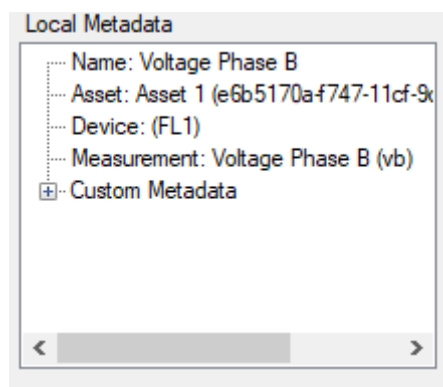


Figure 28 Disturbance Event Area

An event can be selected by clicking on it to show the metadata associated with that event in the **Local Metadata Area (5)** in Fig. 29.

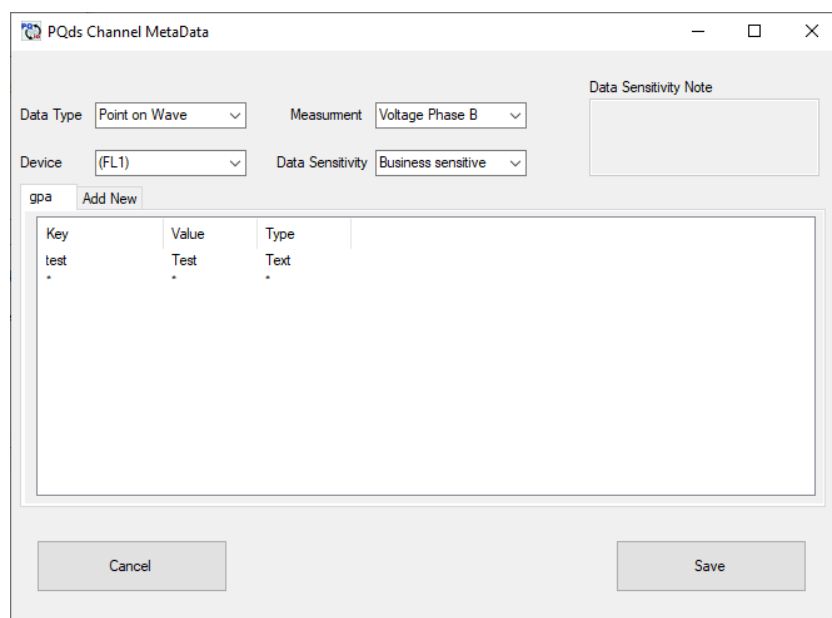




**Figure 29 Local Metadata Area**

### ***Edit channel and event metadata***

The channel and event specific metadata can be edited by double clicking on any of the entries in the **Local Metadata Area (5)**. This will open the channel and custom metadata window in Fig 30.



**Figure 30 Channel and Custom Metadata Window**

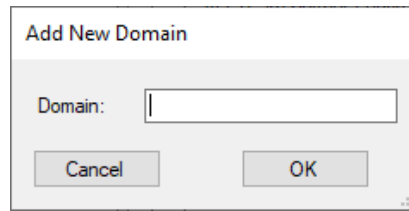
In addition to the channel metadata this window can also be used to change the device associated with the channel. It can also be used to add or edit any custom metadata as described in the “*Edit custom meta data*” Section of this document.

### ***Edit custom metadata***

Any custom metadata can be edited in the channel and custom metadata window in Fig 30. Any custom meta data is associated with a domain as described in the PQDS standard. Each existing domain has a separate tab in the Channel Metadata window.

### Adding a new custom metadata domain

To add a new domain the “Add New” tab is clicked. This will open the domain creation window in Fig 31.



**Figure 31 New Domain Window**

After entering a name for the new domain and clicking ok the domain is added to the existing domains.

### Editing custom metadata in an existing domain

The value or key of an existing metadata field can be edited by clicking on the key or value that should be edited in the channel and custom metadata window.

### Adding new custom metadata to an existing domain

Clicking on the last row with “\*” will add a new key value pair to the selected domain.

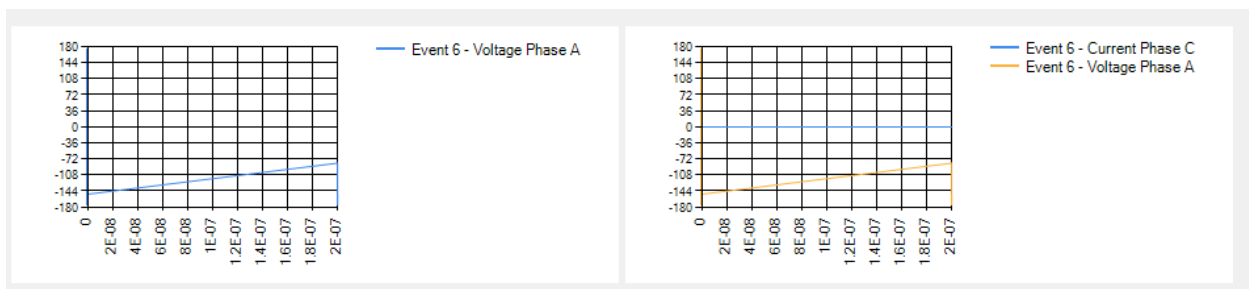
The type of any key value pair can be specified as any valid PQDS metadata type as described in the PQDS file standard in Appendix A.

## Waveform data overview

As shown in the data model in Fig. 1, the waveform data is associated with a channel and a disturbance event. In order to look at waveform data in the PQDS software tool a channel and event have to be selected in the **Asset and Channel Area (3)** and the **Disturbance Event Area (4)**.

### View waveform data

The waveform data associated with a channel and event can be plotted using the PQDS software tool. To show a specific waveform data set the channel has to be selected in the **Asset and Channel Area (3)**. Any event listed in the **Disturbance Event Area (4)** can then be dragged on one of the two graphs in the Waveform Data Area (6) by holding the left mouse button down while dragging it.



**Figure 32 Waveform Graph Area**

Dragging an additional event onto a graph will add the data to the graph without removing any data already shown on the graph.

### ***Clear waveform graphs***

In order to remove all data from a waveform graph the context menu can be used. A right-click in the graph that should be cleared will open the context menu. Selecting the “*Clear*” option will remove all data from that graph.

### ***Accessing PQDS log files***

The PQDS log file is saved in the installation folder of the PQDS software tool. The log file is saved as “PQDSLogFile.csv” and can be distributed together with other PQDS files if necessary. Further information about the logfile can be found in Appendix B of this Manual.

# 5 REFERENCES

## References

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3. Wikipedia, CSV, 2019 URL: [https://en.wikipedia.org/wiki/Comma-separated\\_values](https://en.wikipedia.org/wiki/Comma-separated_values). [webpage]
4. Kasper/GitHub, *Super CSV Package for JAVA*, 2015. [Code]
5. *RFC 4180, Format for Comma-Separated Values*, 2008. [standard]

## 6 GLOSSARY

**CEII.** Critical Energy Infrastructure Information as defined by NERC [1].

**PQDS.** Power Quality Data Sharing; used to describe a collection of the PQDS file format and the PQDS software tool developed by GPA for EPRI.

**PQDIF.** Power Quality Data Interchange Format; a file format specified by IEEE to exchange Power Quality data [2].

# A PQDS.CSV SPECIFICATION

## 1. Introduction

The Power Quality Data Sharing (PQDS) format is a comma-separated value file that enables the easy review, editing and sharing of electric power disturbance waveforms. It is designed to be a simple and extensible human-to-human data format that complements the standard system-to-system waveform data formats of PQDIF and COMTRADE.

The Comma-Separated Value (CSV) file format is supported by almost all spreadsheets and database management systems as well as by libraries that are available in most programming languages. In addition, many utility programs can split files based on the comma delimiter and process CSV files [3].

The PQDS format CSV file includes two information sections

- (1) a meta-data section with key-value information about the waveform, and
- (2) a data section with the time-series voltage and current waveform measurements.

Each of these two sections individually complies with the [4] CSV format specification with header data to identify the names of the fields that follow. Parsers for PQDS files will expect these files to comply with the seven RFC 4180 rules for CSV formatted files [5].

The PQDS format and tools to convert PQDIF and COMTRADE waveform data to PQDS has been developed by EPRI to support utility disturbance monitoring research. The EPRI PQDS program is building a library of waveforms that can be used to evaluate and test automated waveform analytics - including analytics involving artificial intelligence (AI) techniques.

### 1.1 Simplicity

All meta-data and waveform values in PQDS files are in standard engineering units without the need for subsequent scaling or adjustment. Scientific notation for values is not allowed. The time associated with a measurement is in decimal seconds.

While more complex event cases can be included in the waveform data itself, no provisions are made for describing multiple events in the waveform meta-data. If included, PQDS metadata can be used to provide details about a single event in the waveform.

### 1.2 Extensibility

Users and groups of users can easily extend both the PQDS meta-data as well as PQDS time-series waveform data measurement values with low risk of breaking any automation that may have been implemented by other users who have implemented different extensions.

### 1.3 Shareability

The PQDS format is designed to facilitate event waveform data sharing in all its forms - as waveform data may need to be shared in full detail among work colleagues, or as anonymous data may need to be contributed to repositories for power system phenomenon research and analytics improvement. The PQDS supports including (or not including) just the waveform data

that is needed for an individual use case. If necessarily, the waveform data itself can also be easily trimmed down to just to portion of the event that is of interest.

PQDS is designed to make it easier for the data-owner to improve productivity through collaboration with others -- the business-basis for development of the PQDS format.

1. As a human-readable format with easy-to-use spreadsheet tools for review, there is no ambiguity on the data that is being shared.
2. The ability to selectively reduce, anatomize or correct the meta-data associated with the waveform allows waveform data sharing to align with business confidentiality, security and regulatory requirements on a case-by-case basis.
3. The data is provided to the recipient in the flexible, ubiquitous CSV format so that it can be quickly and easily used without the need for specialized tools.
4. The PQDS format is sufficiently well-structured that it can be used as a format for the automated exchange of waveform data such as can be done through spreadsheet macros at the user-level or through automated programming interfaces. For example, the csv-based format of PQDS enables power quality data to be ported to machine learning tools and other statistical analytic tools that are now commonly available and expect data in this form.

## 2. Waveform Metadata

The waveform metadata section begins with a header record than contains the following field names:

Column	Field Name	Requirements
<b>A</b>	key	Not case sensitive <sup>1</sup>
<b>B</b>	value	The information associated with the key <sup>2</sup>
<b>C</b>	value-units	The SI units for numeric values (if any) <sup>1</sup>
<b>D</b>	expected data type	The expected meta-data value type that can be used for validation <sup>3</sup>
<b>E</b>	note	Any other descriptive information about the value <sup>2</sup>

<sup>1</sup> The “key” and “value-units” fields must not exceed 32 characters, must begin with a letter can only contain letters, numerals, the hyphen, underscore and dot characters. “Key” and “value-units” fields may be encapsulated in double quotes. The key "waveform-data" is reserved and cannot be used.

<sup>2</sup> “Value” must not exceed 254 characters and “note” must not exceed 4096 characters and both are limited to standard ASCII characters (32 thru 126). Value and note fields must be encapsulated in double-quotes to avoid truncation at the first comma. Value fields that are intended to be parsed as numbers should not contain commas - even if these are wrapped in quotes.

<sup>3</sup>Expected data types are:

- Enumeration (E): zero or positive integer less than 32,768;
- Numeric (N): digits, decimal point and leading sign with a total length less than 16 numerals;

- Alpha-numeric (A): letters, numbers, dot, hyphen and underscore with a total length less than 255 characters;
- text (T): any ASCII character (32 thru 126). Total length limited to 4096 characters;
- binary (B): the numeral 0 or 1

The data-type field is optional with the data-type of "Text" assumed.

## 2.1 Reserved PQDS Metadata keys

The following key names are reserved to facilitate use of PQDS to support automated data sharing. Users are welcome to add keys as they may be needed.

Metadata about the device taking measurements

Metadata Key	Description	PQDS Datatype
<b>DeviceName</b>	Meter or measurement device name	T
<b>DeviceAlias</b>	Alternate meter or measurement device name	T
<b>DeviceLocation</b>	Meter or device location name	T
<b>DeviceLocationAlias</b>	Alternate meter or device location name	T
<b>DeviceLatitude</b>	Latitude	T
<b>DeviceLongitude</b>	Longitude	T
<b>AccountName</b>	Name of customer or account	T
<b>AccountNameAlias</b>	Alternate customer or account name	T
<b>DeviceDistanceToXFMR</b>	The distance (feet) to the upstream transformer	N
<b>DeviceConnectionTypeCode</b>	The PQDS code for meter connection type	E (0-5)
<b>DeviceNotes</b>	Description of the device	T
<b>DeviceOwner</b>	The utility name	T



Metadata about the electrical asset being monitored

Metadata Key	Description	PQDS Datatype
<b>AssetName</b>	Name of the monitored asset	T
<b>NominalVoltage-LG</b>	Volts - line-to-ground	N
<b>NominalFrequency</b>	Hertz	N
<b>UpstreamXFMR-kVA</b>	Upstream transformer size in kVA	N
<b>LineLength</b>	Length of line in units specified (default miles)	N

Metadata about the disturbance event in the waveform data

Metadata Key	Description	PQDS Datatype
<b>EventGUID</b>	Globally Unique Event Identifier	A
<b>EventID</b>	A user defined ID for this event	A
<b>EventYear</b>	Year	E (0 – 9999)
<b>EventMonth</b>	Month	E (1-12)
<b>EventDayofMonth</b>	Day	E (1-31)
<b>EventHour</b>	Hour	E (0-23)
<b>EventMinute</b>	Minute	E (0-59)
<b>EventSecond</b>	Second	E (0-59)
<b>EventNanoSeconds</b>	Nanosecond	N
<b>EventDate</b>	Event Date	T
<b>EventTime</b>	Event Time	T
<b>EventTimeZone</b>	Event Time Zone	T
<b>EventTypeCode</b>	PQDS Event Type Code	E (0-5)
<b>EventFaultTypeCode</b>	PQDS Fault Type Code	E (0-5)
<b>EventPeakCurrent</b>	Amperes	N

<b>EventPeakVoltage</b>	Volts	N
<b>EventMaxVA</b>	RMS Maximum A-Phase Volts	N
<b>EventMaxVB</b>	RMS Maximum B-Phase Volts	N
<b>EventMaxVC</b>	RMS Maximum C-Phase Volts	N
<b>EventMinVA</b>	RMS Minimum A-Phase Volts	N
<b>EventMinVB</b>	RMS Minimum B-Phase Volts	N
<b>EventMinVC</b>	RMS Maximum C-Phase Volts	N
<b>EventMaxIA</b>	RMS Maximum A-Phase Amperes	N
<b>EventMaxIB</b>	RMS Maximum B-Phase Amperes	N
<b>EventMaxIC</b>	RMS Maximum C-Phase Amperes	N
<b>EventFaultI2T</b>	Amperes <sup>2</sup> (for fault duration)	N
<b>EventPreEventCurrent</b>	Amperes (RMS)	N
<b>EventPreEventVoltage</b>	Volts (RMS)	N
<b>EventDuration</b>	Decimal seconds	N
<b>EventCauseCode</b>	PQDS Event Cause Code	E (0-12)
<b>EventNotes</b>	Description of the event	T
<b>EventCauseNotes</b>	Description of the event cause	T
<b>DistanceToFault</b>	Distance from the meter to the fault	N

Metadata about the measurement in the timeseries data

Metadata Key	Description	PQDS Datatype
<b>WaveformDataTypeFlag</b>	0 = point-on-wave measurements; 1 = RMS measurements	B

Metadata about the use restriction or information classification

Metadata Key	Description	PQDS Datatype
<b>WaveformSensitivityCode</b>	The PQDS Info Classification Code	E (0-3)
<b>WaveformSensitivityNotes</b>	Description of waveform sensitivity	T

Metadata about the author of the PQDS file

Metadata Key	Description	PQDS Datatype
<b>Utility</b>	Utility or organization that produced the PQDS file	T
<b>ContactEmail</b>	Contact email of the author of the PQDS file	T

## **2.2 Adding new keys - User extensions to Metadata**

Additional keys and values can be added to the meta-data section as needed. As these new keys are created the pattern of “domain.key” should be followed with the “domain” typically being a corporate or organizational abbreviation. This approach avoids key conflicts as meta-data is independently extended by multiple parties. e.g., extended meta-data key = “EPRI.SequenceID”

### 3. Waveform Data

The header record (line) is comprised of the following fields and MUST begin with the string “waveform-data” (not case sensitive).

names:

Column	Field Name	Requirements
A	waveform section flag	MUST be set to the string “waveform-data” <sup>4</sup>
B to J	measurement	MUST one of nine measurement names <sup>5</sup>

<sup>3</sup> The first value (column A) will contain time information in decimal seconds and should not exceed 999 seconds or 12 decimal places of precision (picoseconds). Optionally, negative time can be shown with time zero representing the trigger point for the disturbance.

<sup>4</sup> Valid values for measurement names to be included in the waveform data header are “va”, “vb”, “vc”, “vn”, “ia”, “ib”, “ic”, “in”, “f”. These names are not case sensitive and can be in any order. Field names and their respective data can be omitted for data that is not available.

#### 3.1 Adding new measurements - User extensions to waveform data

Additional measurements can be added as additional columns to the standard voltage and current measurement quantities shown in Note 4 above.

### 4. Waveform Data

As part parsing PQDS files, if the waveform metadata section is present it must begin with the three header field names of “key”, “value”, “value-units” (not case sensitive). Metadata keys do not need to appear in any particular order. Empty lines in the metadata section will be ignored. All fields will be ignored for invalid keys (e.g., one containing special characters or with a length greater than 32 characters). Valid keys will contain “” for other fields that are invalid. Other fields may be added to each metadata line (metadata record), but will not be parsed.

#### 4.1 Including embedded quotes and commas

Parsers of PQDS should be expected to behave like Excel when handling strings that include commas and quotes. For example the string: >> “I find that the harder I work, the more luck I seem to have.”, Thomas Jefferson << is placed in the CSV as *”””I find that the harder I work, the more luck I seem to have.”””, Thomas Jefferson*” That is, the overall string is encapsulated in quotes with quotes that are intended represented as double quotes.

### 5. PQDS file naming convention

There is purposely no standard for PQDS file naming except that is recommended that the file extension be “.csv”

## 6. Example PQDS.csv file

```

DeviceName,"(FL1)",,T,"Meter or measurement device name"
DeviceAlias,"e6b51727-f747-11cf-9d89-0080c72e70a3",,T,"Alternate meter device name"
DeviceLocation,"N/A",,T,"Meter or measurement device location name"
AccountName,"e6b5170a-f747-11cf-9d89-0080c72e70a3",,T,""
DeviceOwner,"ptco004",,T,"Utility name"
AssetName,"Asset 1 (e6b5170a-f747-11cf-9d89-0080c72e70a3)",,T,"Asset name"
EventGUID,"3a07e27c-0800-98d9-fc11-0747fa0715b6e",,A,"Unique Event Identifier"
EventID,"Event 6",,T,"A user defined Event Name"
WaveFormSensitivityCode,"1",,E,"PQDS Data Sensitivity Code"
ContactEmail,"clackner@gridprotectionalliance.org",,T,"Email of the author"
Utility,"GridProtectionAlliance",,T,"Utility that generated the PQDS file"
waveform-data,va,vb,vc,ia,ib,ic
0,-148.404,0.7707,149.76,-3.51931,-0.0487,-0.082
0.0013,-145.0518,-8.03,152.65,-0.8474,-0.0906,-0.082

```

Note that similarly to a PQDS file generated by the PQDS software tool, this example PQDS file does not include all possible meta-data fields.

# **B PQDS LOG FILE SPECIFICATION**

## **1. Introduction**

The Power Quality Data Sharing (PQDS) log file format is a comma-separated value file that enables easy tracking and sharing of the metadata not included in the PQDS file for various reasons, such as anonymizing the electric power disturbance waveforms. It is designed to be a simple and extensible human-to-human data format that complements the PQDS file format.

The PQDS log file format can include multiple sections, each corresponding to a single PQDS file generated by the EPRI PQDS application. The EPRI PQDS application will append a new section to the existing log file for each PQDS file generated.

## **2. Header Section**

Each section corresponding to a PQDS file is separated by a single line of 42 >>-<< characters. The first section skips this separator and immediately starts with the identifying header.

## **3. Identifying Header**

Each section contains a line consisting of two fields separated by a comma. The first field is the date and time at which the corresponding PQDS file is generated. The field is encapsulated in double quotations and formatted as d/m/YYYY hh:mm:ss. The date and time are given in UTC to avoid any confusion over the time zone in which the file was generated and formatted using a 24 hour format.

The second field is a uniquely generated GUID associated with the PQDS file. This GUID corresponds to the *EventGUID* field in the meta data section of the PQDS file as found in Appendix A, Section 2.1 of this document. Note that the field is also encapsulated by double quotes.

## **4. Metadata Section**

Immediately following the identifying header the meta data section of the PQDS file is included. Unlike the PQDS file itself all available meta data should be included in the log file. The format of this section is the same as that described in Appendix A, Section 2.1 of this document.

## **5. Waveform Data Section**

The log file does not contain any actual wave form data. However, in order to better describe the content of the PQDS file a header similar to that of the wave form data section in the PQDS file is included. The entry starts with the word “*waveform-data*” followed by comma separated list of the channels included in the PQDS file.

Suggested values include “va”, “vb”, “vc”, “vn”, “ia”, “ib”, “ic”, “in”, and “f”.

## 6. Example PQDS Log File

```

"1/11/2019 09:34:50","3a07e27c-0800-98d9-fc11-0747fa0715b6e"
DeviceName,"(FL1)",T,"Meter or measurement device name"
DeviceAlias,"e6b51727-f747-11cf-9d89-0080c72e70a3",T,"Alternate meter name"
DeviceLocation,"N/A",T,"Meter or measurment device location name"
AccountName,"e6b5170a-f747-11cf-9d89-0080c72e70a3",T,""
DeviceOwner,"ptco004",T,"Utility name"
AssetName,"Asset 1 (e6b5170a-f747-11cf-9d89-0080c72e70a3)",T,"Asset name"
EventGUID,"00000000-0000-0000-0000-000000000000",A,"Unique Event Identifier"
EventID,"Event 6",T,"A user defined Event Name"
WaveFormSensitivityCode,"1",E,"PQDS Data Sensitivity Code"
ContactEmail,"clackner@gridprotectionalliance.org",T,"Email of the author"
Utility,"GridProtectionAlliance",T,"Utility that generated the PQDS file"
waveform-data,va,vb,vc,ia,ib,ic
-----
"1/12/2019 19:35:04","f7c6281b-0858-22df-ae9a-1191d83f81b4"
DeviceName,"(FL1)",T,"Meter or measurement device name"
DeviceAlias,"e6b51727-f747-11cf-9d89-0080c72e70a3",T,"Alternate meter name"
DeviceLocation,"N/A",T,"Meter or measurment device location name"
AccountName,"e6b5170a-f747-11cf-9d89-0080c72e70a3",T,""
DeviceOwner,"ptco004",T,"Utility name"
AssetName,"Asset 1 (e6b5170a-f747-11cf-9d89-0080c72e70a3)",T,"Asset name"
EventGUID,"00000000-0000-0000-0000-000000000000",A,"Unique Event Identifier"
EventID,"Event 6",T,"A user defined Event Name"
WaveFormSensitivityCode,"1",E,"PQDS Data Sensitivity Code"
ContactEmail,"clackner@gridprotectionalliance.org",T,"Email of the author"
Utility,"GridProtectionAlliance",T,"Utility that generated the PQDS file"
waveform-data,va,vb,vc,ia,ib,ic

```

# C PQDS METADATA CODE DESCRIPTIONS

## 1. DeviceConnectionTypeCode

The PQDS code for meter connection type with the following codes predefined:

Code	Description
0	Unknown
1	3 Phase, 4 Wires
2	3 Phase, 3 Wires
3	1 Phase, 2 Wires
4	1 Phase, 3 Wires
5	2 Phase, 3 wires

## 2. EventTypeCode

The PQDS code for the event type with the following codes predefined:

Code	Description
0	Unknown
1	Fault
2	Voltage Sag
3	Coltage Swell
4	Interruption
5	Harmonics



### 3. EventFaultTypeCode

The PQDS code for the fault type with the following codes predefined:

Code	Description
0	Unknown
1	Single Line to Ground (LG)
2	Line to Line (LL)
3	Double Line to Ground (LLG)
4	3 Phase (LLL)
5	3 Phase to Ground (LLLG)

### 4. EventCauseCode

The PQDS code for the event cause with the following codes predefined:

Code	Description
0	Unknown
1	Lightning
2	Animal
3	Vegetation
4	Contamination
5	Smoke
6	Ice or Snow
7	Wind
8	Utility Equipment Issue
9	Customer Equipment Issue
10	Vandalism
11	Human Error
12	Other

**5. WaveFormSensitivityCode**

6. The PQDS code for the waveform data sensitivity with the following codes predefined:

<b>Code</b>	<b>Description</b>
<b>0</b>	Internal use only (i.e., protected, confidential information)
<b>1</b>	Business sensitive (shared under NDA only)
<b>2</b>	Reliability sensitive (shared with other grid entities under NERC data sharing or other reliability or marketing service agreements)
<b>3</b>	Public

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