logo

QE Framework -  
QEGui  
and  
User Interface Design

Andrew Rhyder

12 April 2013

Copyright (C) 2013 Andrew Rhyder.

Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.3 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts.  
A copy of the license is included in the section entitled "GNU Free Documentation License".

Contents

[Introduction 5](#_Toc353525233)

[License 5](#_Toc353525234)

[Overview 5](#_Toc353525235)

[Qt Designer 5](#_Toc353525236)

[QEGui 5](#_Toc353525237)

[QE widgets 6](#_Toc353525238)

[QEGui 6](#_Toc353525239)

[Command format: 6](#_Toc353525240)

[File location rules 7](#_Toc353525241)

[Tricks and tips (FAQ) 7](#_Toc353525242)

[GUI titles 7](#_Toc353525243)

[User levels 8](#_Toc353525244)

[Logging 10](#_Toc353525245)

[Finding files 12](#_Toc353525246)

[Sub form file names 12](#_Toc353525247)

[Sub form resizing 13](#_Toc353525248)

[Ensuring QERadioButton is checked if it matches the current data value 13](#_Toc353525249)

[What top level form to use 13](#_Toc353525250)

[QE widgets 14](#_Toc353525251)

[Common QE Widget properties 14](#_Toc353525252)

[variableName and variableSubstitutions 14](#_Toc353525253)

[variableAsTooltip 16](#_Toc353525254)

[Subscribe 16](#_Toc353525255)

[enabled 16](#_Toc353525256)

[allowDrop 16](#_Toc353525257)

[visible 16](#_Toc353525258)

[messageSourceId 16](#_Toc353525259)

[userLevelUserStyle, userLevelScientistStyle, userLevelEngineerStyle 18](#_Toc353525260)

[userLevelVisibility 18](#_Toc353525261)

[userLevelEnabled 18](#_Toc353525262)

[displayAlarmState 18](#_Toc353525263)

[String formatting properties 19](#_Toc353525264)

[precision 19](#_Toc353525265)

[useDbPrecision 19](#_Toc353525266)

[leadingZero 19](#_Toc353525267)

[trailingZeros 19](#_Toc353525268)

[addUnits 19](#_Toc353525269)

[localEnumeration 19](#_Toc353525270)

[format 20](#_Toc353525271)

[radix 20](#_Toc353525272)

[notation 21](#_Toc353525273)

[arrayAction 21](#_Toc353525274)

[arrayIndex 21](#_Toc353525275)

[QEAnalogIndicator and QEAnalogProgressBar 21](#_Toc353525276)

[QBitStatus and QEBitStatus 22](#_Toc353525277)

[QEConfiguredLayout 23](#_Toc353525278)

[QEFileBrowser 23](#_Toc353525279)

[QELabel 23](#_Toc353525280)

[QELogin 26](#_Toc353525281)

[QELog 26](#_Toc353525282)

[QEPvProperties 27](#_Toc353525283)

[QERecipe 27](#_Toc353525284)

[QEScript 27](#_Toc353525285)

[QEStripChart 27](#_Toc353525286)

[QEPeriodic 27](#_Toc353525287)

[QESubstitutedLabel 27](#_Toc353525288)

[QELineEdit 27](#_Toc353525289)

[QENumericEdit 29](#_Toc353525290)

[QEPushButton and QERadioButton 31](#_Toc353525291)

[QEShape 37](#_Toc353525292)

[QESimpleShape 37](#_Toc353525293)

[QESlider 39](#_Toc353525294)

[QESpinBox 39](#_Toc353525295)

[QEComboBox 39](#_Toc353525296)

[QEForm 39](#_Toc353525297)

[QEPlot 42](#_Toc353525298)

[QEImage 42](#_Toc353525299)

[QEFrame and QEGroupBox 48](#_Toc353525300)

[QELink 48](#_Toc353525301)

[Appendix A 51](#_Toc353525302)

[GNU Free Documentation Licence 51](#_Toc353525303)

# Introduction

This document describes how to use the QE Framework to develop ‘code free’ Control GUI systems. It explains how features of the QE Framework widgets can be exploited, and how the QE Framework widgets interact with each other and with the QEGui application typically used to present the user interface.

While widget properties are referenced, a definitive list of the available properties is available in document QEReferenceManual.pdf.

This document is not intended to be a general style guide, or a guide on using Qt’s user interface development tool, Designer. Style issues should be resolved using facility based style guidelines, EPICS community standards, and general user interface style guides. Consult Qt documentation regarding Designer.

## License

The QE Framework is distributed under the GNU General Public License version 3, distributed with the framework in the file COPYING. It may also be obtained from here: <http://www.gnu.org/licenses/gpl-3.0-standalone.html>

# Overview

In a typical configuration, Qt’s Designer is used to produce a set of Qt user interface files (.ui files) that implement an integrated GUI system. The QE Framework application QEGui is then used to present the set of .ui files to users. The set of .ui files may include custom and generic template forms, and forms can include nested sub forms. Other applications can also be integrated.

<image of a set of GUIs>

## Qt Designer

Designer is used to create Qt User Interfaces containing Qt Plugin widgets. The QE Framework contains a set of Qt Plugin widgets that enable the design of Control System GUIs. These are used, along with standard Qt widgets and other third party widgets.

<image of designer>

## QEGui

QEGui is an application use to display Qt User Interface files (.ui files). Almost all of the functionality of a Control System GUI based on the QE Framework is implemented by the widgets in the user interface files. QEGui simply presents these user interface files in new windows, or new tabs, and provides support such as a window menu and application wide logging.

Simple but effective integration with Qt Designer is achieved with the option of launching Designer from the QEGui ‘Edit’ Menu. The user interface being viewed can then be modified, with the changes being automatically reloaded by QEGui.

Refer to ‘QEGui’ (page 6) for documentation on using QEGui.

## QE widgets

QE widgets are self contained. The application loading a user interface file – typically QEGui – does not have to be aware the user interface file even contains QE widgets. The Qt library locates the appropriate Plugin libraries that implement the widgets it finds in a user interface file.

While QE widgets need no support from the application which is loading the user interface containing them, some QE widgets are capable of interacting with the application, and other widgets. For example, a QEPushButton widget can request that whatever application has loaded it open another user interface in a new window.

QE widgets fall into two categories:

* Standard widgets. These widgets are based on a standard Qt widget and generally allow the widget to write and read data to a control system. For example, QELabel is based on QLabel and displays data updates as text.
* Control System Specific widgets. These widgets are not readily identifiable as a single standard Qt widget and implement functionality specific to Control systems. For example, QEPlot displays waveforms.

# QEGui

## Command format:

QEGui [-s] [-e] [-b] [-h] [v] [-m *macros*] [-p *path-list]* [*filename*]

Command switches and parameters are as follows:

* **-s Single application.**  
  QEGui will attempt to pass all parameters to an existing instance of QEGui. When one instance of QEGui managing all QEGui windows, all windows will appear in the window menu. A typical use is when a QEGui window is started by a button in EDM.  
  An existing instance of QEGui will only be used if it uses the same macro substitutions (see -m switch)
* **-e Enable edit menu option.**  
  When the edit menu is enabled Designer can be launched from QEGui, typically to edit the current GUI.
* **-b Disable the menu bar.**
* **-p *path-list* Search paths.**   
  When opening a file, this list of paths may be used when searching for the file. Refer to ‘File location rules’ (page 5) for the rules QEGui uses when searching for a file.
* **-h Display help text explaining these options and exit.**
* **-v Display version information and exit.**
* **[-m *macros*] Macro substitutions applied to GUIs.**  
  Macro substitutions are in the form: *keyword=substitution,keyword=substitution*,... and should be enclosed in quotes if there are any spaces.  
  Typically substitutions are used to specify specific variable names when loading generic template forms. Substitutions are not limited to template forms, and some QEWidgets use macro substitutions for purposes other than variable names.
* *filename* GUI filename to open.  
  If no filename is supplied, the ‘File Open’ dialog is presented. Refer to ‘File location rules’ (page 5) for the rules QEGui uses when searching for a file.

Switches may be separate or grouped.

Switches that precede a parameter (-p, -m) may be grouped. Associated parameters are then expected in the order the switches were specified. For example:

QEGui -e -p /home

QEGui -epm /home PUMP=02

## File location rules

If a user interface file path is absolute, QEGui will simply attempt to open it as is. If the file path is not absolute, QEGui looks for it in the following locations in order:

1. If the filename is for a sub-form, look in the directory of the parent form.
2. Look in the directories specified by the –p switch.
3. Look in the directories specified by the QE\_UI\_PATH environment variable.
4. Look in the current directory.

<Are macro substitutions applied to filenames???>

QEGui uses file location rules defined by the QE framework. Refer to Finding files (page 12) for more details.

# Tricks and tips (FAQ)

## GUI titles

The QEGui application reads the windowTitle property of the top level widget in a user interface file. It then applies any macro substitutions to the name and uses it as the GUI title. Figure 1 shows a windowTitle property that includes macros being edited in Designer, with the same user interface being displayed by QEGui with the appropriate macro substitution.



Figure windowTitle Property in designer with actual translated window title on form in foreground

## User levels

The QE framework manages three application wide user levels. These are independent of the operating system user accounts.

Within an application using the QE framework (such as the QEGui application), one of three user levels can be set. The three user levels are:

* **User**
* **Scientist**
* **Engineer**

User levels allow the most appropriate view of the system to be presented to different user groups. In Figure 2 for example, while in User mode operational information (beam current) is large. In Scientist mode a ‘maintenance’ panel appears but a maintenance control is not enabled. In Engineer mode, the maintenance control is enabled.

To avoid the annoyance of widgets disappearing while you are trying to design a GUI, widgets will not become ‘not visible’ due to user level while being edited in Qt Designer. This also applies to Designer’s ‘preview’ mode. To check if a widget’s visibility is changes correctly according to user level, open the GUI using the QEGui application.

While the user level can be set and read programmatically using the ContainerProfile class, it is intended to be set using the QELogin widget and acted on by other QE widgets. The QELogin widget imposes a hierarchy to the user levels, requesting passwords when increasing user levels but allowing the user level to be reduced without authority.

The user levels are used to control individual QE widget behaviour. Most commonly, user level is used to determine if a QE widget is visible or enabled for a given user level through the ‘userLevelVisibility’ and ‘userLevelEnabled’ properties respectively. The ‘userLevelUserStyle’, ‘userLevelScientistStyle’ and ‘userLevelEngineerStyle properties, however, allow any style string to be applied for each user level. While user level based style strings allow many simple and convenient user interface changes beyond visibility and enabled state, they can also allow obscure and bizarre behaviour changes. For example, a style string may simply set a QEPushButton background to red in user mode, alternatively a style string could be used to move a QEPushButton to a different location on a form.

The syntax for all Style Sheet strings used by this class is the standard Qt Style Sheet syntax. For example, 'background-color: red'. Refer to Qt Style Sheets Reference for full details. The style sheet syntax includes a 'qproperty' keyword allowing any property to be altered using the style string. For example, 'qproperty-geometry:rect(10 10 100 100);' would move a widget to position 10,10 and give it a size of 100,100.



Figure 2 User level example

## Logging

Several QE widgets generate log messages. These can be caught and displayed by a QELog widget, or a user application. This section describes the overall QE framework message logging system. Refer to ‘QELog’ (page 26) for a description of the QELog widget.

Log messages have three attributes:

1. the message text itself;
2. its severity (information, warning or error); and
3. the message kind, which defines the class or type of message. It may be set to one, one or both of:
   1. event – used of significant system events. These can be displayed by the QELog widget as described below; and/or
   2. status – used for transient status information, such the time/value coordinates associated with the cursor when moving over the plot area of the QEStripChart widget. When running within in QEGui, this class of message are displayed on the form’s status bar.

**Simplest use:**

The simplest use of this system is to drop a QELog widget onto a form. That’s it. Any log messages generated by any QE widgets within the application (for example, the QEGui application) will be caught and displayed provided that the message kind specifies the event attribute. Figure 3 shows a form containing a QELogin widget and a QELog widget. When the user logs in using the QELogin widget, messages generated by the QELogin widget are automatically logged by the QELog widget.

The messages generated by the QELogin widget are denoted as both status and event, and so also shown on the status bar at the bottom of the form.



Figure 3 Simple logging example

**Complex use:**

By default, QELog widgets catch and display any massage, but messages can be filtered to display only messages from a specific sets of QE widgets or a to display messages originating from QE widgets within the same QEForm containing the QELog widget.

A form may contain QEForm widgets acting as sub forms. A QELog widget in the same form as a QEForm widget can catch and display messages from widgets in the QEForm if the QEForm is set up to catch and re-broadcast these messages. QEForm widgets can catch and filter messages exactly like QELog widgets, but selected messages are not displayed, rather they are simply re-broadcast as originating from themselves. When a QELog widget is selecting messages only from QE widgets in the same form it is in it will catch these re-broadcast messages

The messageFormFilter, messageSourceFilter, and messageSourceId properties are used to manage message filtering as follows:

Any QE widget that generates messages has a messageSourceId property. QELog and QEForm widgets with the messageSourceId property set to the same value can then use the messageSourceFilter property to filter messages based on the message source ID as follows:

* **Any** A message will always be accepted. (messages source ID is irrelevant)
* **Match** A message will be accepted if it comes from a QEWidget with a matching message source ID.
* **None** The message will not be matched based on the message source ID. (It may still be accepted based on the message form ID.)

All generated messages are also given a message form ID. The message form ID is supplied by the QEForm the QE widget is located in (or zero if not contained within a QEForm widget). QELog and QEForm widgets with a matching message form ID can then use the messageFormFilter property to filter messages based on the message form ID as follows:

* **Any** A message will always be accepted.
* **Match** A message will be accepted if it comes from a QE widget on the same form.
* **None** The message will not be matched based on the form the message comes from. (It may still be accepted based on the message source ID.)

Note: The internal archive access manager object also generates log messages. As this object is not a widget, the value of its messageSourceId is not modifiable as a property and has been hard-coded as 9,001. The range 9,001 to 10,000 is reserved for internal framework use, and while one is not prohibited from allocating these numbers to widgets within, it is not recommended.

Figure 4 shows a complex logging example. The main form contains two sub forms and a QELog widget. The right hand sub form looks after its own messages. It has a QELog widget with filtering set to catch any messages generated on the same form. The left hand sub form does not display its own messages, but the form is set up to re-broadcast any messages generated by QE widgets it contains, so the QELog widget on the main form can be set up to catch and display these messages. Note, the QEGui application itself also uses a UserMessage class to catch and present the same messages on its status bar.



Figure 4 Complex logging example

Note, Application developers can catch messages from any QE widgets in the same way the QELog and QEForm widgets do, by implementing a class based on the UserMessage class. See the UserMessage class documentation for details.

## Finding files

The QE widgets uses a consistent set of rules when locates files. File names can be absolute, relative to the path of the QEform in which the QE widget is located, relative to the any path in the path list published in the ContainerProfile class or in the QE\_UI\_PATH environment variable, or relative to the current path.

See QEWidget:: findQEFile() in QEWidget.cpp for details on how the rules are implemented.

In the GEQui application, the –p switch is used to specify a path list which is published in the ContainerProfile class.

## Sub form file names

Absolute names simplify locating forms, but make a set of related GUI forms and sub forms less portable. The following rules will help make a set of forms and sub forms more portable.

* No path should be specified for sub forms in the same directory as the parent form.
* A relative path should be given for sub forms in a directory under the parent form directory.
* Paths to directories containing generic sub forms can be added to the–p switch.

Refer to ‘’ (page 5) details on how QEGui searches for a user interface file given absolute and relative file paths.

## Sub form resizing

QEForm widgets are used to embed sub forms in a user interface by loading a Qt user interface (.ui) file into itself at run time. Each QEForm widget has a set of properties (inherited from QWidget) that define how resizing is managed including geometry, size policy, maximum, minimum, and base sizes, size increments and margins. The top level widget in the .ui file loaded by a QEForm also contains these properties. A conflict may exist if the size related properties of the QEForm are not the same as the size related properties of the top level widget in the .ui file the QEForm is loading.

This conflict can be resolved with the resizeContents property of the QEForm. If resizeContents is true, the size related properties of the top level widget in the .ui file are adjusted to match the QEForm. If resizeContents is false, the size related properties of the QEForm are adjusted to match the top level widget in the .ui file.

Refer to ‘QEForm’ (page 39) for complete details about the QEForm widget

## Ensuring QERadioButton is checked if it matches the current data value

When a data update matches the checkText property, the Radio button will be checked.

If the ‘format’ property is set to ‘Default’ (which happens to be the default!), and the data has enumeration strings then the checkText property must match any enumeration string.

This can cause confusion if the values written are numerical – the click text (the value written) can end up different to the clickCheck text. Also, if the enumeration strings are dynamic, it is not possible to specify at GUI design time what enumeration strings to match.

To solve this problem, set the ‘format’ property to ‘Integer’ and set the ‘checkText’ property to the appropriate integer value. Remember, the checkText property is a text field that will be matched against the data formatted as text, so the checkText property must match the integer formatting. For example, a checkText property of ‘ 2’ (includes spaces) will not match ‘2’ (no spaces)

## What top level form to use

If you are using Qt’s Designer to lay out user interfaces as part of an application you are developing, then the top level form you start with will depend on your application, but if you are creating a user interface file for use in QEGui the following guidelines apply:

QEGui can load a user interface file with any sort of top level widget, but the most appropriate is likely to be one of the simpler containers such as QWidget as QEGui is already managing most aspects more complex containers such as are designer to manage.

You select the top level widget when you create a new user interface in Designer. It is recommended that you choose QWidget, but if there is functionality you require provided by other widgets, then feel free to use any other widget.

QEGui opens all user interface files using a QEForm widget. If the user interface file it is opening does not have a layout, the top level widget in the user interface file is resized to match the QEForm.

If it does have a layout, then the QEForm will also have given itself a layout to ensure layout requests are propagated and the top level widget is not resized.

# QE widgets

QE widgets enable the design of control system user interfaces.

This document describes what the widgets are designed to do, what features they have and how they should be used. For a comprehensive list of properties, refer to the widget class documentation in QE\_ReferenceManual.pdf

**EPICS enabled standard Qt widgets:**

Many QE widgets are simply standard Qt widgets that can generally read and write to EPICS variables. For example, a QELabel widget is basically a QLabel widget with a variable name property. When a variable name is supplied, text representing the variable is displayed in the label.

The QE Framework also manages variable status using colour, provides properties to control formatting, etc

**Control System widgets**

Other QE widgets implement a specific requirement of a Control System. For example QEPlot presents waveforms. These widgets are still based on standard low level Qt widgets so still benefit from common Qt widget properties for managing common properties such as geometry.

## Common QE Widget properties

Properties of base Qt widgets are not documented here – refer to Qt documentation for details.

### variableName and variableSubstitutions

All EPICS aware widgets have one or more variable name properties. The variable names may contain macro substitutions that will be translated when a user interface is opened. The same variable name macro substitutions are used by many widgets for translating macros in other text based properties as well. For example, QEPushbutton uses the macro substitutions in the GUIFile property.

Generally the macro substitutions will be supplied from QEGui application command line parameters, and from parent forms when a user interface is acting as a sub form. The widget itself may have default macro substitutions defined in the ‘variableSubstitutions’ property. Default macro substitutions are very useful when designing user interface forms as they allow live data to be viewed when designing generic user interfaces. For example, a QELabel in a generic sub form may be given the variable name SEC${SECTOR}:PMP${PUMP} and default substitutions of ‘SECTOR=12 PUMP=03’. When used as a sub form valid macro substitutions will be supplied that override the default substitutions. At design time, however, the QELabel will connect to and display data for SEC12:PMP03. Note, default substitutions can be dangerous if they are never overridden.

The following example describes a scenario where macro substitutions required for a valid variable name are defined at several levels, and in one case multiple levels.

Figure 5 shows a form containing a QELabel. The variable name includes macros SECTOR, DEVICE and MONITOR. Default substitutions are provided for MONITOR. This is not adequate to derive a complete variable name.

Figure 6 shows a form using the form from Figure 5 as a sub form. Additional macro definitions for SECTOR and DEVICE are provided with the sub-form file name. When the sub form is loaded, the QELabel in the sub form can now derive a complete variable name (SR01BCM01:CURRENT\_MONITOR). While complete, this is not actually functional – the correct sector is SR11.

Figure 7 shows the form from Figure 6 opened by the QEGui application with the following parameters:

QEGui –m “SECTOR=11” example.ui

The MONITOR macro has been overwritten, so the QELabel in the sub form now derives the correct variable name SR11BCM01:CURRENT\_MONITOR.



Figure Sub form with macro substitution for part of the variable name



Figure Main form containing sub form with all macro substitutions satisfied (but one is incorrect)



Figure QEGui displaying form and sub forms with all macro substitutions satisfied correctly

### variableAsTooltip

If checked, the ToolTip is generated dynamically from the variable name or names and status.

toolTip1.png

### Subscribe

If checked, the widget will subscribe for data updates and display them. This is true by default for display QE widgets as QELabel. For control widgets it may be false by default. For example it is false by default for QEPushButtons since it is more common to have static text in the button label, but it can be set to true if the button text should be a readback value, or if the button icon is to be updated by a readback value.

### enabled

Set the preferred 'enabled' state. Default is true.

The standard Qt ‘enabled’ property is set false by many QE widgets to indicate if the data displayed is invalid (disabled). When the data displayed is valid, the QE widget will reset standard Qt ‘enabled’ property to the value of this ‘enabled’ property. Users wanting to enable or disable a QE widget for other purposes should use this property. This property will be used to set the standard Qt ‘enabled’ property except when data is invalid.

### allowDrop

Allow drag/drops operations to this widget. Default is false. Any dropped text will be used as a new variable name.

### visible

Display the widget. Default is true. Setting this property false is useful if widget is only used to provide a signal - for example, when supplying data to a QELink widget.

Note, when false the widget will still be visible in Qt Designer.

### messageSourceId

Set the ID used by the message filtering system. Default is zero.

Widgets or applications that use messages from the framework have the option of filtering on this ID.

For example, by using a unique message source ID a QELog widget may be set up to only log messages from a select set of widgets.

Refer to Logging (page 10) for further details.

### userLevelUserStyle, userLevelScientistStyle, userLevelEngineerStyle

Style Sheet strings to be applied when the widget is displayed in 'User', ‘Scientist’, or ‘Engineer’ mode. Default is an empty string.

The syntax is the standard Qt Style Sheet syntax. For example, 'background-color: red'

This style strings will be safely merged with any existing style string supplied by the application environment for this widget, or any style string generated for the presentation of data.

Refer to User levels (page 8) for details regarding user levels.

### userLevelVisibility

Lowest user level at which the widget is visible. Default is 'User'.

Used when designing GUIs that display more detail according to the user mode.

The user mode is set application wide through the QELogin widget, or programmatically through setUserLevel().

Widgets that are always visible should be visible at 'User'.

Widgets that are only used by scientists managing the facility should be visible at 'Scientist'.

Widgets that are only used by engineers maintaining the facility should be visible at 'Engineer'.

Refer to User levels (page 8) for details regarding user levels.

### userLevelEnabled

Lowest user level at which the widget is enabled. Default is 'User'.

Used when designing GUIs that allows access to more detail according to the user mode.

The user mode is set application wide through the QELogin widget, or programmatically through setUserLevel()

Widgets that are always accessible should be visible at 'User'.

Widgets that are only accessible to scientists managing the facility should be visible at 'Scientist'.

Widgets that are only accessible to engineers maintaining the facility should be visible at 'Engineer'.

Refer to User levels (page 8) for details regarding user levels.

## displayAlarmState

If true (default) the widget will indicate the alarm state of any variable data is displaying. Typically the background colour is set to indicate the alarm state.

Note, this property is included in the set of standard properties as it applies to most widgets. It will do nothing for widgets that don't display data.

## String formatting properties

Many QE widgets present data as text, or interpret text and write data accordingly. Examples are QELabel and QELineEdit.

Common formatting properties are used for all these widgets where possible. Not all are relevant for all data types.

### precision

Precision used when formatting floating point numbers. The default is 4.

This is only used if the ‘useDbPrecision’ property is false.

### useDbPrecision

If true (default), format floating point numbers using the precision supplied with the data.

If false, the ‘precision’ property is used.

### leadingZero

If true (default), always add a leading zero when formatting numbers.

### trailingZeros

If true (default), always remove any trailing zeros when formatting numbers.

### addUnits

If true (default), add engineering units supplied with the data.

### localEnumeration

An enumeration list used to data values. Used only when the ‘format’ property set to 'local enumeration'.

The data value is converted to an integer which is used to select a string from this list.

**Format is:**

[[<|<=|=|!=|>=|>]value1|\*] : string1 , [[<|<=|=|!=|>=|>]value2|\*] : string2 , [[<|<=|=|!=|>=|>]value3|\*] : string3 , ...

Where:

* < Less than
* <= Less than or equal
* = Equal (default if no operator specified)
* >= Greater than or equal
* > Greater than
* \* Always match (used to specify default text)

**Rules are:**

* Values may be numeric or textual
* Values do not have to be in any order, but first match wins
* Values may be quoted
* Strings may be quoted
* Consecutive values do not have to be present.
* Operator is assumed to be equality if not present.
* White space is ignored except within quoted strings.
* \n may be included in a string to indicate a line break

**Examples:**

* 0:Off,1:On
* 0 : "Pump Running", 1 : "Pump not running"
* 0:"", 1:"Warning!\nAlarm"
* <2:"Value is less than two", =2:"Value is equal to two", >2:"Value is greater than 2"
* 3:"Beamline Available", \*:""
* "Pump Off":"OH NO!, the pump is OFF!","Pump On":"It's OK, the pump is on"

The data value is converted to a string if no enumeration for that value is available.

For example, if the local enumeration is '0:off,1:on', and a value of 10 is processed, the text generated is '10'.

If a blank string is required, this should be explicit. for example, '0:off,1:on,10:""'

A range of numbers can be covered by a pair of values as in the following example:

* >=4:"Between 4 and 8",<=8:"Between 4 and 8"

### format

This property indicates how non textual data is to be converted to text:

* Default Format as best appropriate for the data type.
* Floating Format as a floating point number
* Integer Format as an integer
* UnsignedInteger Format as an unsigned integer
* Time Format as a time, source value interpreted as seconds.
* LocalEnumeration Format as a selection from the ‘localEnumeration’ property

### radix

Base used for when formatting integers. Default is 10 (duh!)

### notation

Notation to use when formatting data as a floating point number. Default is Fixed. Options are:

* Fixed Standard floating point. For example: 123456.789
* Scientific Scientific representation. For example: 1.23456789e6
* Automatic Automatic choice of standard or scientific notation

### arrayAction

This property defines how array data is formatted as text. Default is ASCII. Options are:

* **Append** Interpret each element in the array as an unsigned integer and append string representations of each element from the array with a space in between each. For example, an array of three numbers 10, 11 and 12 will be formatted as '10 11 12'.
* **Ascii** Interpret each element from the array as a character in a string. Translate all non printing characters to '?' except for trailing zeros (ignore them). For example an array of three characters 'a' 'b' 'c' will be formatted as 'abc'.
* **Index** Interpret the element selected by setArrayIndex() as an unsigned integer. For example, if arrayIndex property is 1, an array of three numbers 10, 11 and 12 will be formatted as '11'.

### arrayIndex

Index used to select a single item of data for formatting from an array of data. Default is 0.

Only used when the arrayAction property is INDEX. Refer to the ‘arrayAction’ property for more details.

## QEAnalogIndicator and QEAnalogProgressBar

The QEAnalogIndicator widget is used to simulate an analog indicator such as a bar indicator or dial. It is not EPICS aware.

The QEAnalogProgressBar is based on the QEAnalogIndicator and is EPICS aware.

Features include:

* Logarithmic or linear scale
* Optional units
* Same widget used for multiple analog indicators including dial and bar.
* Based on QEAnalogIndicator which is available for non EPICS aware uses.
* Alarm Limits are represented on the scale if required



Figure QEAnalogProgressBar examples

## QBitStatus and QEBitStatus

The QBitStatus widget is used to present a selected set of bits from a data word. It is not EPICS aware. The QEBitStatus widget is based on QBitStatus and is EPICS aware.

Bits are presented as an array of rectangles or circles with presentation properties to control shape, size, orientation, spacing and colour. Other properties allow bit by bit selection of what values display as ‘on’ and ‘off’ and if bits are rendered when ‘on’ or ‘off’.



Figure QEBitStatus widget examples

## QEConfiguredLayout

## QEFileBrowser

## QELabel

The QELabel widget provides a simple textual display of EPICS data. It is based on the QLabel widget and so shares QLabel properties such as justification.

The QELabel widget provides many options for formatting the EPICS data as text. These formatting options are common to all QE widgets that display EPICS data as text. Most of these options to not presume any specific EPICS data type. Refer to ‘String formatting properties’ (page 19) for details about the standard text formatting.



Figure QELabel examples with variations to QLabel properties



Figure QELabel used to display a pump failure



Figure QELabels used icons to represent states



Figure GUI using mostly QELabels to represent numeric and textual data

The text displayed in a QELabel reflects the value of the variable. How that text is presented reflects the state of the variable as follows:

* **Invalid** (not connected) – The QELabel is displayed not-enabled, or ‘greyed out’.
* **In alarm condition** – The QELabel is optionally displayed with an appropriate background colour.

In common with any Qt widget, many aspects of the presentation can be set by the GUI designer, or modified by an imposed ‘style’. It is important that any changes to the presentation of the QELabel is compatible with the display of the variable state.

Display of alarm state is optional – Display of alarm state is on by default. It may be appropriate to turn display of alarm state off if the alarm state is displayed elsewhere, or the alarm state is the actual field being displayed.

## QELogin

## QELog

The QELog widget provides a destination for messages generated by other QE widgets, or other widgets and applications using the QE framework. Messages may be generated due to user actions such as changing user level, data issues such as an invalid variable name, and application errors.

The QELog widget receives and displays messages from the QE framework message system. Any application or widget can generate or consume these messages. For example, the QEGui application displays QE messages in its status bar.

Refer to ‘Logging’ (page 10) for a more general discussion on how the QELog widget is used as part of the QE framework message logging system.



Figure QELog example

The QELog widget is designed to be dropped on a form and automatically catch messages from QE widgets on the same form, or in sub forms. Alternately, it can be used to filter messages from specific sets of QE widgets and forms.

The logged messages can be saved or cleared by the user. The user can also select the type of messages logged from a message filter. Note, the message filter viewed by the user is used by the user to filter message content. For example, the user can select only information messages. Filter properties are also available to filter messages based on the source of the message, rather than content.

Properties of the QELog widget allow:

* Selective display of message time, type and content.
* Presentation of the ‘Clear’ and ‘Save’ buttons and the message filter.
* Message type colour selection.
* Selection of the message filtering based on the source of the message. Note, this is different to the message filter presented to the user which allows the user to filter based on message type.

Each QE widget can be given a message source ID (the messageSourceId property). The GUI designer is free to allocate any ID to any widget. IDs do not need to be unique, so a set of widgets might have the same message source ID if required.

Each QEForm widget also has a unique message form ID allocated by the QE framework.

QELog widgets can be set up to filter messages based on the message source ID (the QE widget or set of widgets it came from) and the QEForm that widget generating the message is in. The filtering is as follows:

* **Form filtering:**
  + **None** - Never match based on the form ID
  + **Match** – Use the message if message came from a widget in the same form as the QELog widget, or from a sub form. Note, Messages are accepted from sub forms because QEForms themselves filter messages and rebroadcast them as their own.
  + **Any** – Always use the message. When this option is selected, message source filtering, below, is irrelevant.
* **Message source filtering:**
  + **None** – Never match based on message source ID
  + **Match** – Use the message if the message came from a widget with the same message source ID.
  + **Any** - Always use the message. When this option is selected, form filtering, above, is irrelevant.

By default a QELog widget form filter is set to ‘Match’ and the message source filter is set to ‘None’. These are the settings required to allow a QELog widget to be dropped onto a form to display all messages from widgets on the form, including those within sub forms.

## QEPvProperties

## QERecipe

## QEScript

## QEStripChart

## QEPeriodic

## QESubstitutedLabel

## QELineEdit

The QELineEdit widget provides the ability to textually modify the value of a single PV. This widget is (indirectly) derived from QLineEdit. The example in Figure 15 shows a QELineEdit widget connected to an ao record. While this widget is primarily intended for writing to string PVs, it can also be used with numerical PVs as in this example. However in this case, a QENumericEdit or a QESpinBox widget may be may be more appropriate.

QELineEdit_runtime.png

Figure QELineEdit example

The behaviour of the widget is defined by the widget specific properties as shown in Figure 16.



Figure QELineEdit properties

As well as the usual PV variable name, substitutions, display format, user level etc. properties, the widget has additional properties to control it mode of operation:

1. subscribe (default true): determines if the widget subscribes for data updates and displays current data;
2. writeOnLoseFocus (default false): when true this widget automatically writes any changes when it loses focus;
3. writeOnEnter (default true): when true writes when the user presses 'enter'. Note, the current value will be written even if the user has not changed it;
4. writeOnFinish (default true): when true writes any changes when the user finished editing (the QLineEdit 'editingFinished' signal is emitted). No writing occurs if no changes were made; and
5. confirmWrite (default false): when true this widget will ask for confirmation (using a dialog box) prior to writing data.

## QENumericEdit

The QENumericEdit widget provides the ability to modify the value of a single numeric, either integer or floating point, PV. This widget is (indirectly) derived from QLineEdit. Figure 17 shows examples of the widget in several configurations, and in each case the widget is connected to the same PV.



Figure QENumericEdit examples

The first example shows a QENumericEdit in its default configuration, and in appearance at least, looks very much like its QELineEdit counterpart. The second example shows the appearance with the separator property set to “comma”. The 3rd, 4th and 5th show the same with the radix property set to Hexadecimal, Octal and Binary respectively. The widgets tool tip will be annotated accordingly.

Unlike the QELineEdit, the user may only enter valid radix digits and if a sign is present enter a plus/minus (“+”, “-“) . A sign is displayed if and only if the allowed range of values encompasses negative values. The user may also the left and right key to navigate sideways to select a digit and use the up and down keys to increment or decrement the overall value by an amount corresponding to the unit value of the selected digit. An example sequence is shown below (using an approximate representation of the widget appearance):

0.2589 Amps   
0.2589 Amps - widget gets focus – the current selected digit is after the first decimal point  
0.2589 Amps - left key – first digit selected – note: the decimal point skipped   
0.2589 Amps - right key three times – third digit after point selected  
0.2599 Amps - up key – increment value by 0.001   
0.2609 Amps - up key – increment value by 0.001, second digit has changed from 5 to 6.

Like the QELineEdit widget, the subscribe, writeOnLoseFocus, writeOnEnter, writeOnFinish and confirmWrite properties modify the behaviour is exactly the same manor. The widget specific properties are shown in Figure 18. These are described below:

1. autoScale (default true): when true the number of leading zeros, precision, minimum and maximum values will be determined from the PV’s associated meta. When false (or when not connected), the precision, leadingZeros, minimum and maximum properties are used;
2. precision (default 4): specifies the number digits after the decimal point for display and editing;
3. leadingZeros (default 3): specified the number of digits before the decimal point;
4. minimum: specifies the minimum value allowed to be entered;
5. maximum: specifies the maximum value allowed to be entered;
6. addUnits (default true): the widget displays includes any engineering units;
7. radix (default Decimal): allows the selection of display/editing radix. Unlike other widgets, this is restricted to just four options: Decimal, Hexadecimal, Octal and Binary.  
   Note: the widget assumes that the precision/leading zeros , manual or automatic, are appropriate for the selected radix; and
8. separator (default None): allows the use of a character to break up the string. This may be one of None, Comma, Underscore or space. For Decimal and Octal, this is between every third digits, whereas for Hexadecimal and Binary, this is every 4th digit.

Note: the widget ensures that items (b), (c), (d) and (e) are consistent. For example: the maximum value is always greater than or equal to the minimum value. When in decimal mode, he sum of (b) and (c) is never greater than 15 which is approximately the maximum significance of an IEEE 64 bit float which is used to hold the underlying widget value (and indeed is the “best” significance supported by Channel Access).



Figure QENumericEdit properties

## QEPushButton and QERadioButton

The QEPushButton and QERadioButton widgets provide the following non exclusive functions:

* Write to a variable
* Read from a variable
* Issue a command to the operating system
* Open a new GUI form.
* Emit a signal

If the properties used to define any or all of these functions are set up, the functions will be carried out.

Both widget types are based on QEGenericButton and on QAbstractButton (through QPushButton and QRadioButton). QEPushButton and QERadioButton widgets share most properties and it is mainly the way the buttons are presented that differentiates them.

Generally, QERadioButtons will be shown as checkable, and properties related to the checked state are more likely to be used for QERadioButtons.

Various data values can be written on any or all or the following button actions:

* Press A mouse press with the pointer over the button
* Release A mouse release with the pointer over the button
* Click A press and release while over the button

By default, values are written on a button click. A click will be accompanied with a press and release.

Writing values on Press and Release typically allows a value to be set momentary, while the button is held down. In this case, no data would be written on the click.

The same value that would be written to a variable is also interpreted as an integer and emitted as a ‘pressed’, ‘released’ or ‘clicked’ signal. This is useful, for example, for selecting a tab in a tab widget or a page in a toolbox widget.

While QEPushButton and QERadioButton widgets can open a new GUI form when set up correctly without any action on the part of the application that created them, this functionality is mainly so the button functionality can be tested from the Designer ‘preview’ window. Applications using QEPushButton and QERadioButton widgets should provide a slot to create new windows through the ContainerProfile class. The application can then respect the creation options set up with the new button and manage the window better – for example it may wish to add the window to its window menu. The QEGui application provides such a slot through the ContainerProfile class. Refer to the QEGui application and the Container Profile class for more details.

**To write to a variable, the following properties are used:**

* **variable**If present, a value will be written to the variable when the button is operated.  
  The value of this variable can also be used to update the button text or image.
* **variable Substitutions**Macro substitutions to apply to ‘variable’ and ‘altReadbackVariable’ properties. Note, the variableSubstitutions property is also applied to pressText, releaseText, and clickText properties prior to writing, is applied to the labelText property if present, and is used in any GUI filename and passed on to any new GUI launched by the QE button.
* **password**  
  Password user will need to enter before any action is taken.
* **confirmAction**  
  If true, a dialog will be presented asking the user to confirm if the button action should be carried out
* **writeOnPress**  
  If true, the 'pressText' property is written when the button is pressed. Default is false.
* **writeOnRelease**  
  If true, the 'releaseText' property is written when the button is released. Default is false
* **writeOnClick**  
  If true, the 'clickText' property is written when the button is clicked. Default is true
* **pressText**  
  Value written when user presses button if 'writeOnPress' property is true.  
  This property is also interpreted as an integer and used in the ‘pressed’ signal.  
  Note, the variableSubstitutions property is also applied to this property before writing. For example, if the property contains MY$(ITEM) and the variable substitutions contains ITEM=CAR, MYCAR will be written.  
  Note, for variables with enumerated values in the database, the text must match one of the enumerated values. So if a variable is set up to display ‘Off’ and ‘On’ instead of 0 or 1, then the press text must be ‘Off’ or ‘On’, not 0 or 1.
* **releaseText**  
  Value written when user releases button if 'writeOnRelease' property is true.  
  This property is also interpreted as an integer and used in the ‘released’ signal.   
  Note, the variableSubstitutions property is also applied to this property before writing. For example, if the property contains MY$(ITEM) and the variable substitutions contains ITEM=CAR, MYCAR will be written.  
  Note, for variables with enumerated values in the database, the text must match one of the enumerated values. So if a variable is set up to display ‘Off’ and ‘On’ instead of 0 or 1, then the press text must be ‘Off’ or ‘On’, not 0 or 1.
* **clickText**  
  Value written when user clicks button if 'writeOnClick' property is true and the button is unchecked.  
  This property is also interpreted as an integer and used in the ‘clicked’ signal when the button is unchecked.   
  Note, the variableSubstitutions property is also applied to this property before writing. For example, if the property contains MY$(ITEM) and the variable substitutions contains ITEM=CAR, MYCAR will be written.  
  Note, for variables with enumerated values in the database, the text must match one of the enumerated values. So if a variable is set up to display ‘Off’ and ‘On’ instead of 0 or 1, then the press text must be ‘Off’ or ‘On’, not 0 or 1.
* **clickCheckedText**  
  Text used to compare with text written or read to determine if push button should be marked as checked.  
  Note, must be an exact match following formatting of data updates.  
  When writing values, the 'pressText', 'ReleaseText', or 'clickedtext' must match this property to cause the button to be checked when the write occurs.
  + **Good example:** formatting set to diaplay a data value of '1' as 'On', clickCheckedText is 'On', clickText is 'On'. In this example, the push button will be checked when a data update occurs with a value of 1 or when the button is clicked.
  + **Bad example:** formatting set to diaplay a data value of '1' as 'On', clickCheckedText is 'On', clickText is '1'. In this example, the push button will be checked when a data update occurs with a value of 1 but, although a valid value will be written when clicked, the button will not be checked when clicked as '1' is not the same as 'On'.

This property is also interpreted as an integer and used in the ‘clicked’ signal when the button is checked.   
Note, the variableSubstitutions property is also applied to this property before writing. For example, if the property contains MY$(ITEM) and the variable substitutions contains ITEM=CAR, MYCAR will be written.

**To read from a variable, the following properties are used:**

* **subscribe**  
  If checked, the button will read and present the current value defined by the ‘variable’ property. If the ‘altReadbackVariable’.property is define, it is used in preference to the ‘variable’ property
* **variable**If present, a value will be written to the variable when the button is operated.  
  The value of this variable can also be used to update the button text or image.
* **altReadbackVariable**If present, the value of this variable will be used to update the button text or image if required.
* **variable Substitutions**Macro substitutions to apply to ‘variable’ and ‘altReadbackVariable’ properties. Note, the variableSubstitutions property is also applied to pressText, releaseText, and clickText properties prior to writing, is applied to the labelText property if present, and is , and is used in any GUI filename and passed on to any new GUI launched by the QE button.
* **updateOption**  
  Used to determine if the data is presented textually using the button’s ‘text’ property, or graphically using the button’s ‘icon’ property, both textually and graphically, or if the data updates the buttons checked state.  
  Options are:
  + Text Data updates will update the button text
  + Icon Data updates will update the button icon
  + TextAndIcon Data updates will update the button text and icon
  + State Data updates will update the button state (checked or unchecked)
* **Pixmap0 to pixmap7**  
  Pixmap to display if updateOption is Icon or TextAndIcon and data value translates to an index between 0 and 7.
* **alignment**  
  Set the buttons text alignment.  
  Left justification is particularly useful when displaying quickly changing numeric data updates.

**General presentation:**

* **labelText**  
  Button label text (prior to substitution).  
  Macro substitutions from the variableSubstitutions property will be applied to this text and the result will be set as the button text.  
  Used when data updates are not being represented in the button text.  
  For example, a button in a sub form may have a 'labelText' property of 'Turn Pump $(PUMPNUM) On'.  
  When the sub form is used twice in a main form with substitutions PUMPNUM=1 and PUMPNUM=2 respectively, the two identical buttons in the sub forms will have the labels 'Turn Pump 1 On' and 'Turn Pump 2 On' respectively.

**A system command can be issued on a button click using the following properties:**

* **program**  
  Program to run when the button is clicked.  
  No attempt to run a program is made if this property is empty.  
  Example:  
   firefox
* **arguments**  
  Arguments for program specified in the 'program' property.

**A new GUI can be started on a button click using the following properties:**

* **guiFile**  
  File name of GUI to be presented on button click.  
  QEWidgets use a common set of rules for locating a file. Refer to Finding files (page 12) for details.
* **creationOption**  
  Creation options when opening a new GUI. Open a new window, open a new tab, or replace the current window.  
  The creation option is supplied when the button generates a newGui signal.  
  Application code connected to this signal should honour this request if possible.  
  When used within the QEGui application, the QEGui application creates a new window, new tab, or replaces the current window as appropriate.  
  Options are:
  + Open Replace the current GUI with the new GUI
  + NewTab Open new GUI in a new tab
  + NewWindow Open new GUI in a new window
* **variableSubstitutions**The variableSubstitutions property is applied to the GUI file name and added to the list of macro substations provided to the new form being opened by the QE button. The macro substitutions present in the variableSubstitutions property **do not** take precedence over any other macro substitutions already defined by any QEForm containing the button, or by the application. Note, the variableSubstitutions property is also used to provide default substitutions for the variable names, is applied to pressText, releaseText, and clickText properties prior to writing, and is applied to the labelText property if present.
* **prioritySubstitutions**  
  The prioritySubstitutions property is added to the list of macro substations provided to the new form being opened by the QE button. The macro substitutions present in the prioritySubstitutions property **do** take precedence over any other macro substitutions already defined by any QEForm containing the button, or by the application. Unlike the variableSubstitutions property, the prioritySubstitutions property is only added to the list of macro substitutions provided to a new GUI being launched by the QE button.  
  The prioritySubstitutions property is particularly useful when re-opening the form containing the QE button, but with different macro substitutions. The variableSubstitutions property can’t be used for this since the macro substitutions it contains do not take precedence over existing macro substitutions.

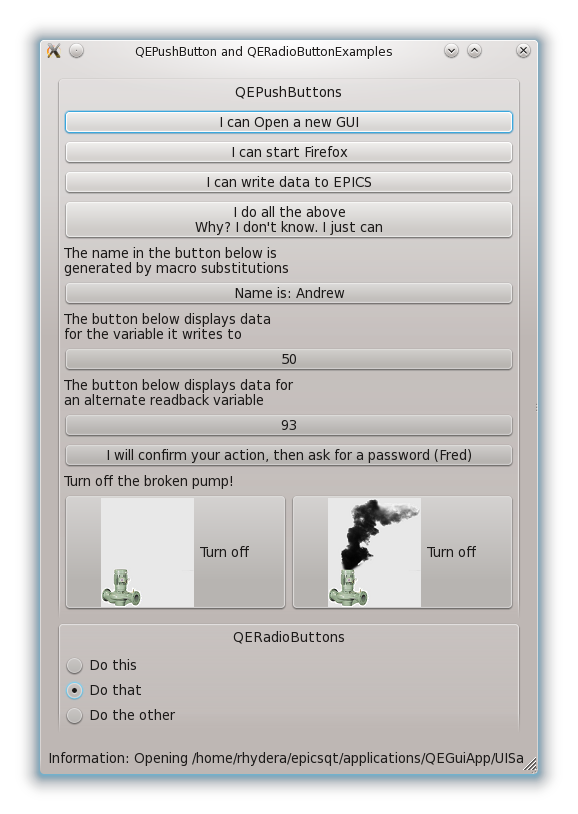


Figure QEPushButton and QERadioButton examples

## QEShape

## QESimpleShape

The QESimpleShape widget is an EPICS aware widget which uses either the alarm state or the value of a single PV to determine the colour of the shape. The shape itself is determined by the widget’s shape property, and may be one of: circle, ellipse, rectangle, roundRectangle, roundSquare, square, triangleUp, triangleDown, triangleLeft, triangleRight, diamond, or equalDiamond. The size of the shape is maximised to just fit within the geometry of the widget. For circle, square, roundSquare and equalDiamond the size is determined by the lesser of the widget’s width and height.

When the displayAlarmState (above) property is set true (the default), the colour of the widget is determined by the alarm state of the PV. Standard framework alarm colours are used, i.e. green for no alarm, yellow for minor alarm, red for major alarm and white for invalid alarm.

When the displayAlarmState property is set false, the value of the PV is used to select a colour from a set of 16 colour properties, i.e. color0, colour1, and so on to colour15. The value of the PV must be capable of being interpreted as an integer. Modulo 16 arithmetic is used to ensure the PV value yields a number in the range 0 to 15. The selection of the number of colours properties was some-what arbitrary. 16 was chosen so that a colour could be associated with each value of an mbbi/mbbo record.

Figure 20 below shows examples of this widget. All the QESimpleShape widgets are monitoring the same PV and have geometries which all have a width of 40 and a height of 20. The first row of widgets all have displayAlarmState set to false, and are blue because the value of the PV is 2 and color2 property has been set to blue. The second row of widgets all have displayAlarmState set to true, and are green because the PV’s severity is no alarm (the third row contains a QELabel which shows the actual value of the PV).



Figure QESimpleShape examples

When disconnected the QESimpleShape is displayed as washed-out gray with a light gray boarder.

Figure 21 below shows the properties values selected for the second row of widgets.



Figure QESimpleShape properties

## QESlider

## QESpinBox

## QEComboBox

## QEForm

The QEForm widget is used to present a Qt user interface (.ui) file. While an application can programmatically achieve this by opening a .ui file with a QFile class and loading the contents using the QUiLoader, the QEForm widget adds the following functionality:

* The QEForm uses consistant rules for locating the file common to all QE widgets that access files. Refer to Finding files (page 12) for details.
* The contents of a QEForm is dynamic and can be changed by changing the ‘uiFile’ property.
* The .ui file used to generate the contents of a QEForm is monitored and re-loaded if it changes.
* The QEForm can be used as a sub form. Forms can share common sub forms. Sub forms can be nested.
* The QEForm uses macro substitutions. This means a form can contain multiple instances of the same sub form, each with a different set of macro substitutions. For example, a form displaying a set of slits could use an identical sub form for each motor.

QEForms help manage messages emitted by QE widgets. Messages can be filtered and displayed based on the QEform they reside in. Refer to

* Logging (page 10) for details.
* The .ui file loaded by a QEForm widget will have a top level widget with size and layout policies that may differ to those of the QEForm. To minimise any confusion, the QEForm widget ensures the top level widget loaded and itself share the same size and layout policies. By default the QEForm widget sets the top level widget loaded to match itself, but this behaviour can be reversed. The ‘resizeContents’ property controls this behaviour. If true, the top level widget loaded is set to match the QEForm. If false, the QEForm is set to match the top level widget loaded.
* QERadioButtons and QEPushButtons look in the ContainerProfile class to see if a slot they can use to create new GUI windows is available. Applications like QEGui publish a slot to open new GUIs using this mechanism. If the ‘handleGuiLaunchRequests’ property is true, the QEForm widget publishes its own slot for launching new GUIs and so all QE widgets within it will use the QEForm’s mechanism for launching new GUIs.

The following properties are specific to the QEForm widget:

* uiFile  
  File name of the user interface file to be presented. Refer to Finding files (page 12) for details on how this file is located.
* handleGuiLaunch  
  If set the QEForm will supply the slot used by any QE widgets it creates to launch new QUIs. (Typically it is QE buttons that will use this slot.)  
  Generally this should be left unset when used within QEGui, allowing the QEGui application to supply the slot used to launch new GUI windows.
* resizeContents  
  If set, the QEForm will resize the top level widget of the .ui file it opens (and set other size and border related properties) to match itself. This is useful if the QEForm is used as a sub form within a main form (possible another QEForm) and you want to control the size of the QEForm being used as a sub form.  
  If clear, the QEForm will resize itself (and set other size and border related properties) to match the top level widget of the .ui file it opens. This is useful if the QEForm is used as a sub form within a main form (possible another QEForm) and you want to the main form to resize to match the size of the QEForm being used as a sub form, or you want the sub form border decorations (such as frame shape and shadow) to be displayed.

In Figure 22, the QEGui application is displaying a user interface (.ui) file. QEGui uses QEForms to present .ui files. In the example given, the .ui file itself includes three QEForm widgets, each referencing the same sub form, but with different macro substitutions, resulting in a different title and the display of data from different variables. In this example the top level widget in the sub form is a QFrame with a border. To ensure the border is displayed, the QEForm widgets in the main form have their ‘resizeContents’ property set to false so the contents (the top level QFrame in the sub form) copies its border properties to the QEFrame, rather than the other way around.



Figure QEForm examples

## QEPlot

## QEImage

The QEImage widget is used to present an EPICS waveform (typically from areaDetector) as an image. It provides local analysis tools, such as displaying pixel profiles of slices through the image, and interacts with central analysis tools, such as areaDetector’s Region of Interest plugin.

Images can be zoomed, panned, and scrolled. Images views can be captured to a local file.

The image has functionality to support sample positioning.

An image input for the QEImage is defined using the following properties:

* imageVariable An EPICS waveform record (typically from areaDetector)
* widthVariable An EPICS record (typically from areaDetector)
* heightVariable An EPICS record (typically from areaDetector)
* formatOption The expected pixel format (unrelated to the data type of the waveform record, except that the pixel format must fit in the waveform record data type)

QEImage user interaction is as follows:

* To pause image updating, press pause.png if the Button Bar is displayed, or select ‘Pause’ from the Right Click menu. To resume image updating, press play.png if the Button Bar is displayed, or select ‘Play’ from the Right Click menu.
* To save the current image to a local file, press save.png if the Button Bar is displayed, or select ‘Save...’ from the Right Click menu.
* To move the target position into the beam, mark the target and beam positions and press target.png on the Button Bar. To mark the target and beam, select ‘Mark Target’ and ‘Mark Beam’ from the select menu (available on the button bar and in the right click menu) and mark the target and beam positions on the image with the mouse. When target.png is pressed, the EPICS variables representing the target and beam will be updated with pixel coordinates and the target trigger variable will be updated.(Note, the coordinates represent coordinates in the original image and are not affected by how the image is zoomed.) Two EPICS calc records can then be used to perform the required move in each dimension. Each calc record subtracts the target position from the beam position, applies a scaling factor to convert pixels to distance, adds this to the current position of the target and writes the result to the target positioned.  
  Target and Beam markers can be seen selected in Figure 23.  
  The EPICS variables written to when marking the beam and target are defined by the following properties:
  + targetXVariable
  + targetYVariable
  + beamXVariable
  + beamYVariable
  + targetTriggerVariable
* To zoom, either:
  + Select the required zoom percentage from the ‘Zoom’ menu on the button bar or in the right click menu.
  + Select ‘Fit’ from the ‘Zoom’ menu on the button bar or in the right click menu to zoom to a percentage that will fit the image in the current window. The image will be resized if the window size changes.
  + Choose ‘Select Area 1’ (Region 1) from the Mode menu on the button bar or from the right click menu, select an area within the image, then select ‘Selected Area’ from the ‘Zoom’ menu on the button bar or in the right click menu.

The image may zoomed and set to an initial scroll position by default using the following properties:

* + resizeOption
  + zoom
  + initialHosScrollPos
  + initialVertScrollPos
* To rotate an image by 90 degrees clockwise or anticlockwise, or 180 degrees, select the appropriate option from the Flip/Rotate menu. Refer to Figure 26 for an example of rotated images.  
  The image may be rotated by default using the following property:
  + rotation
* To flip image vertically or horizontally, select the appropriate options from the Flip/Rotate menu. Refer to Figure 26 for an example of flipped images.  
  The image may be flipped by default using the following properties:
  + verticalFlip
  + horizontalFlip
* To apply contract reversal to an image (present a negative view), select the ‘Contract Reversal from the right click menu. Refer to Figure 26 for an example of contrast reversal.  
  The image contrast may be reversed by default using the following property:
  + contrastReversal
* To display a timestamp in the top left corner of the image, select ‘Show Time’ from the right click menu.  
  The timestamp may be shown by default using the following property:
  + showTime
* To present a profile of pixel values on a vertical ‘Horizontal Slice Profile’, ‘Vertical Slice Profile, or ‘Line Profile’ from the Mode menu and mark a vertical slice, a horizontal slice, or mark an arbitrary line on the image with the mouse. After the markup is drawn, the mouse can be used to drag the markup to a new location or, in the case of the arbitrary line, can also be used to drag either end of the line to a new location. The mark-ups can be cleared by right clicking over the outline and selecting ‘Clear’  
  Figure 23 shows an image with Vertical, Horizontal and arbitrary profiles selected.  
  The profile thickness can be changed from a single line by grabbing the square handle in the middle of the line and moving the line boundary as required. The line boundary lines (dashed) can be grabbed anywhere and dragged to change the line thickness. When dragged back to the centre line the dashed boundary lines disappear, the thickness reverts to a single pixel, and the square handle used to set the thickness reappears in the centre of the line. The line thickness can also be returned to single line thickness from the line’s context menu.  
  The profile plots are simple indicative plots of the profile data. For more detailed analysis, the profile data presented in the plot can be copied by selecting ‘Copy Plot Data’ from the plot context menu. This can then be pasted into another program such as Excel. Note the data displayed and copied is generated from the most resent image update using the full original image data. It is unaffected by the current zoom level. The current zoom level will affect how accurately the lines can be positioned.
* To set the area in up to 4 areaDetector Region of Interest plugins, select ‘Select Area 1’, ‘Select Area 2’, ‘Select Area 3’ or ‘Select Area 4’ from the Mode menu on the button bar or in the right click menu, and mark the area in the image using the mouse. When marked, the four EPICS areaDetector variables representing the Region of Interest area position and size will be updated. Figure 25 shows an example of this.  
  After the area mark-ups are drawn, the mouse can be used to drag the markups to a new location to drag individual sides or corners to a new location. The area can be cleared by right clicking over the outline and selecting ‘Clear’  
  The four EPICS areaDetector variables for each area are defined by the following properties:
  + regionOfInterest1XVariable
  + regionOfInterest1YVariable
  + regionOfInterest1WVariable (width)
  + regionOfInterest1HVariable (height)
  + regionOfInterest2XVariable
  + regionOfInterest2YVariable
  + regionOfInterest2WVariable (width)
  + regionOfInterest2HVariable (height)
  + regionOfInterest3XVariable
  + regionOfInterest3YVariable
  + regionOfInterest3WVariable (width)
  + regionOfInterest3HVariable (height)
  + regionOfInterest4XVariable
  + regionOfInterest4YVariable
  + regionOfInterest4WVariable (width)
  + regionOfInterest4HVariable (height)
* Image clipping can be achieved by defining clipping variables with the following properties:
  + clippingLowVariable
  + clipingHighVariable
  + clipingOnOffVariable
* To simplify the user interfaces, some options can be disabled by default using the following properties:
  + enableVertSliceSelection
  + enableHozSliceSelection
  + enableProfileSliceSelection
  + enableAreaSliceSelection (for all area and region selection)
  + enableTargetSliceSelection (for beam and target selection)
* Markup colors can be altered using the following properties:
  + vertSliceColor
  + hozSliceColor
  + profilecolor
  + areaColor
  + beamColor
  + targetColor
  + timeColor
* Local brightness and contrast controls can be enabled by setting the enableBrightnessContrast property, or by checking ‘Display local brightness and contrast controls’ from the widget’s context menu. Brightness and contrast can then be set by moving the brightness and contrast sliders as required. Local brightness and contrast are independant of areaDetector brightness and contrast settings. If ‘auto brightness and contrast’ is checked then selecting any area or region of interest will cause the brightness and contrast to be adjusted so match the range of pixel in the selected area. The reset button above the brightness and contrast sliders can be pressed to reset the controls to ‘normal’.



Figure QEImage with most options activated



Figure Minimal use of QEImage



Figure QEImage specifying areaDetector Region of Interest



Figure Some QEImage image manipulation options

## QEFrame and QEGroupBox

The QEFrame and QEGroupBox widgets provide a minimalist extension to the QFrame and QGroupBox widgets respectively. It provides user level enabled and user level visibility control to the frame or group box but more significantly to all the widgets enclosed within the QEFrame or QEGroupBox container also. The User Level example in Figure 2 (page 9) shows a QEGroupBox only visible in ‘Engineer’ mode.

## QELink

The QELink widget is part of a general mechanism to allow a GUI to be modified by data changes. For example, to disable a GroupBox if a variable is equal to a nominated value.

QELink widgets are only visible while in Designer. After placing them in a GUI the appropriate signals/slots connections and properties are defined to configure the GUI behaviour based on PV values. Then when opened in QEGui (or in any application except Designer) the functionality remains, but the QELink widget itself is hidden.

Typically, a QE widget sends data update signals to a QELink widget which makes a comparison and signals a value to another widget depending on the comparison result. The output signal can be used to set a widget invisible, or enabled, or click a button, or set focus, or raise, or...

In Figure 27, A QELink widget (circled) is configured to receive data update signals from a QELabel displaying beam current. It compares this to 205 (mA) and if greater sends a signal to enable the group box on the right. The signals used and the relevant QELink Properties are shown in the figure. Figure 28 shows this GUI in use by the QEGui display application. The QELink widget is not visible. The ‘Shutdown’ group box on the right is not enabled as the beam current is less than 205 mA.

The QELink widget can be make visible at all times by setting the ‘visible’ property.

Traditionally, the type of GUI functionality QELink widgets support has been effected by using EPICS database variables (often CALC records) to determine the state of GUI items. Where the variable is primarily a part of the control system this is appropriate. Where the variable is only present to support the GUI, then this functionality should be embedded in the GUI.



Figure QELink being configured



Figure QELink in use

# Appendix A

## GNU Free Documentation Licence

GNU Free Documentation License

Version 1.3, 3 November 2008

Copyright (C) 2000, 2001, 2002, 2007, 2008 Free Software Foundation, Inc.

<http://fsf.org/>

Everyone is permitted to copy and distribute verbatim copies

of this license document, but changing it is not allowed.

0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other functional and useful document "free" in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially.

Secondarily, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of "copyleft", which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free

software, because free software needs free documentation: a free

program should come with manuals providing the same freedoms that the

software does. But this License is not limited to software manuals;

it can be used for any textual work, regardless of subject matter or

whether it is published as a printed book. We recommend this License

principally for works whose purpose is instruction or reference.

1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that

contains a notice placed by the copyright holder saying it can be

distributed under the terms of this License. Such a notice grants a

world-wide, royalty-free license, unlimited in duration, to use that

work under the conditions stated herein. The "Document", below,

refers to any such manual or work. Any member of the public is a

licensee, and is addressed as "you". You accept the license if you

copy, modify or distribute the work in a way requiring permission

under copyright law.

A "Modified Version" of the Document means any work containing the

Document or a portion of it, either copied verbatim, or with

modifications and/or translated into another language.

A "Secondary Section" is a named appendix or a front-matter section of

the Document that deals exclusively with the relationship of the

publishers or authors of the Document to the Document's overall

subject (or to related matters) and contains nothing that could fall

directly within that overall subject. (Thus, if the Document is in

part a textbook of mathematics, a Secondary Section may not explain

any mathematics.) The relationship could be a matter of historical

connection with the subject or with related matters, or of legal,

commercial, philosophical, ethical or political position regarding

them.

The "Invariant Sections" are certain Secondary Sections whose titles

are designated, as being those of Invariant Sections, in the notice

that says that the Document is released under this License. If a

section does not fit the above definition of Secondary then it is not

allowed to be designated as Invariant. The Document may contain zero

Invariant Sections. If the Document does not identify any Invariant

Sections then there are none.

The "Cover Texts" are certain short passages of text that are listed,

as Front-Cover Texts or Back-Cover Texts, in the notice that says that

the Document is released under this License. A Front-Cover Text may

be at most 5 words, and a Back-Cover Text may be at most 25 words.

A "Transparent" copy of the Document means a machine-readable copy,

represented in a format whose specification is available to the

general public, that is suitable for revising the document

straightforwardly with generic text editors or (for images composed of

pixels) generic paint programs or (for drawings) some widely available

drawing editor, and that is suitable for input to text formatters or

for automatic translation to a variety of formats suitable for input

to text formatters. A copy made in an otherwise Transparent file

format whose markup, or absence of markup, has been arranged to thwart

or discourage subsequent modification by readers is not Transparent.

An image format is not Transparent if used for any substantial amount

of text. A copy that is not "Transparent" is called "Opaque".

Examples of suitable formats for Transparent copies include plain

ASCII without markup, Texinfo input format, LaTeX input format, SGML

or XML using a publicly available DTD, and standard-conforming simple

HTML, PostScript or PDF designed for human modification. Examples of

transparent image formats include PNG, XCF and JPG. Opaque formats

include proprietary formats that can be read and edited only by

proprietary word processors, SGML or XML for which the DTD and/or

processing tools are not generally available, and the

machine-generated HTML, PostScript or PDF produced by some word

processors for output purposes only.

The "Title Page" means, for a printed book, the title page itself,

plus such following pages as are needed to hold, legibly, the material

this License requires to appear in the title page. For works in

formats which do not have any title page as such, "Title Page" means

the text near the most prominent appearance of the work's title,

preceding the beginning of the body of the text.

The "publisher" means any person or entity that distributes copies of

the Document to the public.

A section "Entitled XYZ" means a named subunit of the Document whose

title either is precisely XYZ or contains XYZ in parentheses following

text that translates XYZ in another language. (Here XYZ stands for a

specific section name mentioned below, such as "Acknowledgements",

"Dedications", "Endorsements", or "History".) To "Preserve the Title"

of such a section when you modify the Document means that it remains a

section "Entitled XYZ" according to this definition.

The Document may include Warranty Disclaimers next to the notice which

states that this License applies to the Document. These Warranty

Disclaimers are considered to be included by reference in this

License, but only as regards disclaiming warranties: any other

implication that these Warranty Disclaimers may have is void and has

no effect on the meaning of this License.

2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either

commercially or noncommercially, provided that this License, the

copyright notices, and the license notice saying this License applies

to the Document are reproduced in all copies, and that you add no

other conditions whatsoever to those of this License. You may not use

technical measures to obstruct or control the reading or further

copying of the copies you make or distribute. However, you may accept

compensation in exchange for copies. If you distribute a large enough

number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and

you may publicly display copies.

3. COPYING IN QUANTITY

If you publish printed copies (or copies in media that commonly have

printed covers) of the Document, numbering more than 100, and the

Document's license notice requires Cover Texts, you must enclose the

copies in covers that carry, clearly and legibly, all these Cover

Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on

the back cover. Both covers must also clearly and legibly identify

you as the publisher of these copies. The front cover must present

the full title with all words of the title equally prominent and

visible. You may add other material on the covers in addition.

Copying with changes limited to the covers, as long as they preserve

the title of the Document and satisfy these conditions, can be treated

as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit

legibly, you should put the first ones listed (as many as fit

reasonably) on the actual cover, and continue the rest onto adjacent

pages.

If you publish or distribute Opaque copies of the Document numbering

more than 100, you must either include a machine-readable Transparent

copy along with each Opaque copy, or state in or with each Opaque copy

a computer-network location from which the general network-using

public has access to download using public-standard network protocols

a complete Transparent copy of the Document, free of added material.

If you use the latter option, you must take reasonably prudent steps,

when you begin distribution of Opaque copies in quantity, to ensure

that this Transparent copy will remain thus accessible at the stated

location until at least one year after the last time you distribute an

Opaque copy (directly or through your agents or retailers) of that

edition to the public.

It is requested, but not required, that you contact the authors of the

Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under

the conditions of sections 2 and 3 above, provided that you release

the Modified Version under precisely this License, with the Modified

Version filling the role of the Document, thus licensing distribution

and modification of the Modified Version to whoever possesses a copy

of it. In addition, you must do these things in the Modified Version:

A. Use in the Title Page (and on the covers, if any) a title distinct

from that of the Document, and from those of previous versions

(which should, if there were any, be listed in the History section

of the Document). You may use the same title as a previous version

if the original publisher of that version gives permission.

B. List on the Title Page, as authors, one or more persons or entities

responsible for authorship of the modifications in the Modified

Version, together with at least five of the principal authors of the

Document (all of its principal authors, if it has fewer than five),

unless they release you from this requirement.

C. State on the Title page the name of the publisher of the

Modified Version, as the publisher.

D. Preserve all the copyright notices of the Document.

E. Add an appropriate copyright notice for your modifications

adjacent to the other copyright notices.

F. Include, immediately after the copyright notices, a license notice

giving the public permission to use the Modified Version under the

terms of this License, in the form shown in the Addendum below.

G. Preserve in that license notice the full lists of Invariant Sections

and required Cover Texts given in the Document's license notice.

H. Include an unaltered copy of this License.

I. Preserve the section Entitled "History", Preserve its Title, and add

to it an item stating at least the title, year, new authors, and

publisher of the Modified Version as given on the Title Page. If

there is no section Entitled "History" in the Document, create one

stating the title, year, authors, and publisher of the Document as

given on its Title Page, then add an item describing the Modified

Version as stated in the previous sentence.

J. Preserve the network location, if any, given in the Document for

public access to a Transparent copy of the Document, and likewise

the network locations given in the Document for previous versions

it was based on. These may be placed in the "History" section.

You may omit a network location for a work that was published at

least four years before the Document itself, or if the original

publisher of the version it refers to gives permission.

K. For any section Entitled "Acknowledgements" or "Dedications",

Preserve the Title of the section, and preserve in the section all

the substance and tone of each of the contributor acknowledgements

and/or dedications given therein.

L. Preserve all the Invariant Sections of the Document,

unaltered in their text and in their titles. Section numbers

or the equivalent are not considered part of the section titles.

M. Delete any section Entitled "Endorsements". Such a section

may not be included in the Modified Version.

N. Do not retitle any existing section to be Entitled "Endorsements"

or to conflict in title with any Invariant Section.

O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or

appendices that qualify as Secondary Sections and contain no material

copied from the Document, you may at your option designate some or all

of these sections as invariant. To do this, add their titles to the

list of Invariant Sections in the Modified Version's license notice.

These titles must be distinct from any other section titles.

You may add a section Entitled "Endorsements", provided it contains

nothing but endorsements of your Modified Version by various

parties--for example, statements of peer review or that the text has

been approved by an organization as the authoritative definition of a

standard.

You may add a passage of up to five words as a Front-Cover Text, and a

passage of up to 25 words as a Back-Cover Text, to the end of the list

of Cover Texts in the Modified Version. Only one passage of

Front-Cover Text and one of Back-Cover Text may be added by (or

through arrangements made by) any one entity. If the Document already

includes a cover text for the same cover, previously added by you or

by arrangement made by the same entity you are acting on behalf of,

you may not add another; but you may replace the old one, on explicit

permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License

give permission to use their names for publicity for or to assert or

imply endorsement of any Modified Version.

5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this

License, under the terms defined in section 4 above for modified

versions, provided that you include in the combination all of the

Invariant Sections of all of the original documents, unmodified, and

list them all as Invariant Sections of your combined work in its

license notice, and that you preserve all their Warranty Disclaimers.

The combined work need only contain one copy of this License, and

multiple identical Invariant Sections may be replaced with a single

copy. If there are multiple Invariant Sections with the same name but

different contents, make the title of each such section unique by

adding at the end of it, in parentheses, the name of the original

author or publisher of that section if known, or else a unique number.

Make the same adjustment to the section titles in the list of

Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections Entitled "History"

in the various original documents, forming one section Entitled

"History"; likewise combine any sections Entitled "Acknowledgements",

and any sections Entitled "Dedications". You must delete all sections

Entitled "Endorsements".

6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other

documents released under this License, and replace the individual

copies of this License in the various documents with a single copy

that is included in the collection, provided that you follow the rules

of this License for verbatim copying of each of the documents in all

other respects.

You may extract a single document from such a collection, and

distribute it individually under this License, provided you insert a

copy of this License into the extracted document, and follow this

License in all other respects regarding verbatim copying of that

document.

7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate

and independent documents or works, in or on a volume of a storage or

distribution medium, is called an "aggregate" if the copyright

resulting from the compilation is not used to limit the legal rights

of the compilation's users beyond what the individual works permit.

When the Document is included in an aggregate, this License does not

apply to the other works in the aggregate which are not themselves

derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these

copies of the Document, then if the Document is less than one half of

the entire aggregate, the Document's Cover Texts may be placed on

covers that bracket the Document within the aggregate, or the

electronic equivalent of covers if the Document is in electronic form.

Otherwise they must appear on printed covers that bracket the whole

aggregate.

8. TRANSLATION

Translation is considered a kind of modification, so you may

distribute translations of the Document under the terms of section 4.

Replacing Invariant Sections with translations requires special

permission from their copyright holders, but you may include

translations of some or all Invariant Sections in addition to the

original versions of these Invariant Sections. You may include a

translation of this License, and all the license notices in the

Document, and any Warranty Disclaimers, provided that you also include

the original English version of this License and the original versions

of those notices and disclaimers. In case of a disagreement between

the translation and the original version of this License or a notice

or disclaimer, the original version will prevail.

If a section in the Document is Entitled "Acknowledgements",

"Dedications", or "History", the requirement (section 4) to Preserve

its Title (section 1) will typically require changing the actual

title.

9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document

except as expressly provided under this License. Any attempt

otherwise to copy, modify, sublicense, or distribute it is void, and

will automatically terminate your rights under this License.

However, if you cease all violation of this License, then your license

from a particular copyright holder is reinstated (a) provisionally,

unless and until the copyright holder explicitly and finally

terminates your license, and (b) permanently, if the copyright holder

fails to notify you of the violation by some reasonable means prior to

60 days after the cessation.

Moreover, your license from a particular copyright holder is

reinstated permanently if the copyright holder notifies you of the

violation by some reasonable means, this is the first time you have

received notice of violation of this License (for any work) from that

copyright holder, and you cure the violation prior to 30 days after

your receipt of the notice.

Termination of your rights under this section does not terminate the

licenses of parties who have received copies or rights from you under

this License. If your rights have been terminated and not permanently

reinstated, receipt of a copy of some or all of the same material does

not give you any rights to use it.

10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the

GNU Free Documentation License from time to time. Such new versions

will be similar in spirit to the present version, but may differ in

detail to address new problems or concerns. See

http://www.gnu.org/copyleft/.

Each version of the License is given a distinguishing version number.

If the Document specifies that a particular numbered version of this

License "or any later version" applies to it, you have the option of

following the terms and conditions either of that specified version or

of any later version that has been published (not as a draft) by the

Free Software Foundation. If the Document does not specify a version

number of this License, you may choose any version ever published (not

as a draft) by the Free Software Foundation. If the Document

specifies that a proxy can decide which future versions of this

License can be used, that proxy's public statement of acceptance of a

version permanently authorizes you to choose that version for the

Document.

11. RELICENSING

"Massive Multiauthor Collaboration Site" (or "MMC Site") means any

World Wide Web server that publishes copyrightable works and also

provides prominent facilities for anybody to edit those works. A

public wiki that anybody can edit is an example of such a server. A

"Massive Multiauthor Collaboration" (or "MMC") contained in the site

means any set of copyrightable works thus published on the MMC site.

"CC-BY-SA" means the Creative Commons Attribution-Share Alike 3.0 license published by Creative Commons Corporation, a not-for-profit corporation with a principal place of business in San Francisco,

California, as well as future copyleft versions of that license published by that same organization.

"Incorporate" means to publish or republish a Document, in whole or in

part, as part of another Document.

An MMC is "eligible for relicensing" if it is licensed under this

License, and if all works that were first published under this License somewhere other than this MMC, and subsequently incorporated in whole or

in part into the MMC, (1) had no cover texts or invariant sections, and

(2) were thus incorporated prior to November 1, 2008.

The operator of an MMC Site may republish an MMC contained in the site under CC-BY-SA on the same site at any time before August 1, 2009, provided the MMC is eligible for relicensing.

ADDENDUM: How to use this License for your documents

To use this License in a document you have written, include a copy of

the License in the document and put the following copyright and

license notices just after the title page:

Copyright (c) YEAR YOUR NAME.

Permission is granted to copy, distribute and/or modify this document

under the terms of the GNU Free Documentation License, Version 1.3

or any later version published by the Free Software Foundation;

with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts.

A copy of the license is included in the section entitled "GNU

Free Documentation License".

If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts,

replace the "with...Texts." line with this:

with the Invariant Sections being LIST THEIR TITLES, with the

Front-Cover Texts being LIST, and with the Back-Cover Texts being LIST.

If you have Invariant Sections without Cover Texts, or some other

combination of the three, merge those two alternatives to suit the

situation.

If your document contains nontrivial examples of program code, we

recommend releasing these examples in parallel under your choice of

free software license, such as the GNU General Public License,

to permit their use in free software.