EPICS Qt at GitHub

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# Introduction

Welcome to EPICS Qt at GitHub.

EPICS Qt is a layered framework based on Qt for accessing Experimental Physics and Industrial Control System (EPICS) data using Channel Access (CA). Designed for rapid development of control system graphical interfaces, initially developed at the Australian Synchrotron.

The QE Framework can be used in three ways:

* **Code Free GUI systems** using Qt's Designer application with the QE Framework plugin to design GUIs, and the QEGui application to present GUIs to users.
* **Code Rich GUI development** using Qt's Integrated Development Environment with the QE Framework widgets and data objects to design GUI applications.
* **Console application development** using Qt's Integrated Development Environment with the QE Framework data objects to design console applications that can access EPICS data.

Note, there are many variations to the above, such as using another Integrated Development Environment like Eclipse, or developing new plugin widgets to implement desired functionality, then using those widgets within a code free GUI development.

Other documents you may be interested in are:

* [QE\_QEGuiAndUserInterfaceDesign.pdf](https://github.com/qtepics/qeframework/blob/master/documentation/QE_QEGuiAndUserInterfaceDesign.pdf) - All documentation for developing code free GUI applications.
* [QE\_FrameworkOverview.pdf](https://github.com/qtepics/qeframework/blob/master/documentation/QE_FrameworkOverview.pdf) - Technical overview of the QE framework.
* [QE\_ReferenceManual.pdf](https://github.com/qtepics/qeframework/blob/master/documentation/QE_ReferenceManual.pdf) - Reference manual for programmers using QE widgets and classes.

# Quick Road-map for Code Free GUI Development

* **Ensure you have**: EPICS, Qt and QWT installed – see Prerequisites for EPICS Qtbelow.
* **Download source** – see Download source code and documentationbelow.
* **Set up build environment**, i.e. the RELEASE files – see Modify RELEASE files; and 2 environment variables – see [environment variables](https://qtepics.github.io/environment_variables.html).
* **Build framework** – see Build Plugin Library and Display Manager*.*
* **Build qegui** (display manager) – see Build Plugin Library and Display Manager*.*
* **Set up run time environment** (environment variables) – – see [environment variables](https://qtepics.github.io/environment_variables.html).
* **Run** *qegui*.

# Structure

This describes how the repositories at GitHub are organised.  
  
The transfer of the EPICS Qt framework from SourceForge to GitHub has been an ideal opportunity for a few organisational changes. These are outlined below. There were no major functionality changes per se as part of the initial transfer.  
  
The major transfer change was that EPICS Qt was been split into a number of components, each managed in its own GitHub repository.  
  
The two primary repositories are the [QE Framework](https://github.com/qtepics/qeframework) repository which provides the framework functional and plugin libraries and the [QEGui Display Manager](https://github.com/qtepics/qegui) repository which provides the *qegui* display manager. The documentation is included within the qeframework repository.  
  
The other repositories are optional, and basically provide examples of using or extending the framework.

* [QE Monitor](https://github.com/qtepics/qeMonitor)
* [QE Read Archive](https://github.com/qtepics/qeReadArchive)
* [QE Widget Display](https://github.com/qtepics/qeWidgetDisplay)
* [QE Example Plugin](https://github.com/qtepics/qeExamplePlugin)
* [QE Byte Array Test](https://github.com/qtepics/qeByteArrayTest)

There is no longer an epicsqt.pro overall project file to build all sub projects. Each repository still has its own project file(s), e.g. framework.pro, QEGuiApp.pro, and these may be opened by *qtcreator* in order to build each component as could be done previously.

However, each component is now located within its own EPICS *top* directory that allows the component to be readily and headlessly built in a much more EPICS-like fashion by just calling make from within the *top* directory. Under-the-covers, each component's application directory's own Makefile essentially invokes *qmake* and then make on the generated Makefile.

In the case of qeframework, the include files are placed in *top*/include and the shared library/dll file is placed in *top*/lib/*epics\_host\_arch*. In the case of qegui, this is located in *top*/bin/*epics\_host\_arch*. The use of the environment variable QE\_TARGET\_DIR may still be used to override this.

Each code repository has a **r3.4.2** tag which corresponds to the last SourceForge 3.4.2 release. The latest release is 3.5.2, and each repository has a corresponding **r3.5.2** tag.

# License

The EPICS QT Framework is free software: you can redistribute it and/or modify it under the terms of the GNU Lesser General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.

The EPICS QT Framework is distributed in the hope that it will be useful, but **WITHOUT ANY WARRANTY**; without even the implied warranty of **MERCHANTABILITY** or **FITNESS FOR A PARTICULAR PURPOSE**. See the GNU Lesser General Public License for more details.

You should have received a copy of the GNU Lesser General Public License along with the EPICS QT Framework. If not, see <https://www.gnu.org/licenses/>.

# Prerequisites for EPICS Qt

### Install/build EPICS

Please visit the [EPICS](http://www.aps.anl.gov/epics/) web page for details, or speak to your local EPICS expert.

### Install Qt

Versions 4.6, 4.8.4, 5.6, 5.7, 5.9 and 5.10 have been successfully used at the Australian Synchrotron. Version 4.8.4 is the earliest version we now actively support. For a new user I would recommend Qt 5. Qt is available from <https://www.qt.io/>.

### Install QWT

The version must be compatible with your version of Qt. Please visit <http://qwt.sourceforge.net/>.

### Prepare Environment for EPICS Archiver Appliance (Optional)

Please visit [EPICS Archiver Appliance support documentation.](https://qtepics.github.io/archiver_appliance.html)

### Example Configurations

The following configuration combinations have all recently been built at the Australian Synchrotron.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Host OS | Compiler | EPICS HOST ARCH | **EPICS** | **QWT** | **QT** | **EpicsQt** |
| Linux CentOS release 6.8 | g++ (GCC) 4.8.2 | linux-x86\_64 | 3.14.12.4 | 5.1.1 | 4.6.2 | 3.3.1 |
| Linux CentOS release 6.8 | g++ (GCC) 4.8.2 | linux-x86 | 3.14.12.4 | 5.1.1 | 4.6.2 | 3.3.1 |
| Linux CentOS release 6.9 | g++ (GCC) 4.4.7 | linux-x86\_64 | 3.15.5 | 5.1.1 | 4.8.4 | 3.4.2 |
| Linux CentOS release 7.3.1611 | g++ (GCC) 4.8.5 | linux-x86\_64 | 3.14.12.4 | 6.1.1 | 4.8.5 | 3.3.1 |
| Linux CentOS release 7.3.1611 | g++ (GCC) 4.8.5 | linux-x86\_64 | 3.15.5 | 6.1.3 | 5.7.1 | 3.4.2 |
| Linux CentOS release 7.3.1611 | g++ (GCC) 4.8.5 | linux-x86\_64 | 3.15.5 | 6.1.3 | 5.8.0 | 3.4.3 |
| Linux CentOS release 7.3.1611 | g++ (GCC) 4.8.5 | linux-x86\_64 | 3.15.5 | 6.1.3 | 5.9.0 | 3.4.3+ |
| Windows 7 | g++ 4.6.2 | win32-x86-mingw | 3.14.12.3 | 6.0.1 | 4.8.5 | 3.4.2 |
| Windows 7 | g++ (i686-posix-dwarf-rev1, Built by MinGW-W64 project) 4.9.2 | win32-x86-mingw | 3.14.12.4 | 6.1.3 | 5.6 | 3.4.2 |
| Windows 7 | MSVC 14.0, 64 bit | windows-x64 | 3.14.12.3 | 6.1.3 | 5.7.0 | 3.4.3 |
| Windows 8.1 | mingw 4.9.2 32 bit | win32-x86-mingw | 3.15.3 | 6.1.3 | 5.5.1 | 3.4.3 |
| Windows 10 Pro | Microsoft Visual C++ Compiler 15.0 (amd64) | windows-x64 | 3.15.5 | 6.1.3 | 5.9 | 3.4.3+ |
| Debian testing (Stretch) | GCC 6.3.0 | linux-x86\_64 | 3.15.5 | 6.1.2 | 4.8.7 | 3.4.2+ |

Please visit [Andrew Rhyder's Windows 10 notes](https://qtepics.github.io/andrew_rhyder_windows_10.html) for more information.

# Getting Started - Headless Build

There is a lot useful information in [QE\_GettingStarted.pdf](https://github.com/qtepics/qeframework/blob/master/documentation/QE_GettingStarted.pdf), however this document still refers to the old structure and to SourceForge as the source, so must be read taking that into account.

The commands shown here illustrate downloading and building epicsQt in the directory **/home/user/qtepics**. This is just for the purposes of providing example commands. You are free to to down load and install anywhere on your system. Replace the **green** part of the path in the examples below to suit your own environment.

Note: This instructions are currently Linux-centric, however Windows users should have no trouble translating these to the Windows equivalent.

### Download source code and documentation

Clone the framework and the qegui repositories.

mkdir -p /home/user/qtepics

cd /home/user/qtepics

git clone <https://github.com/qtepics/qeframework.git>

git clone <https://github.com/qtepics/qegui.git>

### Modify RELEASE files

Modify **/home/user/qtepics**/qeframework/configure/RELEASE file such that:

QE\_FRAMEWORK=/home/user/qtepics/qeframework  
 EPICS\_BASE=<a reference your EPICS base>

Modify **/home/user/qtepics**/qegui/configure/RELEASE file such that:

QE\_FRAMEWORK=/home/user/qtepics/qeframework  
 EPICS\_BASE=<a reference your EPICS base>

### Environment Variables

Define EPICS\_HOST\_ARCH (e.g. export EPICS\_HOST\_ARCH=linux-x86\_64)  
  
Define QWT\_INCLUDE\_PATH (e.g. export QWT\_INCLUDE\_PATH=/usr/include/qwt)  
  
*Optional:* Define QE\_FFMPEG if mpeg streaming is required (on Windows, this must point to the FFMPEG directory; on Linux just being defined is sufficient).  
  
*Optional:* Define QE\_CAQTDM if integration of PSI's caQtDM into QEGui is required. If you want caQtDM integrated, download and build it and define the environment variable QE\_CAQTDM to point to the caQtDM\_Project directory.

*Optional - deprecated:* Defining QE\_TARGER\_DIR forces libraries, header files and binaries to be built/installed into the nominated directory. This is not recommended and included for legacy purposes only. ***Note***: If this environment variable is defined, you ***must*** modify the QE\_FRAMEWORK definitions in the configure/RELEASE files to be consistent with this variable.

### qmake

When building in headless mode, the *qmake* program is invoked to generate a Makefile based on the project .pro file. Ensure that your PATH environment variable results in required version of qmake being available. For some versions of Qt 4, the *qmake* program is known as *qmake-qt4*. In this case it will be necessary to "fake" it, e.g.:

cd ${HOME}/bin

ln -s /usr/bin/qmake-qt4 qmake

or something similar. Also, *qmake* is called without the -spec option defined and relies on the default spec file (e.g. linux-g++) being suitable. If this is not the case then you must “fake” the *qmake* command to suit your environment. Alternatively, one could also modify the make files:

/home/user/qtepics/qeframework/qeframeworkSup/Makefile

/home/user/qtepics/qeframework/qepluginApp/Makefile

/home/user/qtepics/qegui/qeguiApp/Makefile

to suit your environment.

### MinGW compiler

Since commit 69d1623 (qeframework repository), the \_MINGW macro is automatically defined TRUE if the EPICS\_HOST\_ARCH is either “win32-x86-mingw” or “windows-x64-mingw”. See the **/home/user/qtepics**/qeframework/qeframeworkSup/project/framework.pro project file (approximately line 86) for details.

### QWT Version

For windows, you may have to modify the line (approximately line 244) to suit your version of QWT

win32:LIBS += -LC:/qwt-6.1.3/lib

### Build Plugin Library and Display Manager

cd /home/user/qtepics/qeframework

make

cd /home/user/qtepics/qegui

make

# Getting Started - qtcreator Build

There is a lot useful information in [QE\_GettingStarted.pdf](https://github.com/qtepics/qeframework/blob/master/documentation/QE_GettingStarted.pdf), however this document ***still*** refers to the old structure and to SourceForge as the source, so must be read ***taking*** that into account.

This getting started section assumes the reader is familiar with *qtcreator*.

As stated above, each Qt project, is now a separate stand-alone project – there is no overall project to build them all. One consequence of this is that qeframework, qeplugin and qegui are managed as separate Qt projects.

A second consequence is when building the QE Framework, *qtcreator* must be configured with an extra build step in install the header files so that they are available when building the *qeplugin* library, *qegui* or any other QE Framework client. This step is done automatically when using the headless build option above.

The third consequence is that in addition to the environment variables required for the headless build as described above, the environment variables EPICS\_BASE and QE\_FRAMEWORK *must* also be defined manually when using qtcreator.

### qeframework

Again using **/home/user/qtepics** as the git clone location, open the following project file in *qtcreator*:

/home/user/qtepics/qeframework/qeframeworkSup/project/framework.pro

During the qmake phase the following message is output.

Project MESSAGE: Note: By default qtcreator does not have a 'make install' build step. When using qtcreator, modify project

Project MESSAGE: ....: to add an install build step which is required to install header files to ../../include

Do do this, open the project build configuration page in *qtcreator* and click on Add Build Step button/combo box and select Make. In the Make arguments line edit specify install. In the existing regular make step, consider adding a “-j N” argument to allow parallel compilation (where N is the number of available CPU cores).



Note: if you know of a way of automatically adding this build step by adding some directive into the project file, do let me know.

A third issue is the Qt plugin path variable: QT\_PLUGIN\_PATH. A peculiarity of Qt is that this path is ***not*** a path of plugin libraries as one might expect, but a path to find directories called *designer* that contain plugin libraries. This is at odds with the EPICS build paradigm that expect to find libraries in *top*/lib/*epics\_host\_arch*. The headless build overcomes this issue by effectively doing both by creating an extra designer sub-directory and a symbolic (Linux) or hard (Windows) link. When using *qtcreator* there is no additional build step defined to achieve this, therefore it must be dome manually.

### qeplugin

Still using **/home/user/qtepics** at the git clone location, open the following project file in *qtcreator*:

/home/user/qtepics/qeframework/qepluginApp/project/qeplugin.pro

### qegui

Again using **/home/user/qtepics** as the example, open the following project file in *qtcreator* :

/home/user/qtepics/qegui/qeguiApp/project/QEGuiApp.pro

# Environment Variables

These are documented separately in [environment\_variables.html](https://qtepics.github.io/environment_variables.html).

# Future Plans

### Complete Transition to GitHub

Tidy up documentation, especially the getting started.

### Pre-Built Libraries and QEGui program

Provide a simple download and run capability for a number of common platforms.

### PV Access Integration

Some prototype work has started to handle NT Scalars and NT Scalar Arrays.

# Feed Back and Collaboration

Please email: andrew.starritt@synchrotron.org.au

# Release Notes

These are documented separately and are available [here](https://qtepics.github.io/release_notes.html).

# Credits

### Developers

Andrew Ryder, Glenn Jackson, Anthony Owen, Ricardo Fernandes, Anton Maksimenko, Andraz Pozar, Andrew Starritt.

### 3rd Party Software

Apart from EPICS base and Qt itself, the EPICS Qt framework uses the following.

The framework relies on QWT for plotting. <https://sourceforge.net/projects/qwt/>.

To access the Channel Access Archive data, the framework relies on the maiaXmlRpcClient and support classes written by Frerich Raabe <[raabe@kde.org](mailto:raabe@kde.org)>, Ian Reinhart Geiser <[geiseri@kde.org](mailto:geiseri@kde.org)>, Karl Glatz and Sebastian Wiedenroth <[wiedi@frubar.net](mailto:wiedi@frubar.net)>.

When build with EPICS Archiver Appliance support, the EPICS Qt framework relies on Google Protocol Buffers <https://developers.google.com/protocol-buffers/>

When built with MPEG support, the EPICS Qt framework relies on FFmpeg for reading MPEG image streams. <https://www.ffmpeg.org/> .

The QEGui application can be built to support caQtDM widgets provided by The Paul Scherrer Institute. <https://epics.web.psi.ch/software/caqtdm/>.

*Last updated: Wed Apr 18 18:31:04 AEST 2018*