

# Quarch Technology Ltd

## IEC Mains Power Analysis Module

### Technical Manual

For use with:

**QTL2843 – IEC Mains Power Analysis Module**



## Change History

1.0	October 2022	Initial release
1.1	November 2022	Updated pictures with new metalwork Added fuse change instructions and additional safety notes
1.2	22 <sup>nd</sup> May 2023	“Additional Safety Notes” edited to direct the user to the Service Manual for details on product maintenance.
1.3	25 <sup>th</sup> July 2023	Altered maximum load current across all 3 outputs to be 10A and changed the fuse to match the new 10A rating. Added note on hazardous voltages (page
1.4	24 <sup>th</sup> September 2024	Added quick-start section Updated averaging or FW 5.117

## Contents

<b>Change History</b> .....	<b>2</b>
<b>About this Manual</b> .....	<b>5</b>
<b>Product Safety</b> .....	<b>6</b>
Safety Warnings.....	6
Additional Safety Notes.....	6
Risk Assessment .....	8
Manufacturer Details .....	8
Environmental Conditions .....	8
Installation.....	9
Product Misuse .....	9
<b>In the Box</b> .....	<b>10</b>
<b>Technical Specifications</b> .....	<b>10</b>
Layout .....	11
<b>Introduction</b> .....	<b>13</b>
Getting Started - Connections.....	13
Getting Started – Software.....	18
<b>LEDs 19</b>	
Action LED .....	19
Status LED.....	19
<b>Connection and accessories</b> .....	<b>20</b>
<b>Capturing Data</b> .....	<b>21</b>
<b>Controlling the Module</b> .....	<b>22</b>
Communication protocol .....	22
Control options.....	23
<b>Default Startup State</b> .....	<b>24</b>
<b>Command Set</b> .....	<b>25</b>

Identify commands.....	25
Basic Setup commands .....	26
Ethernet commands.....	27
Debug Commands.....	29
Record Commands .....	30
Trigger Commands .....	33
<b>Customer support from Quarch.....</b>	<b>34</b>
Contact us direct.....	34
Access support from the Quarch website .....	34

## About this Manual

Thank you for your purchase of this Quarch Module. This manual is intended as a technical reference, describing the features, operations and control API of the unit.

Additional documents available include Quick start guides, Datasheets and Application notes. These can be located on our website: [www.quarch.com](http://www.quarch.com)

This manual provides the following:

- Safety information
- An overview of the product and its features
- Details of the control interfaces
- Command specification
- Locations of additional help and examples.

## Product Safety

This product is intended for experienced technical users in a test lab environment. It is essential that you are familiar with this manual before using the device.

### Safety Warnings

This product must be connected to an appropriate earthed mains supply.

There are no user serviceable parts inside; do **NOT** open the enclosure.

The unit is 2kg, and requires care to relocate it. Do not relocate while cables are plugged in.

While in use, this unit will have high voltages and currents travelling through it. Do **NOT** position the equipment so that it is difficult to disconnect from mains, and do **NOT** move the equipment while in use.

Hazardous voltages may be present on the plug pins.



### Additional Safety Notes

- A 250V, 10A rated cartridge fuse is used on this product for the live voltage between the input and the output test points. Please refer to the Service Manual for guidance on how this may be replaced.
- This product must be connected to an appropriate 12V DC, 0.8A supply or PoE injector. We recommend using the 30W PoE injector supplied with the product. Other supplies can be used but should be appropriately rated and IEC tested to LPS-PS2 or better. To avoid transient voltages, the PoE connection point and the equipment must be within the same building.
- The insulation rating of external circuitry may affect the safety of the test setup. Ensure any equipment connected to our module has at least basic insulation, with at least IEC Insulation Class I.
- Always ensure the module supply voltage (when provided via a 12V DC supply) and the mains supply are turned off before plugging or unplugging cables. Always take care when attaching or de-attaching cords.



## Risk Assessment

While these products have no significant hazard cases, they must be used carefully by competent personnel.

In new use cases, a risk assessment should be completed, to ensure the entire test setup is safe to operate and will not cause an unacceptable risk to the operators or other lab users.

This should include careful routing of power and control cables to avoid trip hazards, and positioning equipment so that it can be disconnected from mains with ease.

A risk assessment must be carried out if the fuse needs replacement. Ensure all equipment is turned off and unplugged before replacement.

## Manufacturer Details

The Torridon System is designed and manufactured by:

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## Environmental Conditions

The products are designed for use in dry, dust free, indoor lab conditions, at altitudes below 2000m and ambient temperatures between 10C-40°C and 0-80% non-condensing humidity. The intended environment is to be no more than Pollution Degree 2.

This device is of Overvoltage Category II, in accordance with EN 60664-1:2007 / VDE 0110-1.

## Installation

The product is designed for use on a desk/bench location.

The device is powered through either a 12V PSU or power over ethernet connection (PoE). Ensure the PoE connection point and equipment are within the same building, to avoid issues from transient voltages.

Ensure the device and any equipment plugged in are in secure in position, with no chance of any parts falling off the desk/bench location. Position the equipment so that it can be easily disconnected from mains.

## Product Misuse

The product is designed lab testing industry standard interfaces, complying with the relevant industry specifications. Other uses may cause incorrect operation, protection impairment or damage to the product and should be avoided.

## In the Box

Each IEC Mains PAM comes with the same basic kit of parts.

1x Main unit



1x USB cable for optional USB control



1x PoE injector and region-specific power cable



## Technical Specifications

### Layout

*Left panel of QTL2843*



*Right panel of QTL2843*



*Rear panel of QTL2843*



### Connections and indicators

Item	Location	Purpose
Status LED	Rear panel	Indicates the recording /action status
Action LED	Rear panel	Unit power on and fault state
USB-B	Rear panel	Connects to controlling PC
Reset	Rear panel	Recessed hard reset button
LAN	Rear panel	100Base-T network port for remote control PoE power supply input PoE Input: 48-56V $\overline{=}$ , 48mA Maximum
Power	Rear panel	12V DC 0.8A power supply input
C14 Input	Left panel	AC power input Terminal Input: 250VAC, 50/60Hz, 10A Maximum AC power supply input, which is connected through 3 independent measurement channels to the 3 C13 outputs “L1”, “L2” and “L3”.
Fuse holder	Left panel	250V, 10A rated cartridge fuse
C13 Outputs marked “L1”, “L2” and “L3”	Right panel	AC power outputs Each terminal Output: 250VAC, 50/60Hz. The sum of the loads across all 3 outputs should be less than the 10A maximum rating.

## Introduction

The IEC Mains Power Analysis Module (PAM) allows you to capture all key metrics needed to analyze AC performance.

Instantaneous voltage current and power are sampled 8000 times per second. RMS, phase, frequency, THD and much more are then calculated to give you a wide range of useful measurements.

The data can be captured in high resolution and viewed in real time in Quarch Power Studio. Full automation is also available.

## Getting Started – DUT Connections

*Connect the AC supply to the 'INPUT' connector*

*This is the power from the wall socket, and will be used to power your device  
Use a standard C13 cable*



*Connect one or more loads to the 'OUTPUT'*

*These are the devices you want to measure  
Use a C13 extension cable or adapter of your choice*



## Getting Started – Device Power & Comms

The device requires power, either from PoE (Power over Ethernet) or a separate 12v supply.



Only one should be connected at a time.

### PoE Switches

If you have an ethernet switch that supports PoE (common in many labs), you can simple connect a standard ethernet cable between your switch and the PoE port on the device. This will supply power and LAN connection.

## PoE Injector



To use the supplied injector:

- Connect the AC input cable to the wall power
- Connect the PoE port on the QTL2843 to the 'PoE & Data' port on the injector
- Connect the 'Data' port to your network (\*optional if you want to control via LAN)

### USB connection

Optionally connect the USB port on the QTL2843 to the PC you wish to control it from.

## Getting Started – Example Setup

Here is a simple example, using the QTL2843 to measure power on a PC

The AC power to the PC is now to be plugged into the QTL2843 (INPUT side)

The OUTPUT side of QTL2843 is plugged into the PC using a standard IEC extension cable (or similar adaptor, depending on your input connector)

In this example we will use the PoE injector to supply power and network control



Here is the final setup with all cables connected.

QTL2843 can be used to measure many different devices, any appropriately rated AC adaptor or cable can be used on the output side.



## Getting Started – Software

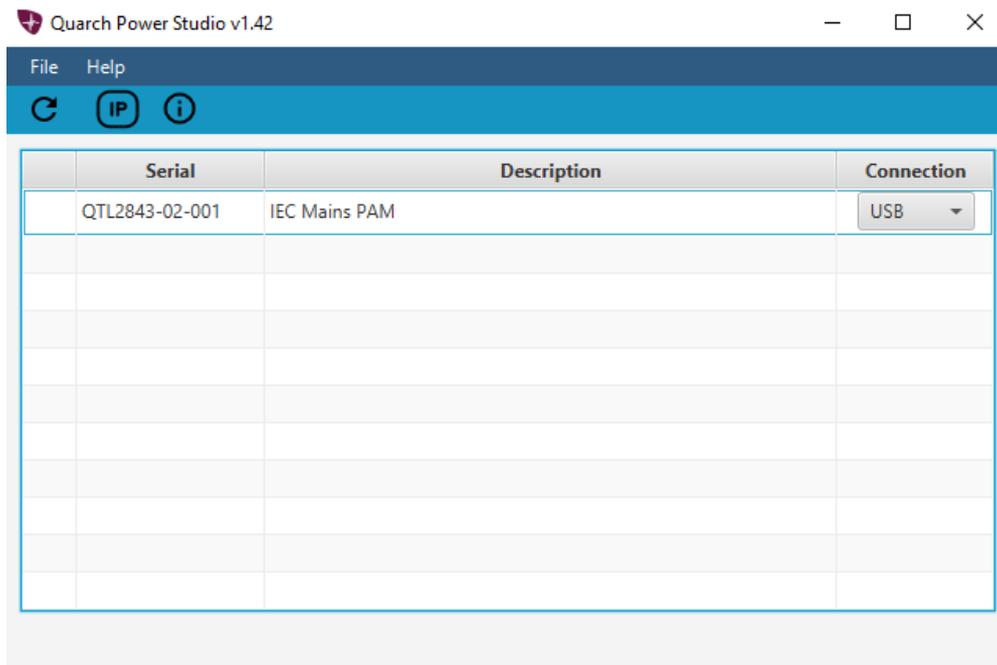
Download and install USB drivers if you are using windows:

<https://quarch.com/file/torridon-driver-win8/>

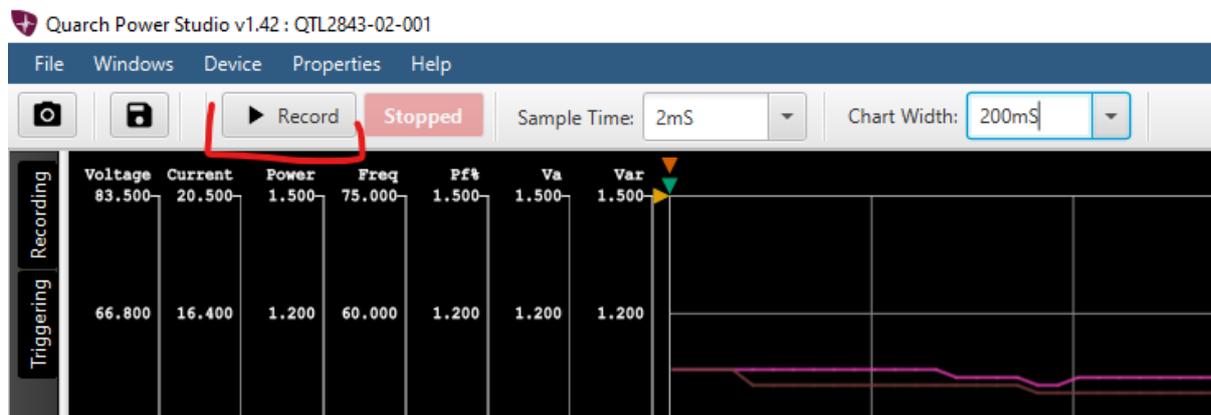
Download and install Quarch Power Studio:

<https://quarch.com/file/power-studio/>

Run the software and double-click on the instrument you want to connect to



Click the 'Record' button to begin capture



## LEDs

The IEC Mains PAM provides 2 LEDs on the front panel. These provide basic information on the function of the product

### Action LED

Color	Meaning
Off	No Power
Green	Power on standard state
Red	Unit fault

### Status LED

Color	Meaning
Off	Idle
Red (Flashing)	Recording

## Connection and accessories

The product is designed to connect to a PC via USB-B (using the supplied cable), or directly to a standard LAN, via the RJ-45 port.

The power supply being tested must connect to the IEC Mains PAM via an IEC C14 connection on the input side, and IEC C13 connections on the load side, which must be rated for your voltage and current requirements.

## Capturing Data

'Streaming' mode allows the module to record data over an unlimited period of time (depending on the storage space you have available on disk).

In this mode, the module sends data to the controlling PC in real time, where it can be stored for later analysis.

Capture can be started from a number 'Trigger' of events:

- Manual trigger from the GUI or scripted command
- Trigger on the power outputs being activated
- Trigger on a voltage pattern being activated
- Trigger on a defined current or power threshold being exceeded.

When triggered, the recording will continue until memory is full or a command is sent to stop.

### Memory depth to record

The user can limit the percentage of RAM to be used for recording. This will limit the record time.

### Pre-trigger buffer

The user can select the percentage of RAM to be used as a pre-trigger buffer. This allows capture of a region before the capture trigger occurs.

It is strongly recommended to begin with capture in Quarch Power Studio first. You can move on to automated capture in Python when you understand the capabilities of the tool.

## Controlling the Module

The control interface for Power Analysis Modules is via a LAN connection.

All major features are available over both interfaces.

### Communication protocol

Commands sent to the module are simple, text based commands, roughly based on the SCPI specification. For instance:

**MEASure:VOLTage:SELF 12v?**

Quarch applications and examples handle the sending of commands and processing of recorded data, allowing very simple automation from Python scripts and similar.

#### LAN

A simple TCP based custom protocol is the default. Simplified HTTP/REST is also available.

#### USB

USB control is supported. The Quarch USB driver is required on Windows PCs. LibUSB can be used for Linux.

## Control options

There are several applications and scripted control options:

- **Torridon Terminal**

This is a simple terminal application that can connect to a module and send manual commands. It is useful for testing, debugging and small amounts of manual control.

This is a Windows-only application and can be run directly (no installer needed). It can connect to the module over USB or LAN.

- **QPS GUI**

This application is designed for fast control of the power analysis modules, allowing real time viewing and long term recording of large data traces

- **Python scripts**

The quarchpy python package provides simple control of the module. Python scripting can also be used to automate QPS

## Default Startup State

On power up or reset, the module enters a default state.

Basic setting	Default value
Recording	Idle
Power State (Hot-Plug)	PLUGGED
Record Averaging	No Averaging
Memory Depth	100%
Pre Trigger	0%
Triggering	Disabled

LAN setting	Default value
DHCP	ON
IP address	192.168.1.99
IP mask	255.255.255.0
DNS1,2	0.0.0.0
GATEWAY	192.168.1.1
NetBIOS	QTL2582-nn-nnn or QTL2751-nn-nnn

nn-nnn = Serial number section, as stated on the product label

## Command Set

These commands are based on the SCPI style control system that is used by many manufacturers of test instruments. The entire SCPI specification has NOT been implemented but the command structure will be very familiar to anyone who has used it before.

- Commands are NOT case sensitive.
- Commands are in a hierarchy separated by ‘:’ (LEVEl1:LEVEl2:LEVEl3).
- Most words have a short form (e.g. ‘register’ shortens to ‘reg’). This will be documented as REGister, where the short form is shown in capitals.
- Many commands take parameters. These are separated by spaces after the main part of the command (e.g. “meas:volt:self 3v3?” obtains the 3v3 self test measurement).
- Query commands that return a value have a ‘?’ on the end.
- Commands with a preceding ‘\*’ are special control/query commands, found on all devices.
- Commands that do not return a particular value will return “OK” or “FAIL”. Unless disabled, the fail response will also append a text description for the failure if it can be determined.

## Identify commands

### HELLO?

Returns the descriptive name of the module

### HELP

Returns basic help to the terminal, including a list of more detailed help commands.

### CONFig:ALIAS [Name]

### CONFig:ALIAS?

Sets or returns the module Alias. This is a custom text descriptor which can be used to identify between modules where multiple units are used.

## Basic Setup commands

These are standard commands to setup the module

### # [comments]

Any command beginning with a # character is ignored as a comment.

### \*RST

Triggers a reset; the module will behave as if it had just been powered on. A reset will cause USB/LAN connections to be lost and the module must be reconnected again.

### CONFig:DEFault STATE

Sets the unit to its power on default state. This will leave the unit in the same state as if it was power cycled.

### CONFig:DEFault FACTory

Sets the unit to the state it left the factory in. This will set any EEPROM stored parameters to factory defaults. It will not affect the calibration settings for the unit.

If this command changes the NetBIOS name, a power cycle or \*RST command will be required for the change to take effect.

### CONFig:FAULT:RESet

Resets fault flags and activates the unit if outputs have tripped due to over current/over power.

### CONFig:FAULT?

Returns the state of the output fault flags. This will return OK unless an over current/over power fault has occurred.

### CONFig:MESSages [SHORT|USER]

#### CONFig:MESSages?

Sets or returns the message returns mode. When 'SHORT', detailed error messages will be suppressed.

## Ethernet commands

Ethernet commands are generally persistent through reset. Some network settings may not take effect until a power cycle.

**CONFig:ETHernet:NAME[xxxx]**

**CONFig:ETHernet:NAME?**

Sets the NetBIOS name of the unit. This is persistent through reset. You will have to reset/power cycle the unit for the changes to take effect.

**CONFig:ETHernet:IP [x.x.x.x]**

**CONFig:ETHernet:IP?**

Sets the static IP address of the unit. Setting a static IP address will disable DHCP if it is currently enabled. You will have to reset/power cycle the unit for the change to take effect.

**CONFig:ETHernet:MASK [xxx.xxx.xxx.xxx]**

**CONFig:ETHernet:MASK?**

Sets the IP mask of the unit.

**CONFig:ETHernet:DNS[1|2] [x.x.x.x]**

**CONFig:ETHernet DNS[1|2]?**

Sets the primary and secondary DNS addresses for the unit.

**CONFig:ETHernet:GATE[x.x.x.x]**

**CONFig:ETHernet GATE?**

Sets the Gateway of the unit. You will have to reset/power cycle the unit for the change to take effect.

**CONFig:ETHernet:DHCP [ON|OFF]**

**CONFig:ETHernet:DHCP?**

Enables/disables the DHCP client. When enabled, the controller will try to obtain an IP address from the local DHCP server.

**CONFig:ETHernet:HTTP:PORT [#Number]**

**CONFig:ETHernet:HTTP:PORT?**

Gets/sets the port number to use for HTTP control

**CONFig:ETHernet:TCP:PORT [#Number]**

**CONFig:ETHernet:TCP:PORT?**

Gets/sets the port number to use for TCP control

**CONFig:ETHernet:REST [ON|OFF]**

**CONFig:ETHernet:REST?**

Gets/sets the enable state for REST control of the device

**CONFig:ETHernet:TCP [ON|OFF]**

**CONFig:ETHernet:TCP?**

Gets/sets the enable state for TCP control of the device

**CONFig:ETHernet:LOCATE [ON|OFF]**

**CONFig:ETHernet:LOCATE?**

Gets/sets the enable state for the LAN location system. This allows devices to be located on the network via a broadcast packet. Disabling this will prevent applications such as TestMonkey and QIS from locating the module automatically (though manual connection can still be used).

## Debug Commands

These commands are used to look at the details of the module and its operation. You may be requested to use these if reporting a fault to Quarch.

### **\*IDN?**

Displays a standard set of information, identifying the device. An example return is shown below:

Family: Torridon System	[The parent family of the device]
Name: Programmable Power Module	[The name of the device]
Part#: QTL1999-02	[The part number of the hardware]
Serial#: QTL1944-02-012	[Serial number of the module]
Enclosure#: QTL1999-02-003	[Enclosure number of the module]
Processor: QTL1159-01,3.50	[Part# and version of firmware]
Bootloader: QTL1170-01,1.00	[Part# and version of bootloader]
FPGA 1: 1.3	[Version of FPGA core]

### **\*TST?**

Runs a set of standard tests to confirm the device is operating correctly; these tests are also performed at start up. Returns 'OK' or 'FAIL' followed by a list of errors that occurred, each on a new line.

### **\*SERIAL?**

Returns the serial number of the internal power module.

### **\*MAC?**

Returns the MAC address of the module

## Record Commands

These commands control the recording and downloading of data.

**RECORD [RUN|STOP|TERMINATE]**

**RECORD?**

In the RUN state, recording will either start immediately (MANUAL trigger mode) or at the point that the currently set trigger occurs.

STOP will end the recording. If streaming is running, stream will continue until all data is downloaded

TERMINATE will end the recording and also immediately end a stream if active.

This command **MUST** be run before any recording can be taken. It will clear the current recording and setup for pre-trigger (if a pre-trigger option is set).

**RECORD:TRIGGER:MODE [mode]**

**RECORD:TRIGGER:MODE?**

The trigger mode can be set to one of the following:

<b>MANUAL</b>	No Trigger; recording starts on issuing <b>RECORD:RUN</b> command.
<b>THRESHOLD</b>	Trigger is taken from the set current/power threshold levels. Recording will start if any of the limits is exceeded.

**RECORD:LIMIT:PERCENTAGE [#percent]**

**RECORD:LIMIT:PERCENTAGE?**

The memory to use for recording can be limited to a percentage of the total capacity. This can be specified as a fraction (e.g., "30.33") for greater resolution.

**RECORD:TRIGGER:PRE [#percent]**

**RECORD:TRIGGER:PRE?**

The record function can pre-trigger, to capture data before the trigger occurs. This sets the percentage of available memory to be used for the pre-trigger region.

**RECORD:AVERAGING [rate]**

**RECORD:AVERAGING?**

By default, the module collects samples at a rate of 8000 samples per second. This can be reduced by averaging across multiple measurements to give a longer recorded period.

The averaging option allows  $2^n$  samples to be averaged together for a single recorded reading.

This command also affects the

Valid rate enumerations are:

[rate]	Samples averaged	Averaging window
0 / 1	No Averaging	125 uS

**NOTE: Hardware averaging is disabled on AC devices, as we need the full speed data stream to calculate RMS values prior to averaging. Instead use software averaging in QIS/QPS using 'stream mode resample'**

**RECORD:TRIGGER:TYPE [EDGE|LEVEL]**

**RECORD:TRIGGER:TYPE?**

Sets the record trigger to EDGE (start on trigger edge) or LEVEL (record while trigger is high)

## Trigger Commands

These commands control the various trigger options. Commands currently available:

**TRIGger:[Chan\_Type][Chan\_Name]:ENABle [ON|OFF]**

**TRIGger:[Chan\_Type][Chan\_Name]:ENABle?**

Enable triggering for a given channel type and name, channels are defined by the attached fixture.

Example: rec:trig:voltage:av:ena on

**TRIGger:[Chan\_Type][Chan\_Name]:THReshold [#level]**

**TRIGger:[Chan\_Type][Chan\_Name]:THReshold?**

Set the level threshold for triggering on a channel

#level = -100 to 100 (As a percentage of the maximum channel range)

**TRIGger:[Chan\_Type][Chan\_Name]:POLarity [RISING|FALLING]**

**TRIGger:[Chan\_Type][Chan\_Name]:POLarity?**

Set the trigger polarity, deciding if the trigger should be issued when the level rises above or falls below the trigger level

**TRIGger:[Chan\_Type][Chan\_Name]:POLarity [RISING|FALLING]**

**TRIGger:[Chan\_Type][Chan\_Name]:POLarity?**

Set the trigger polarity, deciding if the trigger should be issued when the level rises above or falls below the trigger level

**TRIGger?**

Returns a list of active threshold triggers on the fixture

**RECOrd:TRIGger CLEAr**

Clears all active threshold triggers

## Customer support from Quarch

There are multiple ways to access the support you need. You can contact us directly or access an extensive range of valuable support materials from <http://quarch.com/support>.

### Contact us direct

Get going quickly and easily, with help direct from the engineers:

- Call **+44 1343 508 140** or email [support@quarch.com](mailto:support@quarch.com) during UK office hours.
- Our international partners are well trained in the use of our products and can deal with many basic technical queries from within your time zone, if you prefer. Check <http://quarch.com/resellers> for the contact details of your regional supplier.

### Access support from the Quarch website

You can download up-to-date software and drivers, technical manuals, datasheets and more from our website. To help you get started quickly we provide additional documents, such as examples in Perl, Python and C# and Telnet and Serial instructions.

#### Key places to visit on the Quarch website

- Register your Quarch product to confirm your international warranty: <http://quarch.com/product-registration>
- Download a wide range of documentation, free applications and drivers to help you make the best possible use of your Quarch tools: <http://quarch.com/content/downloads>
- Access the Quarch support forum (<http://quarch.com/forum>):
  - Find discussion topics, support information and testing ideas.
  - Browse existing topics or login to your user account to ask for information and advice.
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