Quarch Technology Ltd

Programmable Power Module

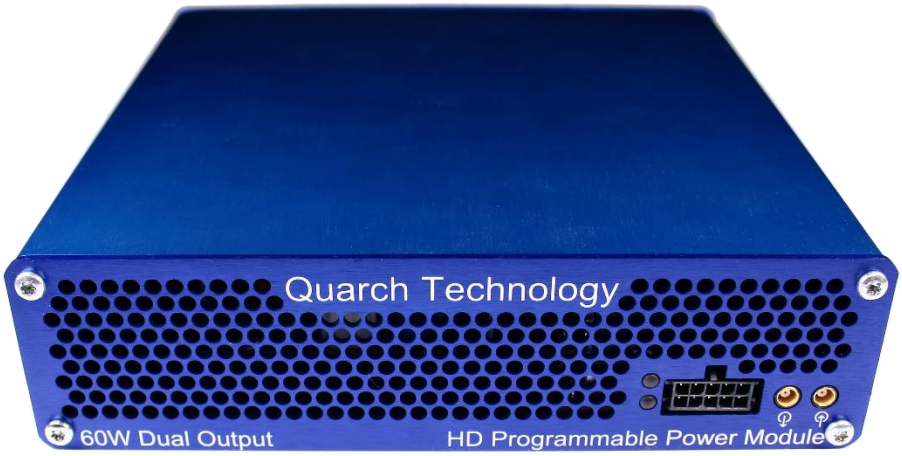
Technical Manual

For use with:

XLC Programmable Power Modules
QTL1847/QTL1824

Programmable Power Modules
QTL1455/QTL1658/QTL1730/QTL1727

Friday, 16 March 2018



Change History

1.0	8th August 2012	First release
1.1	7th September 2012	New commands added
		Updated output specification graphs
1.2	19th October 2012	Corrected maximum time value
		Updated for 1U enclosure
1.3	6th November 2012	Added info on the Power Injection Fixture
1.4	2nd January 2012	Added info on Triggering option
1.5	6th May 2013	Added info on 3v3 modules
1.6	16th July 2014	Added info on streaming measurement mode
1.7	17th December 2014	Added XLC module and record limit feature
1.8	8th April 2015	Corrected error on streaming rate Extra information on measurement options
1.9	10th August 2015	Updated to new style manual
1.10	4th May 2016	Added additional Module details
1.11	16th March 2017	Added ‘target’ command

Contents

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

Scope and the Purpose

This manual provides the following:

- Safety information
- An overview of the Programmable Power Margining Module.
- General description of the module and its features
- Details of its control interfaces
- Full Command spec

Getting help

If you have any problems, then please email support@quarch.com, or contact your regional reseller: www.quarch.com/resellers

Technical Specifications

Usage and Safety:

The separate 'Torridon System Manual' contains important information regarding usage and safety that apply to all parts of the Torridon System. 'HD' Power Modules are NOT part of the Torridon System, and are entirely described here

This Product is classified as 'industrial test equipment' and intended for use by experienced technical users in a test lab environment. You should ensure you are familiar with this information before using this device.

HD modules use an internal mains PSU and have no user serviceable parts inside.

Power Requirements – External DC Supply

Standard modules and XLC modules are supplied with a 15V 63W DC power supply. Only original Quarch provided or approved parts should be used with the system.

Front Panel - Original PPM, and XLC

Trigger IN/OUT: (Triggering modules only). 2x SMA connectors allow trigger to/from external equipment. Trigger signal is 3.3v

Power LED: Green when unit has external power

Output: Power output and remote voltage measurement port. Pins are numbered 1-6 from the top left:

1: Common GND	2: Common GND	3: 5V Remote voltage sense
4: 12V Output	5: 12V Remote voltage sense	6: 5V Output

Back Panel - Original PPM, and XLC

15v:	2.1mm centre Positive jack. For use with the supplied 15V PSU
Torridon:	For control via a Separate ‘Torridon’ controller
USB:	For control via USB

Output Characteristics

Parameter	Min	Max	Step
3v3 Output Voltage	0mV	3960mV	~3.54mV
5v Output Voltage	0mV	6000mV	~3.54mV
12v Output Voltage	0mV	14400mV	~5.54mV
Continuous Output Current (5V)	0mA	4000mA	-
Continuous Output Current (12V)	0mA	4000mA	-
Output Voltage Slew Rate (No Load)	0.6V/uS	0.6V/uS	-
XLC Output Voltage Slew Rate (No Load)	1V/uS	1V/uS	-

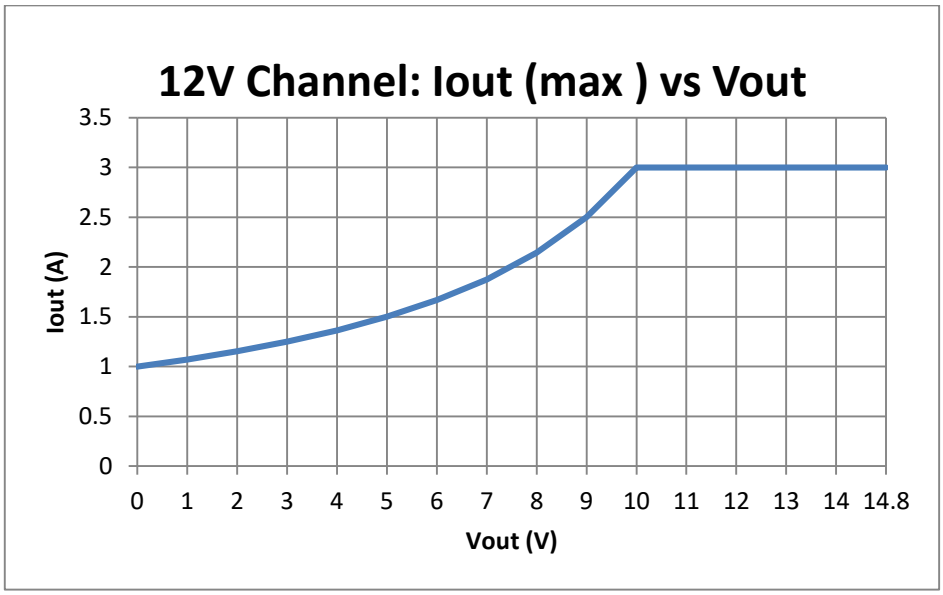
Output Protection:

The module will automatically turn off the outputs if the current exceeds the limits (See the graphs in the next section) for more than 1mS. The Power faults can be seen as a self-test failure on the start screen or by giving the following command

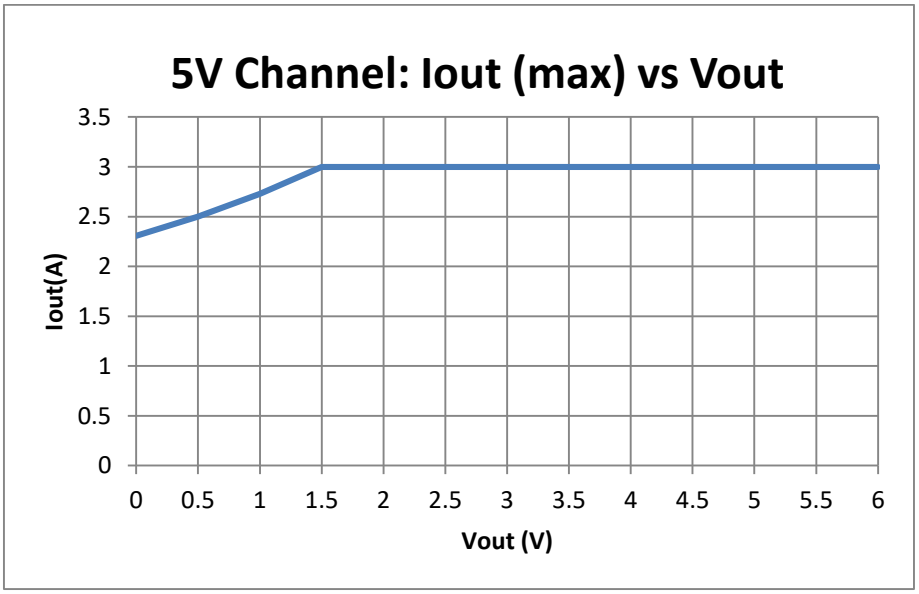
A similar shutdown will occur if the unit is over temperature. The status of the module can be seen in the TestMonkey GUI, or via a command line query.

Output Current Limit vs Output Voltage

The output current limit of the module decreases at low output voltages, the following graphs show the continuous current capability against output voltage:



12V Channel: Max Continuous Current vs Vout



5V Channel: Max Continuous Current vs Vout

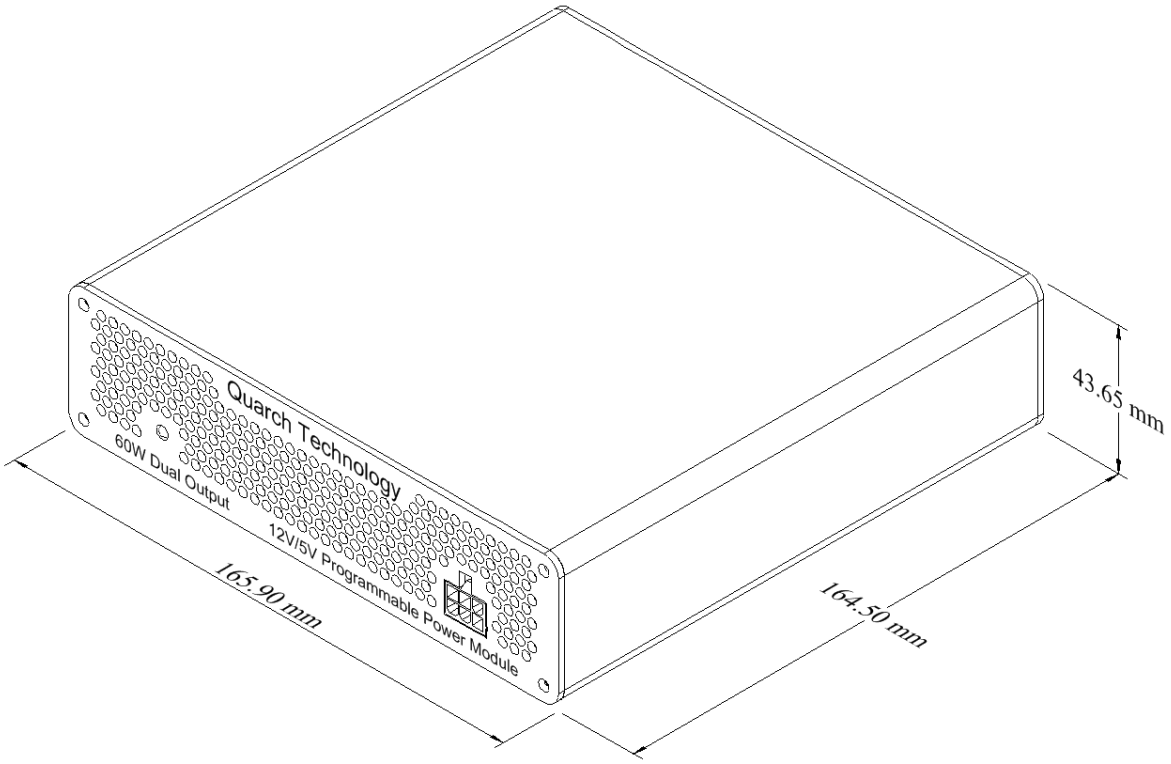
Measurement and Recording

The Power Module samples constantly at 250K Samples/Second. 'Averaging' allows multiple samples to be combined to give a single result. This reduces noise in a reading, and also allows a larger recording time

Parameter	Min	Typical	Max
Recording Sample Rate	-	4uS	-
Record Sample Averaging	1 Sample	-	32K Samples
Voltage Accuracy		± 1%	
Current Accuracy		± 1%	± (2 mA + 3%) @ 30 - 4000mA
XLC Current Accuracy		± 1%	± (2 mA + 1%) @ 1 - 4000mA
XLC Current Accuracy (Low Range)			± (2 uA + 2%) @ 100uA - 1mA

Mechanical Characteristics

This Figure shows the mechanical dimensions of the Programmable Power Module



Introduction

Programmable Power Modules are a combined (dual channel) power supply and recording scope. They are designed to test and characterise storage devices, like HDD or SSD but there are many other applications as well.

Outputs

The Module can output a voltage from 0 to nominal +20%, independently on each channel. This allows full power margining of the attached device. Instantaneous voltage, current and power measurements allow the user to monitor the performance of the attached device.

The output voltage on each channel can be controlled independently, with microsecond resolution and up to 1V/uS slew rate. This allows complex power patterns such as ramps, steps, glitches and even sine waves on a DC level.

Each channel can output up to 4 Amps continuous current. An unrestricted current can be supplied for up to 1mS, allowing for large inrush current during startup of a device.

Measurement

A high speed record feature takes simultaneous samples of current and voltage every 4uS (250K Samples/Second). This provides an oscilloscope like function to record the operation of the device, and allow precise power measurement.

Measurement data can be requested in a number of ways

1. A measurement can be polled at any time. A single value will be returned
2. Data can be recorded to internal RAM, either on a user instruction, triggered from an external device, or triggered from an internal setting (power threshold reached, pattern started,

power up event occurred). Recorded data can be downloaded later.

3. Data can be 'streamed' back to the controlling PC. This allows for an unlimited record duration, but the resolution will be lower due to the limited USB download speed.

Averaging

Where the full 4uS resolution is not needed, an 'Averaging' option allows multiple samples to be combined together. This gives a smoother measurement, and can be used to increase the recording duration in RAM.

The averaging setting can combine 2,4,8,16,32 … up to 32,768 samples into one measurement point. This allows averaging between 4uS to 131mS

Module Types

The programmable Power Module comes in several different variants

1) Basic Programmable Power Module
    a. Option available with external triggering
    b. Option for second channel to be 5v or 3v3

    This was the initial power module. It has 4 different variants and can accurately measure down to 30mA

2) XLC Programmable Power Module
    a. Option available with external triggering
    b. Second channel can be software switched between 5v and 3v3

    This enhanced module comes in 2 variants. It has 8x the RAM of the basic power module and can measure down to 100uA, ideal for low power drive sleep states

3) HD Programmable Power Module
    a. Multiple units can be mounted in a 1U rack enclosure
    b. Further increased recording RAM

    The HD module has another 8x more RAM than the XLC module and a much faster processor to allow for streaming over USB at higher resolutions.

    It also has LAN control for remote operation, and an extended output port that will support 'active' interposers, allowing for a range of additional accessories to be added.

    This module is detailed in a separate manual.

Standard Features

All power modules have the same core feature set

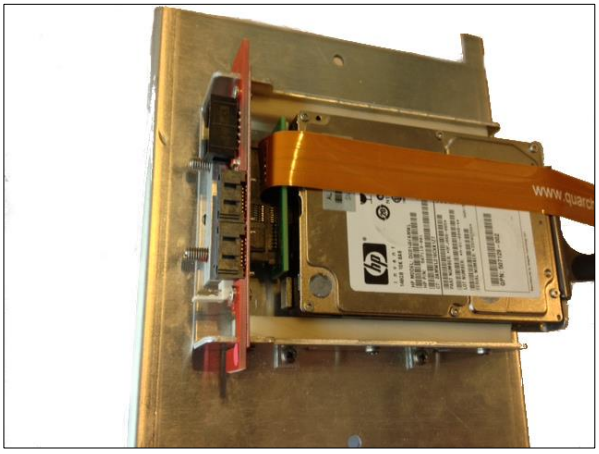
- Dual output programmable power supply
- Programmable voltage output waveforms
- Flexible power margining
- High speed measurement and recording
- Simultaneous sampling of voltage and current on both outputs
- Accurate power consumption measurement
- External triggering option available
- Simple test automation from any standard scripting language

Power Injection Fixtures

A number of 'Power Injection Fixtures' are available which allows power to be supplied to a device under test.

An example is the QTL1809 SAS/SATA/U.2 fixture, which sits between the drive and the backplane. Power is supplied down a thin flex cable while data connections are passed directly through to the drive from the backplane.

Power Injection Fixture fitted behind a 2.5" Drive



Drive slides into its normal enclosure, power is supplied externally, through the flex cable

Fixtures are available for all major storage interfaces, and custom fixtures can be designed if you require something special.

Control Interfaces

Power Margining Modules have a range of control ports

- USB
- Torridon (8-pin Connector)
- LAN (RJ-45)

Standard Modules

These have USB and Torridon ports on the rear. USB is the main mode of control.

The Torridon port, when connected to an Interface Kit allows Serial and USB virtual COM port control. When connected to an Array Controller, Telnet is also available.

XLC Modules

These are identical to Standard Modules

USB Notes

The USB 2 port requires the Torridon USB driver on Windows, The LibUSB driver is also supported for Linux, or if you are developing your own automation scripts.

Controlling the Module

All control interfaces use the same simple, text command set. Each command is human readable ASCII text of up to 64 characters in length.

For example: “SIGnal:5V:VOLTage 4950” will set the output voltage on the 5V channel to 4950mV.

All responses to commands are 1 or more lines, of up to 64 characters each. This makes issuing commands and parsing responses very simple.

The exception to this is fast download of measurement trace data, which is transferred as a simple binary format.

Commands can be sent from a standard terminal program, such as Putty, TerraTerm or command line Telnet clients. They can also be generated from scripts or user code (Perl, Python, C, .NET and more).

USB Control

USB is the primary mode of control for most Power Modules, and allows for the fastest transfer of data.

Quarch’s TestMonkey application can control the module via USB. Alternatively you can use Python, Java, .NET (or any language which supports libUSB). We provide examples showing how to get started easily.

USB uses the same commands as the other modes, but the correct driver must be present. There are also some additional commands to be sent to ensure the module is in the correct mode. Please contact us for the latest examples, or see the application notes on the Quarch website.

Serial Control

Serial communications is slower than other means, so not recommended if you need to download scope traces in real time. Serial is very simple to use though, so it a useful option for basic automation.

Any script, code or terminal program capable of opening a serial port can use this communication method.

Serial Settings

The table below shows the serial settings

Settings	Required value
Baud Rate	19,200
Data Bits	8
Stop Bits	1
Handshaking	None or Hardware

Telnet

When connected to an Array Controller, QTL1461 or QTL1079 then Telnet is available. This mode uses exactly the same commands as the serial ASCII terminal, but sent over a standard LAN Telnet connection. This can be done from any standard Telnet client, or most scripting languages such as Perl and Python.

Again, this mode is relatively slow, so not suitable for real-time download of scope traces.

ReST

HD Modules use a ReST API for remote access over a LAN. This is under development, and will be described in more detail soon.

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.

- SCPI commands are NOT case sensitive
- SCPI 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.
- Some 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 all have a '?' on the end
- Commands with a preceding '*' are basic control 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.

Basic Commands

[comments]

Any line beginning with a # character is ignored as a comment. This allows commenting of scripts for use with the module.

*RST

Triggers a full reset reset, the module will behave as if it had just been powered on

*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: Ethernet Cable Pull Module[The name of the device]
Part#: QTL1271-01 [The part number of the hardware]
Processor: QTL1159-01,3.50 [Part# and version of firmware]
Bootloader: QTL1170-01,1.00 [Part# and version of bootloader]
FPGA 1: 1.0 [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.

Control Commands

RUN:POWer [UP|DOWN]

Activates/deactivates the outputs. The output voltage will be the current DC voltage setting for the channel when in power up mode

RUN:POWer?

Returns the current power state

SIGnal:[name]:VOLTage [#mV]
SIGnal:[name]:VOLTage?

Sets/Returns the DC voltage level for the given channel where [name] is one of 12V or 5V. If the outputs are enabled, the voltage will change to the new level immediately.

SIGnal:[name]:TARGET [#mV]

While the 'voltage' command sets the voltage based on calibration, the 'target' command is a one-shot levelling command to account for voltage loss is cabling and fixtures.

This will adjust the output to match the requested level, taking using the remote voltage sense for feedback. It is strongly recommended that you set the output voltage first, and then use 'target' to correct for cabling losses.

RUN:PATtern [n]

Starts the currently stored output patterns and runs them in a loop [n] times. As patterns are relative, if you run a pattern more than once, it is normally important that the pattern finishes at the same voltage that it started at. This will avoid the output tending towards it maximum as the pattern repeats.

RUN:PATtern CYCLE

Starts the currently stored output patterns and runs them in a constant loop. As patterns are relative, if you run a pattern

more than once, it is normally important that the pattern finishes at the same voltage that it started at. This will avoid the output tending towards it maximum as the pattern repeats.

RUN:PATtern STOP

Immediately stops a pattern that is currently running. The outputs will remain at the state they were in when the pattern stopped.

RUN:PATtern END

Stops a pattern that is currently running, at the end of its current cycle. This is used to stop a cycling/repeating pattern such that the outputs will always end up in a known state (the last point in the pattern).

RUN:PATtern?

Returns the running state of a pattern.

Config Commands

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: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

CONFig:TERMinal:SERial:SPEED 19k

Sets the serial port to 19,200 baud serial (default mode, required for connection to an Array Controller).

CONFig:TERMinal:SERial:SPEED 115k

Sets the serial port to 115,000 baud serial. This is an increased speed mode for use with an interface kit only. It allows faster transfer of measurement data to the host PC

CONFig:OUTput:LIMit:[5v:12v]:VOLTage [#mV]
CONFig:OUTput:LIMit:[5v:12v]:VOLTage?

Sets or returns the voltage output limit on a channel. This limit can be chosen to ensure the output voltage never goes above the set level.

The setting is persistent over reset/power cycle.

CONFig:OUTput:[5v:12v]:CAPacitance [ON|OFF]
CONFig:OUTput:[5v:12v]:CAPacitance?
Sets or returns the output capacitance enable state. This is ONLY available on XLC modules

CONFig:OUTput:[5v:12v]:PULLdown [ON|OFF]
CONFig:OUTput:[5v:12v]:PULLdown?
Sets or returns the output pulldown enable state. When enabled, the module will actively pull down the rail when the requested voltage is below the current rail level. This is ONLY available on XLC modules

Measurement Commands

MEASure:VOLTage [name]?
MEASure:CURrent [name]?
MEASure:POWer [name]?
Returns the voltage/current/power of the given output where [name] is 3V3, 5V or 12V.

MEASure:OUTputs?
Returns the voltage and current measurements for both channels at the same time

MEASure:TEMPerature [name]?
Returns the output temperature in Deg C where [name] is 3V3, 5V or 12V.
MEASure:TEMPerature UNIT?
Returns the temperature in Deg C of the enclosure

Pattern Setup Commands

SIGnal:[name]:PATtern ADD [#Time] [#Voltage] [i]

Adds a point to the output pattern for the output named [name]

Where [name] is 5V or 12V. The point will at time [#Time]

Where [#Time] is in the form XuS, XmS or XS ,X is an integer value.

The voltage for the point is specified by [#Voltage] and is an integer value in mV. The value is relative to the DC output voltage before the first point in the pattern and so this parameter may be negative to allow a point to be specified that is lower that the initial voltage.

[i] is an optional parameter. Placing an “i” at the end of the command will tell the unit to interpolate (ramp) to the new voltage rather than making an immediate step.

If you specify a time point that has already been used, the original value will be overwritten.

SIGnal:[name]:PATtern DELete [index]

Deletes the point in the output pattern at position: [index]. The index of a given point can be found by displaying the current pattern with the DUMP command.

SIGnal:[name]:PATtern CLEAR

Deletes all points in the output pattern

SIGnal:[name]:PATtern DUMP?

Displays all points currently in the pattern

Record Commands

RECord [RUN|STOP]

RECord?

In the STOP state, recording will not run. In the RUN state, recording will either start immediately (MANUAL trigger mode) or at the point that the currently set trigger occurs.

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:[channel]:[channel_type]:ENAble [ON|OFF]

RECord: [channel]:[channel_type]:ENAble?

Enables/Disables the record of each of the 4 available channels

Where [channel] is: 5V or 12V

And [channel_type] is: VOLTage or CURrent

The module can store 65k measurement samples so each channel enabled will reduce the total length of time that can be recorded.

RECord:TRIGger:MODE [mode]
RECord:TRIGger:MODE?

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

PATTERN	Trigger occurs when at output pattern is started
POWER	Trigger occurs when the power state is changed to 'ON'
MANUAL	No Trigger, recording starts on issuing "RECord:RUN" command
EXTERNAL	Trigger is taken from the external trigger in connector (supporting modules only)
THRESHOLD	Trigger is taken from the set current/power threshold levels. Recording will start if any of the limit 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 (eg: "30.33") for greater resolution.

RECord:TRIGger:PRE [#percent]
RECord:TRIGger:PRE?

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

RECord:AVEraging [rate]
RECord:AVEraging?

By default, the module collects samples at a rate of 250,000 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.

Valid rate enumerations are:

[rate] value	Samples Averaged	Approx averaging window
0	No Averaging	N/A
2	2	8 uS
4	4	16 uS
8	8	32 uS
16	16	64 uS
32	32	0.13 mS
64	64	0.25 mS
128	128	0.5 mS
256	256	1 mS
512	512	2 mS
1K	1024	4.1 mS
2K	2048	8.2 mS
4K	4096	16.4 mS
8K	8192	32.8 mS
16K	16384	65.5 mS
32K	32768	131 mS

RECord:DUMP [#Time] [#Time]
RECord:DUMP ALL

This command displays recorded measurements on the terminal. The time values specify the start and end times in memory to display. Due to communications limitations it is not recommended to dump large number of samples at the same time as it will be a slow process.

[#Time] is in the form *X*uS, *X*mS or *X*S where X is an integer value

RECord:DUMP [#Time] [#Time] BIN
RECord:DUMP ALL BIN

This command downloads recorded memory in a fast binary format. On Standard and XLC modules, this command can only be run over a USB connection.

For standard modules, post processing will be needed to calibrate the results. XLC modules return calibrated data, and do not require post-processing.

Quarch application note AN004 demonstrates how to perform this via Python, and includes all relevant libraries to implement automated control into your own scripts.

Triggering Commands

Triggering commands are only available on modules with the triggering option fitted

TRIGger:OUT:MODE [PATtern|RECord|THReshold]
TRIGger:OUT:MODE?

Sets the action that will cause a trigger out to occur. In Pattern mode, the trigger will assert while a pattern is running. In Record mode, the trigger will assert while the recording is running. In Threshold mode, the pattern will assert while any power/current value is above the user set threshold for that value.

TRIGger:OUT:THReshold:[channel]:CURrent [#mA]
TRIGger:OUT:THReshold:[channel]:CURrent?

Where [channel] is: 5V or 12V and

[mA] is a current level in milli Amps.

Sets the current threshold for the channel. If the measured current exceeds this level, trigger out will be asserted (if the trigger out mode is set to threshold)

TRIGger:OUT:THReshold:[channel]:POWer [#mW]
TRIGger:OUT:THReshold:[channel]:POWer?

Where [channel] is: 5V or 12V and

[mW] is a power level in milli Watts.

Sets the power threshold for the channel. If the measured power exceeds this level, trigger out will be asserted (if the trigger out mode is set to threshold)

Due to the nature of the calibration, power threshold values will not be quite as accurate as current threshold values. If you require a very accurate threshold value, it may be better to use a current threshold instead.

PATtern:TRIGger:EXTernal [ON|OFF]
PATtern:TRIGger:EXTernal?

Sets the enable state of the external pattern trigger. When enabled, an external trigger will cause the current pattern to start running

PATtern:TRIGger:EXTernal:TYPE [EDGE|LEVEL]
PATtern:TRIGger:EXTernal:TYPE?

Sets the type of external trigger expected that will control the pattern start. An Edge trigger will start the pattern when the trigger in asserted. The pattern will stop when completed, or when stopped manually. If a cycled pattern is currently set, it will only end when stopped manually.

A Level trigger will start the pattern when asserted and will end the pattern immediately when de-asserted.

RECord:TRIGger:EXTernal:TYPE [EDGE|LEVEL]
RECord:TRIGger:EXTernal:TYPE?

Sets the type of external trigger expected that will control the recording start. An Edge trigger will start the recording when the trigger in asserted. The recording will stop when memory is full, or when stopped manually.

A Level trigger will start the recording when asserted and will end immediately when de-asserted.

Pattern Generation

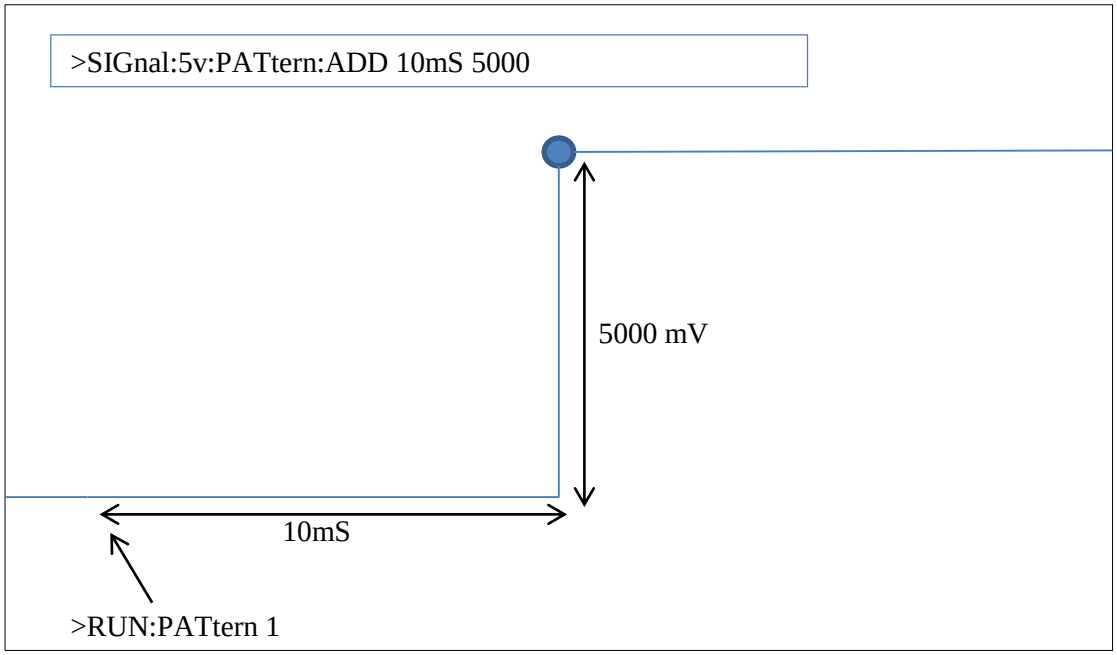
The 5V and 12V outputs each have a pattern generator with the following capabilities

Parameter	Min	Max
Number of points in a pattern	1	1023
Time Value for a point	0s	~71 Minutes
Time between two points	1uS	-

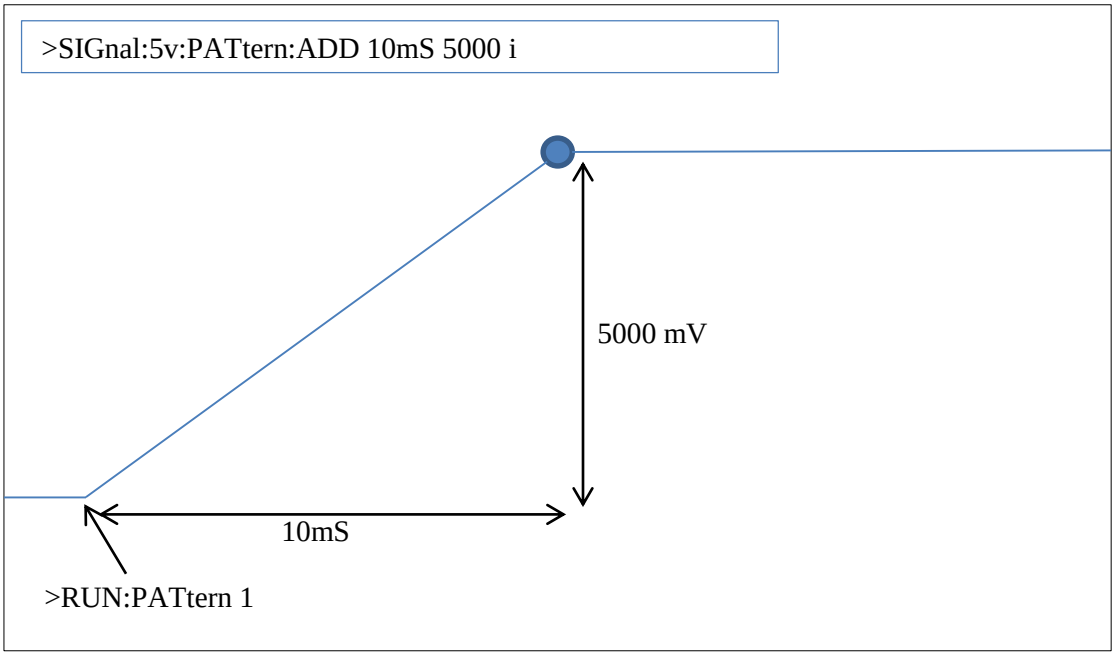
A Pattern is made up of one or more points; each point has a time value (relative to the start of the pattern), a voltage (relative to the starting DC level, at the point the pattern is run), and an interpolate flag that specifies if the voltage should ramp or step between values

+ve pattern voltages will increase the voltage above the starting level
-ve pattern voltages will decrease the voltage below the starting level
0mV pattern voltage points will return to the starting voltage before the pattern was run.

IMPORTANT: As the voltage of each point is relative, you MUST set the DC ensure the DC output level is correct before you run the pattern. This will normally involve setting both rails no nominal, or both to 0mV. If the last point in your pattern is not 0mV, then the DC levels after the pattern has run will be different than it was at the start.

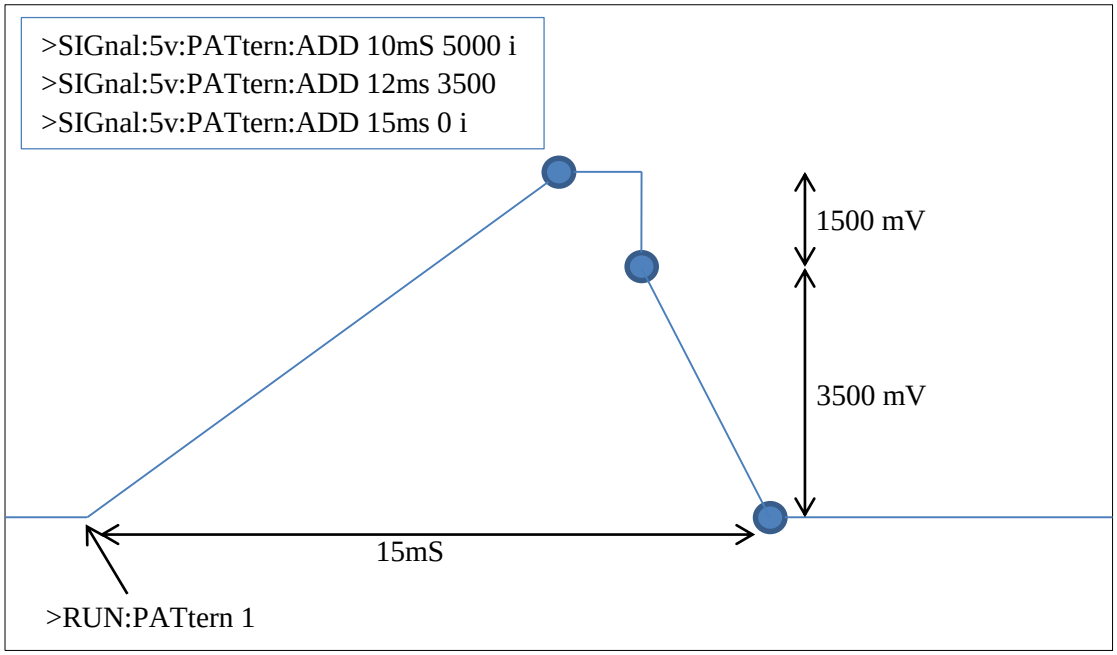


A pattern with a single point at 10mS, 5000mV, no interpolation



A pattern with a single point at 10mS, 5000mV, interpolation on

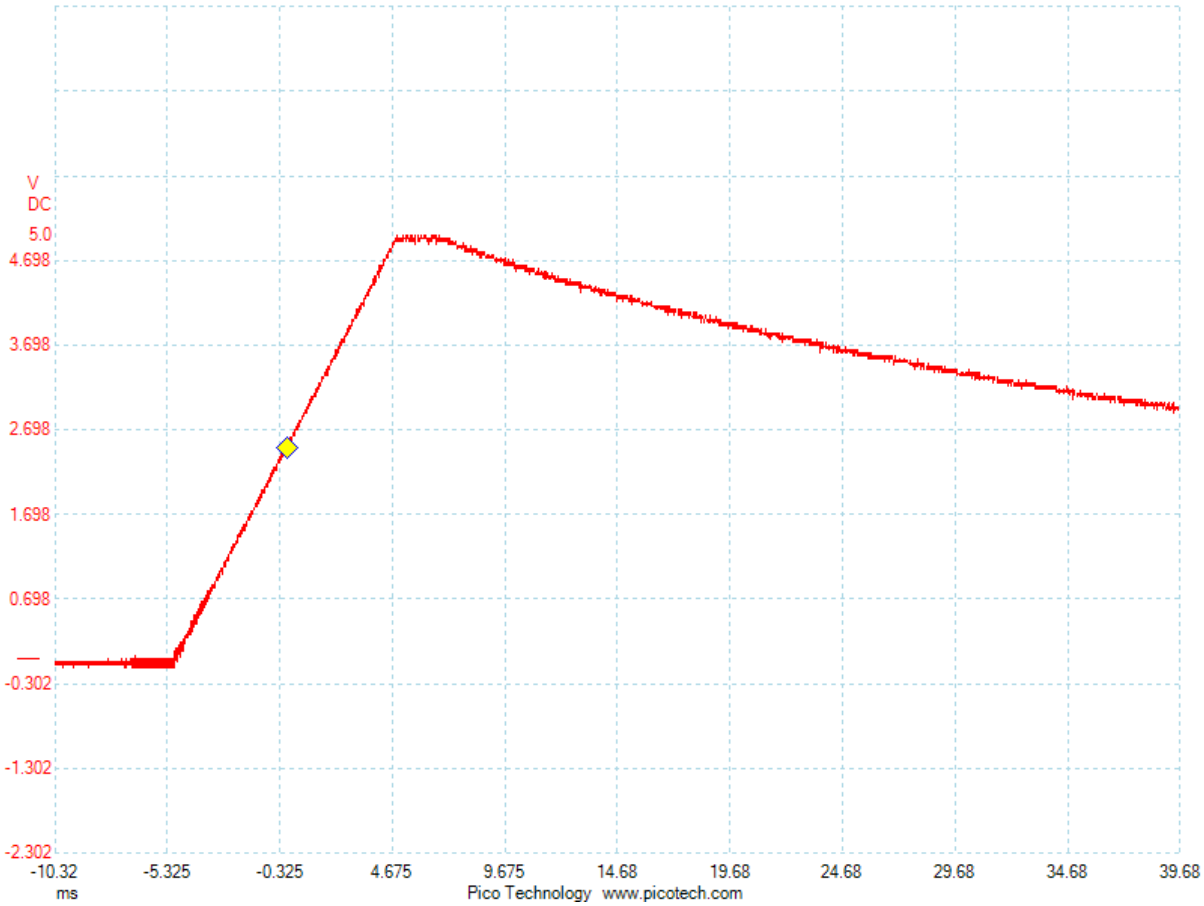
We can combine multiple points to make up complex patterns:



Pattern with multiple points

Real World Patterns

The patterns shown above in this section demonstrates the voltage the module is trying to achieve but in real world the unit is able to source current not sink it which is just like a typical power supply, which means that the capacitance of the output and the load may prevent the voltage from dropping even when the module's output is OFF. The graph below shows the pattern run on a hard drive, the capacitance of the drive continues to keep the rail charged long after the module's power has been turned OFF.



Recording

The module is able to record voltage and current on both outputs simultaneously every 4µS. These samples may then be averaged within the module to create a slower sample rate or reduce noise as required by the user.

Standard modules have 1Mbit memory and XLC modules have 8Mbit and HD modules have 64Mbit which is allocated between the four measurements (5v voltage, 5v current 12v voltage, 12v current).

The user can disable recording of any of the four measurements with the command

RECord:[channel]:[VOLTage|CURrent]:ENAble [ON|OFF]

[NOTE: Disabling channel(s) will allow a longer recording time.]

A Recording session is initiated by a trigger which could be commands like

RUN:POWER UP, RUN:PATTERN, an external trigger, threshold trigger or similar.

The trigger mode is selected with the command

Record:TRIGger:MODE [PATTERN|POWER|MANUAL|EXTERNAL|THRESHOLD]

In manual mode, the Record RUN will start the recording.

In other modes, the Record RUN command will prepares the buffer for recording (filling any pre-trigger buffer if required). This command must be run before the trigger occurs otherwise no data will be recorded. Recording will continue until the memory is full or until the command RECord STOP

To retrieve the data from the module, use the command

RECord:DUMP [#start time] [#stop time]

To retrieve the data between the set interval

RECord:DUMP ALL

Retrieve all the data, this will stream the recorded data on the terminal, not recommended as this may take a while.

Recorded data can be downloaded using the TestMonkey or the API with the module communicating via USB.

External Triggering – Trigger IN

This is only available for modules with the Triggering option.

- Run Pattern on Trigger In

In this mode, you can set the module to run a pattern to completion when the Trigger In is received (Edge trigger) or to begin running a pattern and continue while the Trigger is set (Level trigger).

This allows you to insert a power spike/level change/noise at a given point in the operation of the drive (perhaps using a data analyser as the source of the trigger).

- Begin Recording on Trigger In

In this mode, recording can be started when the trigger is received. In Edge triggered mode, recording will end when the memory is full. In Level triggered mode, recording will end when the trigger is cleared. This allows specific points or regions of operation to be captured.

- Enable Outputs on Trigger in

When enabled, the primary output enable control will follow the external trigger IN signal

External Triggering – Trigger OUT

Trigger out can be used to sync external equipment with the PPM

- Trigger out on pattern state:

  The PPM will assert trigger out when a pattern is running

- Trigger out on recording state:

  The PPM will assert trigger out when recording is running

- Trigger out on current/power threshold:

The PPM will assert the trigger out while either power or current output has exceeded a user set threshold. This might be used to identify points in operation where the drive exceeds expected power consumption.

Measurement Methods

There are various ways to bring the measured data back from the module, and they are briefly described here in this section

Instantaneous measurement

You can request a measurement from the module at any time, using one of the measurement commands, such as MEASure:POWer 5v?

This will return a single value. All instantaneous measurements are affected by the measurement averaging setting.

You can request the instantaneous voltage and current values for both channels in a block with the MEASure:OUTputs? Command.

This method is ideal when you want small numbers of measurements at particular times, but precise timing is not required.

Recorded measurements

The internal memory of the module can be used to record a block of measurement data at a sample rate up to 250 KHz. This requires you to 'trigger' the recording to start, either with a manual command, or via one of the various built in trigger options (threshold, pattern start, power up, external, and more).

When the data has been recorded, you can dump it from memory (see the Recording section for details). Recorded measurements are affected by the measurement averaging setting.

This method is best when you want to start measuring at a precise time (such as when a current threshold is exceeded) or when you want to record a block of data at a high sample rate.

Basic Streaming

You can order the module to stream measurements. In this mode, the module will return data constantly until it is instructed to stop. The basic mode returns a single measurement every 2mS. This mode is best for long term measuring, where you want to record for minutes or many hours at a time, but very fast sampling is not required.

- Streaming Data Format

This feature will stream constant measurement data from the module at a 2mS intervals. Data is returned in compressed text form, ideal for processing with Perl/Python script.

[Note: All measurements are affected by the current averaging settings]

Also make sure to use a high speed serial mode or else data return rate will not be fast enough.

To change the settings use the command below

CONF:TERM:SERIAL:SPEED 115K

This can be done without re-opening the serial port

And then send the command to begin streaming

MEAS:STREAM

Send an ‘x’ character to the terminal to end the streaming

Data returned is in the form:

HEADER:
AAAA
DATA:
BBBBCCCCDDDDEEEE
BBBBCCCCDDDDEEEE
…
…

HEADER data is one ASCII encoded hex byte, showing the number of samples currently being averaged.

DATA rows are returned one per millisecond and consist of 4 ASCII encoded hex bytes. Each one is a single measurement in the order:

5v(or 3v3) Voltage, 12v Voltage, 5v(or 3v3) Current, 12v Current

Standard Streaming

The standard streaming mode uses USB to continuously read data back from the module. HD modules can also stream over the LAN interface.

Streaming is activated with the command

RECord:STREAM

When activated, any existing data in RAM will be lost. The RAM will be used as a circular buffer, recording measurements at the current averaging rate. The PC now reads data as quickly as possible from the device.

Small delays in reading are handled by the circular buffer, but if this fills completely then streaming will terminate. As such, the speed of the PC performing the reads will affect the resolution of the data that can be downloaded.

Using the example Python interface and 16 sample averaging (15K samples/second), a fast PC can record for an indefinite period. Slower PCs will require a larger averaging setting.

The streaming format is identical to the format used for dumping previously recorded data from RAM. As such we recommend working from our API examples.

Measurement Resolution

The module is capable of measuring voltage, current and power at any time. The measurement is done by channel name:

Measurement Command	Description	Resolution
MEASure:VOLTage 12v?	Returns the 12v output sense voltage	3.54mV
MEASure:VOLTage 5v?	Returns the 5v output sense voltage	3.54mV
MEASure:CURrent 12v?	Returns the current on the 12v output	1.83mA
MEASure:CURrent 5v?	Returns the current on the 5v output	1.83mA
MEASure:POWer 12v?	Returns the power on the 12v output	8µW
MEASure:POWer 5v?	Returns the power on the 5v output	8µW
MEASure:OUT?	Returns simultaneous 12V and 5V voltage and current measurements	

Returned measurements are instantaneous values, but ARE affected by the current averaging setting.

Default Startup State

On power up or reset, the module enters a default state. In this state, the outputs will be turned OFF and the DC level setting will be set to the nominal value of the voltage rails. Running a "RUN:POWer UP" command will therefore enable the outputs immediately at their nominal value

Setting	Default Value
Output Enable	OFF
12v Level	12000 mV
5v Level	5000 mV
3v3 Level	3300mV
Patterns	NONE
Measurement Averaging	No Averaging

Appendix

Customer Support

For further help and support, email us on

support@quarch.com

Software Updates and Drivers

For up to date software and drivers, visit our website

www.quarch.com

Documentation

You can also download technical manuals, datasheets and more from our website. To help you start quickly we can provide you the additional documents, such as examples in Perl, Python and C#, Telnet and Serial instructions and more.