QontrolDoc Documentation

Release 0

Qontrol

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CONTENTS:

Welcome to Qontrol's documentation!

This documentation describes teh functionality of the main commands for the python **Qontrol** code. See 'https://qontrol.co.uk/'

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qontrol.py is a library for configuring and controlling through python the qontrol products.

This guide will guide you through the process of setting up your Qontrol Q8 device and give you a description of the basic commands.

CHAPTER

ONE

GETTING STARTED GUIDE

This Getting started document will guide you through the first configuration and test of the q8 unit attached to a Qontrol motherboard.

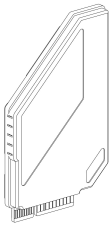
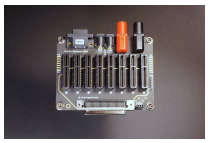
The operations described in this guide require:

- a Qontrol controller (e.g. Q8iv or Q8)
- a Qontrol motherboard (e.g. BP8)
- the corresponding power supply (e.g. PS15KIT)
- a computer connected to the internet to let the system download the serial port USB drivers
- (optionally) a program for serial port communication (e.g. Teraterm for windows, CoolTerm for Mac Osx, Linux)

1.1 Connection of the unit

This procedure is valid for both the Q8 and the Q8iv products.

- Insert the Q8iv (or any other compatible control unit) in one of the backplanes/motherboards (e.g. BP8):

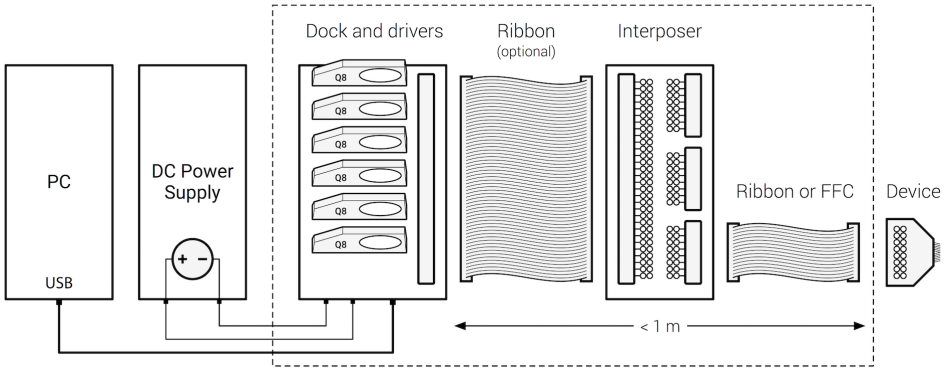



- In the Q8iV the 5 leds indicate (from the bottom): pwr, rx, tx, activity, err. In the Q8b the 3 leds indicate: pwr, activity, err
- Connect the backplane (motherboard) unit to the computer using a cable/adapter with a USB mini b female plug at one of the two ends, like the one shown below:

- Power the unit, using a compatible power supply (e.g. PS15KIT):

- Al the side LEDs in the units should progressively turn on and off again leaving only the bottom green LEDs on, while the units are in idle.

Whole system:



1.2 Configuration of the serial communication

1.2.1 Controlling the unit using the provided Qontrol API serial communication commands

This API provides also a command line interface for direct communication with the Qontrol unit. The program is called run_interactive_shell(). To run it follow these steps: start python, import qontrol and run the interactive shell.

:: $ python

```
>>> import qontrol
```

```
>>> qontrol.run_interactive_shell()
```

Select your controller from the list of available serial devices and you are ready to go.

1.2.2 Controlling the unit using a serial communication software

In addition, serial communication software in any operating system (OS) can be used to control the units, some examples:

- Teraterm (Windows)
- CoolTerm (Mac)
- Terminal/Command line (Linux)

General Configuration settings.

Serial parameters settings :

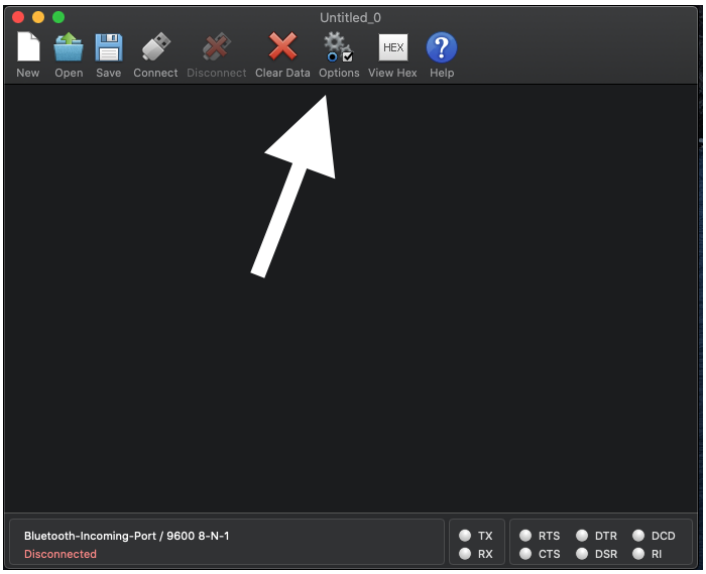
Setting	Value
Data bits	8
Stop bit	1
Par. check	None
Flow ctrl.	None
Baud rate	115200

Windows Teraterm Configuration

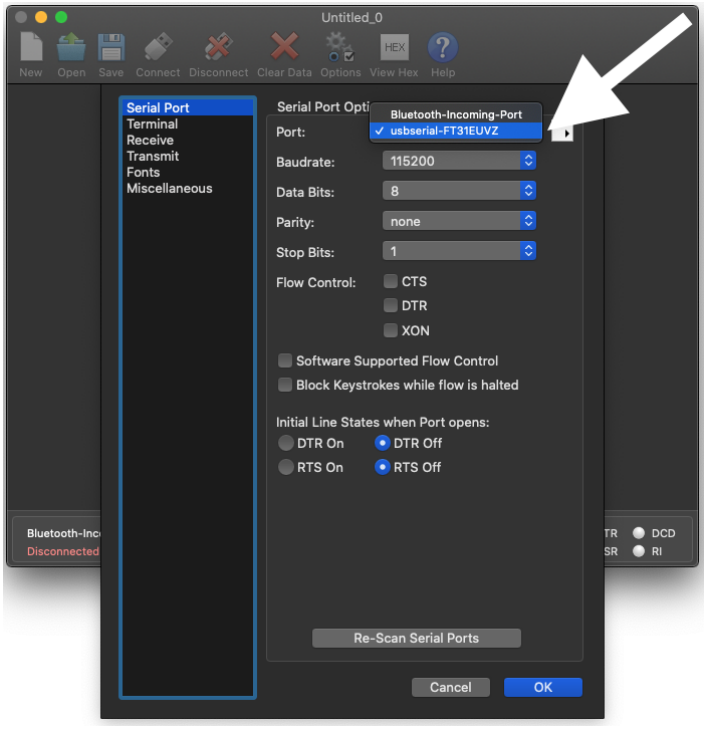
Mac OSX CoolTerm Configuration

- Open a Terminal
- check the name of the device with the command:

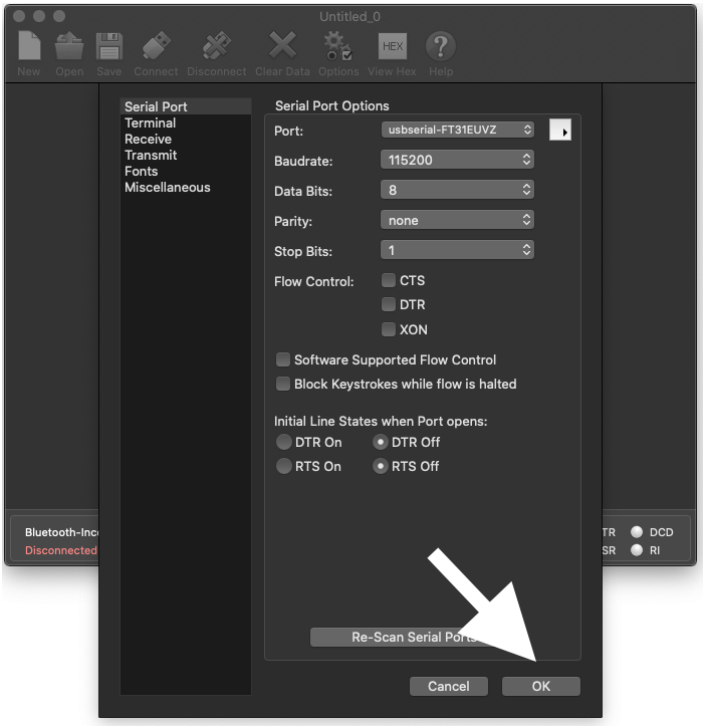
  ls /dev/tty.usb*
- Example of output: /dev/tty.usbserial-FT31EUVZ
- the name "FT31EUVZ" identifies the connection to the Qontrol motherboard
- Open CoolTerm and select options



- Select the correct device and the proper settings
- Open CoolTerm and select the appropriate options



- Select Ok and start typing the commands



Linux Command Line

In Linux is also possible to use terminal software such as **minicorn**

- Check the name of the device

  ls /dev/tty.usb*

- Serial ports devices will appear as /dev/ttyS#
- To change the serial port configuration use the command **'ssty'**, use the command "man stty" for specific operation details
- Example to set the Baudrate to 115200 and odd parity stty -F /dev/ttyS# 115200 parodd
- Issue Comands using the **"echo"** command echo 'vipall?' > /dev/ttyusb#
- Read the data with **cat**: cat /dev/ttyusb#

1.3 Main commands and error codes

From the serial interface you can always obtain te list of commands by typing:

:: > help

CORE COMMAND SET

- Set voltage of a specific "port" to "value" (V) -> v[port]=[value]
- Set current of a specific "port" to "value" (mA) -> i[port]=[value]
- Read voltage of a specific "port" (V) - > v[port]?
- Read current of a specific "port" (mA) - > i[port]?
- Read voltage current and power on all the ports (V, mA, mW)-> vipall?
- Set max voltage limit (V) to a "value" of a specific "port" -> vmax[port]=[value]
- Set max current limit (mA) to a "value" of a specific "port" -> imax[port]=[value]

Error Code	Description
00	Unknown error
01	Overvoltage
02	Overcurrent
03	Power error
04	Calibration error
10	Unrecognised command
11	Unrecognised parameter
12	Unrecognised port
13	Operation forbidden
14:00	Instruction buffer overflow
14:01	Single instruction overflow
15:X0	Serial overflow detected
15:X1	Serial framing error detected
16	Internal software error

1.4 Frequently asked questions (FAQ) and basic troubleshooting

** Which operating systems are supported? **

Our Python API can be used on any modern OS. All of them that can control a serial port can also use our products in any other language, if you are willing to program this yourself.

** Why does the backplane error light turn on when drivers are activated?**

The LSD is inserted the wrong way around!

1.5 Running the example code

The example code *example.py* can be found in the intallation directory of *qontrol.py*.

To run it sympy type:

$ python example.py

The example will set some voltages on your device so it is important to check that no sensitive equipment is connected when running it.

If the example code runs successfully, the lights on your qontroller will flash as commands are transmitted, and output channels are energised. The qontroller's device ID will be read out, as well as its number of channels. The voltage on each channel will be briefly set to the channel's number, then return to zero (e.g. channel 3 is set to 3 V). The current of each channel will be read out. Next, we'll take a look at exactly what's inside.

1.6 API basics

First, we read in the qontrol.py API with an import call.

```
import qontrol
```

To initialise an output device (or daisy-chain), like a Q8iv, first use a definition like

```
q = qontrol.QXOutput(serial_port_name = "COM1")
```

where q is our qontroller object, which stores information about the hardware, such as its device ID (q.device_id) and number of channels (q.n_chs), and handles all communications and commands. COM1 is an example of what the connected serial port name might be on Windows.

Port numbers greater than 10 must be written like

```
//./COM42.
```

On Mac or Linux, this will look something like

```
/dev/tty.usbserial-FT123ABC.
```

When your code is done with the hardware, it's good practice to close the connection with a call to

```
q.close()
```

Controlling outputs, and reading inputs is easy.

Writing to the qontroller object's v or i arrays (using standard Python array indexing) sets the output for channel with that index.

Reading from those arrays reads the input values back from the hardware. For example, we can set the voltage on output channel 3 to 4.5V and read back the current (in mA) assigning the value to the variable "measured_current" with the code:

```
q.v[3] = 4.5
measured_current = q.i[3]
```

We can do bulk changes to channels using slices.

```
q.v[2:5] = 4.5
measured_current = q.i[2:5]
```

The slice character in Python, :, means either "everything between two indices" (e.g. v[2:5]), "everything from the beginning until an index" (e.g. v[:5]), or "everything from an index until the end" (e.g. v[2:]).

1.7 Notes and disclaimer

If you find an error in this document, or have suggestions for how we could make it better, please do get in touch with us at support@qontrol.co.uk with your comments.

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CHAPTER

TWO

QONTROL_API

2.1 qontrol module

class qontrol.**ChannelVector**(*base_list*)
Bases: object

Custom list class which has a fixed length but mutable (typed) elements, and which phones home when its elements are read or modified.

get_handle = None

set_handle = None

valid_types = (<class 'int'>, <class 'float'>)

class qontrol.**QXOutput**(**args*, ***kwargs*)
Bases: *qontrol.Qontroller*

get_all_values(*para='V'*)

get_value(*ch*, *para='V'*)

set_all_values(*para='V'*, *values=0*)
Convenience function for slicing up set commands into vectors for each module and transmitting.

para: Parameter to set {'V' or 'I'} values: Either float/int or list of float/int of length n_chs

set_value(*ch*, *para='V'*, *new=0*)

class qontrol.**Qontroller**(**args*, ***kwargs*)
Bases: object

Super class which handles serial communication, device identification, and logging.

device_id = None Device ID serial_port = None Serial port object serial_port_name = None Name of serial port, eg 'COM1' or '/dev/tty1' error_desc_dict = Q8x_ERRORS Error code descriptions log = fifo(maxlen = 256) Log FIFO of sent commands and received errors log_handler = None Function which catches log dictionaries log_to_stdout = True Copy new log entries to stdout response_timeout = 0.050 Timeout for response or error to commands inter_response_timeout = 0.020 Timeout for response or error to get commands

Log handler: The log handler may be used to catch and dynamically handle certain errors, as they arise. In the following example, it is set up to raise a RuntimeError upon reception of errors E01, E02, and E03:

q = Qontroller()

fatal_errors = [1, 2, 3]

def my_log_handler(err_dict):

if err_dict['type'] is 'err' and err_dict['id'] in fatal_errors: raise RuntimeError('Caught Qontrol error "{1}" at {0} ms'.format(1000*err_dict['proctime'], err_dict['desc']))

q.log_handler = my_log_handler

close()
Release resources

issue_binary_command(*command_id*, *ch=None*, *BCAST=0*, *ALLCH=0*, *ADDM=0*, *RW=0*, *ACT=0*, *DEXT=0*, *value_int=0*, *addr_id_num=0*, *n_lines_requested=2147483648*, *target_errors=None*, *output_regex='(.*)'*, *special_timeout=None*)
Transmit command ([command_id][ch][operator][value]) to device, collect response.

command_id: Command descriptor, either int (command index) or str (command name). ch: Channel address (0x0000..0xFFFF for ADDM=0, 0x00..0xFF for ADDM=1). BCAST,

ALLCH, ADDM, RW, ACT, DEXT: Header byte bits. See Programming Manual for full description.

value_int: Data, either int (DEXT=0) or list of int (DEXT=1). addr_id_num: For device-wise addressing mode (ADDM=1) only, hex device ID code.

All other arguments same as those for issue_command()

issue_command(*command_id*, *ch=None*, *operator=''*, *value=None*, *n_lines_requested=2147483648*, *target_errors=None*, *output_regex='(.*)'*, *special_timeout=None*)
Transmit command ([command_id][ch][operator][value]) to device, collect response.

command_id Command header (e.g. 'v' in 'v7=1.0') ch Channel index to apply command to (e.g. '7' in 'v7=1.0') operator Type of command in {?, =} (e.g. '=' in 'v7=1.0') value Value of set command (e.g. '1.0' in 'v7=1.0') n_lines_requested Lines of data (not error) to stop after receiving, or timeout target_errors Error numbers which will be raised as RuntimeError special_timeout Timeout to use for this command only (!= self.response_timeout)

log_append(*type='err'*, *id=''*, *ch=0*, *value=0*, *desc=''*, *raw=''*)
Append an event to the log, adding both a calendar- and a process-timestamp."

parse_error(*error_str*)
Parse an encoded error (e.g. E02:07) into its code, channel, and human-readable description.

print_log(*n=None*)
Print the n last log entries. If n == None, print all log entries.

receive()
Low-level receive data method which also checks for errors.

transmit(*command_string*, *binary_mode=False*)
Low-level transmit data method. command_string can be of type str or bytearray

wait(*seconds=0.0*)
Do nothing while watching for errors on the serial bus.

qontrol.**run_interactive_shell**()
Interactive shell for interacting directly with Qontrol hardware.

CHAPTER

THREE

INDICES AND TABLES

- genindex
- modindex
- search

PYTHON MODULE INDEX

q

INDEX