ds1054z Documentation

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Contents

Thanks for reading the documentation of the Python package ds1054z. This software makes it easy to talk to your Rigol DS1054Z oscilloscope or any DS1000Z / MSO1000Z series oscilloscope using Python.

ds1054z is free software, published on Github by Philipp Klaus.

It comes with a neat command line tool allowing you to control many functions of your scope such as grabbing waveforms or screenshots, or adjusting settings such as trigger, horizontol, or vertical setup.

Contents:

CHAPTER 1

Installation

Installing *ds1054z* is dead simple if you can use pip to install Python packages:

```
pip install ds1054z[savescreen,discovery]
```

The package depends on python-vxi11 for the communication with the scope. It should automatically get installed along with ds1054z.

By specifying `savescreen` and `discovery` in square brackets after the package name, you're asking pip to install the requirements for those extras as well:

- `savescreen` makes it possible to use the *save-screen* action with the CLI tool. (Pillow will get installed)
- `discovery`: To be able to automatically discover the IP address of the scope on your local network, this extra will install `zeroconf`.

If you don't have access to `pip` , the installation might be a bit more tricky. Please let me know how this can be done on your favorite platform and I will add this information here.

CHAPTER 2

Using the Command Line Tool

This package installs a versatile command line (CLI) tool called `ds1054z`.

The signature of the command line tool is as follows:

```
philipp@lion$ ds1054z --help

usage: ds1054z [-h] [-v] <action> ...

CLI for the DS1054Z scope by Rigol

This tool can be used in very versatile ways.
Ask it for --help on the individual actions
and it will tell you how to use them.

positional arguments:
  <action>        Action to perform on the scope:
    discover      Discover and list scopes on your network and exit
    info          Print information about your oscilloscope
    cmd           Send an SCPI command to the oscilloscope
    save-screen   Save an image of the screen
    save-data     Save the waveform data to a file
    properties    Query properties of the DS1054Z instance
    run           Start the oscilloscope data acquisition
    stop          Stop the oscilloscope data acquisition
    single        Set the oscilloscope to the single trigger mode.
    tforce        Generate a trigger signal forcefully.
    shell         Start an interactive shell to control your scope.

optional arguments:
  -h, --help      show this help message and exit
  -v, --verbose   More verbose output
```

2.1 Global Options

You can increase the verbosity of the tool by stating `--verbose` before the action argument

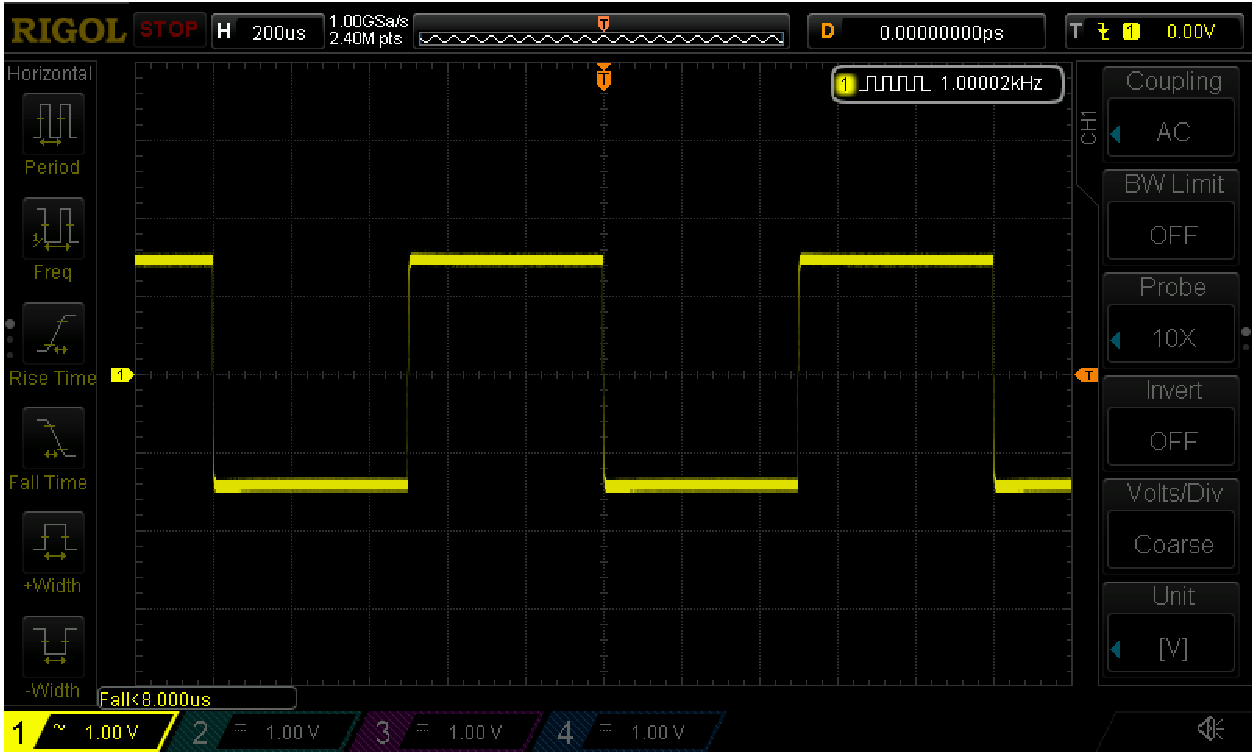
If you want to know what's going on behind the scenes, and for tracing errors in this software, you might also enable the debugging output by using the undocumented `--debug` parameter. Also put it in front of your action argument.

2.2 Saving Screenshots

You can use the tool to save the screen of your scope, for example:

```
ds1054z save-screen --overlay 0.6
```

As a result, a file like this will be saved to your current working directory:



H 200us
1.00GSa/s
2.40M pts
D 0.00000000ps
T 1 0.00V
1 1.00002kHz
Coupling AC
BW Limit OFF
Probe 10X
Invert OFF
Volts/Div Coarse
Unit [V]
Fall<8.000us
1 1.00 V
2 1.00 V
3 1.00 V
4 1.00 V

2.3 Zeroconf Device Discovery

Note that no oscilloscope IP address was specified in the last command. This works because the tool performs discovery of DS1000Z devices on the local network. If it finds a single one, it picks that as your device.

If you have multiple oscilloscopes in your network, or want the cli tool to perform your action faster (discovery takes about 1 second upfront), or discovery doesn't work for you (please file a bug report in that case), then you can just as well specify the scope by its IP address or hostname as a positional parameter to most of the actions:

```
ds1054z save-screen --overlay 0.6 192.168.0.23
```

2.4 Exporting Data

You can save the waveform data to a file with the `save-data` command:

```
ds1054z save-data --filename samples_{ts}.txt
```

CHAPTER 3

Using the DS1054Z Class

The Class *ds1054z.DS1054Z* is a very easy and convenient way to interact with your oscilloscope programmatically.

First, import the class from the *ds1054z* module:

```
>>> from ds1054z import DS1054Z
```

Now you're able to instantiate the class providing the host you want to connect to. This can be an IP address or a VISA resources string:

```
>>> scope = DS1054Z('192.168.0.21')
>>> # or
>>> scope = DS1054Z('TCPIP::192.168.1.104::INSTR')
```

More information on the resources string can be found in the README of the `vxi11` package which *ds1054z.DS1054Z* uses to connect to the scope.

You can then check the identification of the device by accessing its `idn` property:

```
>>> print(scope.idn)
```

which will print something like `RIGOL TECHNOLOGIES,DS1054Z,DS1ZA116171318,00.04.03`.

To send a command to the oscilloscope, use the `ds1054z.DS1054Z.write()` method. Here we start the scope:

```
>>> scope.write(":RUN")
```

Note that for those very basic functions there might already be a convenience function present. In this case it's called *ds1054z.DS1054Z.run()*:

```
>>> scope.run()
```

If you want to read back values from the scope, use the *ds1054z.DS1054Z.query()* method:

```
>>> scope.query(":ACQuire:SRATe?")
u'5.000000e+08'
```

Please note that the answer is given as a (unicode) string here. You still need to convert the value to a float yourself.

```
>>> float(scope.query(":ACQuire:SRATe?"))
1000000000.0
```

CHAPTER 4

API Documentation

This section contains the documentation of the APIs provided by the package *ds1054z*.

Contents:

4.1 The class ds1054z.DS1054Z - Easy communication with your scope

class ds1054z.**DS1054Z**(*host*, **args*, ***kwargs*)

Bases: vxi11.vxi11.Instrument

This class represents the oscilloscope.

Variables

- **product** – like 'DS1054Z' (depending on your device)
- **vendor** – should be 'RIGOL TECHNOLOGIES'
- **serial** – e.g. 'DS1ZA118171631'
- **firmware** – e.g. '00.04.03.SP1'

static decode_ieee_block(*ieee_bytes*)

Strips headers (and trailing bytes) from a IEEE binary data block off.

This is the block format commands like :WAVeform:DATA?, :DISPlay:DATA?, :SYSTem:SETup?, and :ETABle<n>:DATA? return their data in.

Named after decode_ieee_block() in python-ivi

static format_si_prefix(*number*, *unit=None*, *as_unicode=True*, *number_format='{0:.6f}'*)

Formats the given number by choosing an appropriate metric prefix and stripping the formatted number of its zero-digits giving a nice human readable form.

If you provide a unit, it will be appended to the resulting string.

Example:

```
>>> DS1054Z.format_si_prefix(2E-9, unit='s')
'2 ns'
```

get_channel_measurement(*channel*, *item*, *type='CURRent'*)

Measures value on a channel

Parameters

- **channel** (*int or str*) – The channel name (like CHAN1, ...). Alternatively specify the channel by its number (as integer).
- **item** (*str*) – Item to measure, can be vmax, vmin, vpp, vtop, vbase, vamp, vavg, vrms, overshoot, preshoot, marea, mparea, period, frequency, rtime, ftime, pwidth, nwidth, pduty, nduty, rdelay, fdelay, rphase, fphase, tvmax, tvmin, pslewrate, nslewrate, vupper, vmid, vlower, variance, pvrms
- **type** (*str*) – Type of measurement, can be CURRent, MAXimum, MINimum, AVERages, DEViation

get_channel_offset(*channel*)

Returns the channel offset in volts.

get_channel_scale(*channel*)

Returns the channel scale in volts.

Returns channel scale

Return type float

get_probe_ratio(*channel*)

Returns the probe ratio for a specific channel

get_waveform_bytes(*channel*, *mode='NORMal'*)

Get the waveform data for a specific channel as `bytes`. (In most cases you would want to use the higher level function `get_waveform_samples()` instead.)

This function distinguishes between requests for reading the waveform data currently being displayed on the screen or if you will be reading the internal memory. If you set mode to RAW, the scope will be stopped first and you will get the bytes from internal memory. (Please start it again yourself, if you need to, afterwards.) If you set the mode to MAXimum this function will return the internal memory if the scope is stopped, and the screen memory otherwise.

In case the internal memory will be read, the data request will automatically be split into chunks if it's impossible to read all bytes at once.

Parameters

- **channel** (*int or str*) – The channel name (like CHAN1, ...). Alternatively specify the channel by its number (as integer).
- **mode** (*str*) – can be NORMal, MAXimum, or RAW

Returns The waveform data

Return type bytes

get_waveform_samples(*channel*, *mode='NORMal'*)

Returns the waveform voltage samples of the specified channel.

The mode argument translates into a call to `:WAVeform:MODE` setting up how many samples you want to read back. If you set it to normal mode, only the screen content samples will be returned. In raw mode, the whole scope memory will be read out, which can take many seconds depending on the current memory depth.

If you set mode to RAW, the scope will be stopped first. Please start it again yourself, if you need to, afterwards.

If you set mode to NORMal you will always get 1200 samples back. Those 1200 points represent the waveform over the full screen width. This can happend when you stop the acquisition and move the waveform horizontally so that it starts or ends inside the screen area, the missing data points are being set to float('nan') in the list.

Parameters

- **`channel`** (*int or str*) – The channel name (like ‘CHAN1’ or 1).
- **`mode`** (*str*) – can be ‘NORMal’, ‘MAX’, or ‘RAW’

Returns voltage samples

Return type list of float values

`query`(*message*, **args*, ***kwargs*)

Write a message to the scope and read back the answer. See `vxi11.Instrument.ask()` for optional parameters.

`query_raw`(*message*, **args*, ***kwargs*)

Write a message to the scope and read a (binary) answer.

This is the slightly modified version of `vxi11.Instrument.ask_raw()`. It takes a command message string and returns the answer as bytes.

Parameters **`message`** (*str*) – The SCPI command to send to the scope.

Returns Data read from the device

Return type bytes

`run`()

Start acquisition

`set_channel_offset`(*channel*, *volts*)

Set the (vertical) offset of a specific channel in Volt.

The range of possible offset values depends on the current vertical scale and on the probe ratio. With the probe ratio set to 1x the offset can be set between:

•-100V and +100V (if vertical scale 500mV/div), or

•-2V and +2V (if vertical scale < 500mV/div).

The range scales with the probe ratio. Thus, when the probe ratio is set to 10x, for example, the offset could be set between:

•-1000V and +1000V (if vertical scale 5V/div), or

•-20V and +20V (if vertical scale < 5V/div).

Parameters

- **`channel`** (*int or str*) – The channel name (like CHAN1, ...). Alternatively specify the channel by its number (as integer).
- **`volts`** (*float*) – the new vertical scale offset in volts

`set_channel_scale`(*channel*, *volts*, *use_closest_match=False*)

The default steps according to the programming guide:

•1mV, 2mV, 5mV, 10mV...10V (for a 1x probe),

•10mV, 20mV, 50mV, 100mV...100V (for a 10x probe).

You can also set the scale to values in between those steps (as with using the fine adjustment mode on the scope).

Parameters

- **`channel`** (*int or str*) – The channel name (like CHAN1, ...). Alternatively specify the channel by its number (as integer).
- **`volts`** (*float*) – the new value for the vertical channel scaling
- **`use_closest_match`** (*bool*) – round new scale value to closest match from the default steps

`set_probe_ratio`(*channel*, *ratio*)
Set the probe ratio of a specific channel.

The possible ratio values are: 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500, and 1000.

Parameters

- **`channel`** (*int or str*) – The channel name (like CHAN1, ...). Alternatively specify the channel by its number (as integer).
- **`ratio`** (*float*) – Ratio of the probe connected to the channel

`set_waveform_mode`(*mode='NORMal'*)
Changing the waveform mode

`single`()
Set the oscilloscope to the single trigger mode.

`stop`()
Stop acquisition

`tforce`()
Generate a trigger signal forcefully.

`display_data`
The bitmap bytes of the current screen content. This property will be updated every time you access it.

`displayed_channels`
The list of channels currently displayed on the scope. This property will be updated every time you access it.

`idn`
The `*IDN?` string of the device. Will be fetched every time you access this property.

`memory_depth_curr_waveform`
The current memory depth of the oscilloscope. This value is the number of samples to expect when reading the waveform data and depends on the status of the scope (running / stopped).

Needed by *`waveform_time_values`*.

This property will be updated every time you access it.

`memory_depth_internal_currently_shown`
The number of samples in the **raw (=deep) memory** of the oscilloscope which are **currently being displayed on the screen**.

This property will be updated every time you access it.

`memory_depth_internal_total`
The total number of samples in the **raw (=deep) memory** of the oscilloscope. If it's running, the scope will be stopped temporarily when accessing this value.

This property will be updated every time you access it.

`timebase_offset`
The timebase offset of the scope in seconds.

You can change the timebase offset by assigning to this property:

```
>>> scope.timebase_offset = 200e-6
```

The possible values according to the programming manual:

- -Screen/2 to 1s or -Screen/2 to 5000s.

timebase_scale

The timebase scale of the scope in seconds.

The possible values according to the programming guide:

- Normal mode: 5 ns to 50 s in 1-2-5 steps
- Roll mode: 200 ms to 50 s in 1-2-5 steps

You can change the timebase like this:

```
>>> scope.timebase_scale = 200E-9
```

The nearest possible value will be set.

waveform_preamble

Provides the values returned by the command `:WAVeform:PREamble?`. They will be converted to float and int as appropriate.

Those values are essential if you want to convert BYTE data from the scope to voltage readings or if you want to recreate the scope's display content programmatically.

This property is also accessible via the wrapper property *waveform_preamble_dict* where it returns a `dict` instead of a `tuple`.

This property will be fetched from the scope every time you access it.

Returns (fmt, typ, pnts, cnt, xinc, xorig, xref, yinc, yorig, yref)

Return type tuple of float and int values

waveform_preamble_dict

Provides a dictionary with 10 entries corresponding to the tuple items of the property *waveform_preamble*.

This property will be fetched from the scope every time you access it.

Returns {'fmt', 'typ', 'pnts', 'cnt', 'xinc', 'xorig', 'xref', 'yinc', 'yorig', 'yref'}

Return type dict

waveform_time_values

The timestamps that belong to the waveform samples accessed to to be accessed beforehand.

Access this property only after fetching your waveform data, otherwise the values will not be correct.

Will be fetched every time you access this property.

Returns sample timestamps (in seconds)

Return type list of float

waveform_time_values_decimal

This is a wrapper for *waveform_time_values*. It returns the time samples as `Decimal` values instead of float which can be convenient for writing with an appropriate precision to a human readable file format.

Access this property only after fetching your waveform data, otherwise the values will not be correct.

Will be fetched every time you access this property.

Returns sample timestamps (in seconds)

Return type list of `Decimal`

4.2 The submodule `ds1054z.discovery` - Zeroconf Discovery for Rigol DS1000Z-series scopes

This submodule depends on the Python package `zeroconf`. Thus,

```
>>> import ds1054z.discovery
```

raises an ImportError in case, the zeroconf package is not installed.

class `ds1054z.discovery.`**`DS1000ZServiceInfo`**(*type*, *name*, *address=None*, *port=None*, *weight=0*, *priority=0*, *properties=None*, *server=None*)

Patched version of zeroconf.ServiceInfo for DS1000Z devices.

`ds1054z.discovery.`**`discover_devices`**(*if_any_return_after=0.8*, *timeout=2.5*)

Discovers Rigol DS1000Z series oscilloscopes on the local networks.

Parameters

- **`if_any_return_after`** (*float*) – Return after this amount of time in seconds, if at least one device was discovered.
- **`timeout`** (*float*) – Return after at most this amount of time in seconds whether devices were discovered or not.

Returns The list of discovered devices. Each entry is a dictionary containing a ‘model’ and ‘ip’ entry.

Return type list of dict

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