PyTek Documentation

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Contents

PyTek provides a python API for interacting with Tektronix oscilloscopes over a serial interface. It currently supports some basic commands for the `TDS3k` series of DPO's (Digital Phosphor Oscilloscopes), especially `capturing waveforms` and `screen shots` from the device.

Note: Serial Port not Included

PyTek relies on a thirdparty serial port for communications, specifically one that matches the pyserial API. It is recommended that you simply use pyserial itself.

CHAPTER 1

Getting Started

To get started, try the *README*, or for complete documentation, check out the *pytek module* API documentation page.

CHAPTER 2

Documentation Contents:

2.1 README

PyTek provides a python API for interacting with Tektronix oscilloscopes over a serial interface. It currently supports some basic commands for the TDS3000 series of Digital Phosphor Oscilloscopes, especially *capturing waveforms* and *screen shots* from the device.

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2.1.1 tl;dr

What?

A python package that gives you an API for interacting with supported Tektronix oscilloscopes over a serial interace.

Install?

```
$ pip install pytek
```

Or, from source:

```
$ python setup.py install
```

Serial?

We don't provide a serial port implementation. We suggest, pyserial:

```
$ pip install pyserial
```

Examples?

```
>>> from serial import Serial
>>> from pytek import TDS3k
>>>
>>> port = Serial("COM1", 9600, timeout=1)
>>> tds = TDS3k(port)
>>>
>>>
>>> # Make the scope identify itself.
...
>>> tds.identify()
'TEKTRONIX,TDS 3034,0,CF:91.1CT FV:v2.11 TDS3GM:v1.00 TDS3FFT:v1.00 TDS3TRG:v1.00'
>>>
>>>
>>>
>>> # Capture waveform data
...
>>> waveform = tds.get_waveform(start=100, stop=109)
>>> waveform
<generator object <genexpr> at 0x0238B8A0>
>>
>>> for x,y in waveform:
...     print x, y
...
-0.0045 -0.16
-0.004499 -0.04
-0.004498 -0.04
-0.004497 -0.12
-0.004496 -0.12
-0.004495 -0.08
-0.004494 -0.12
-0.004493 -0.16
-0.004492 -0.2
-0.004491 -0.08
>>>
>>> tds.x_units()
's'
>>> tds.y_units()
'V'
>>>
>>>
>>>
>>> # Grab a screen shot (this will take a few minutes).
...
>>> ofile = open("screenshot.tiff", "wb")
```

```
>>> tds.screenshot(ofile, "tiff")
>>>
>>>
>>>
>>>
>>> #Fin.
...
>>> tds.close()
>>>
```

Dependencies?

You'll need a serial port interface. See the "Serial?" section, above.

To build the sphinx docs from source (as is), you'll need the **'sphinx_rtd_theme'_**:

```
$ pip install sphinx_rtd_theme
```

Extras?

PyTek package includes the following extras (optional installs):

serial Adds pyserial package as a requirement, the recommended serial port interface.

docs Adds **'sphinx_rtd_theme'_** package as a requirement, needed for building sphinx docs.

Docs?

- Read The Docs (.org)
- Python Hosted (.org)

2.1.2 Misc.

Contact Information

This project is currently hosted on bitbucket, at https://bitbucket.org/bmearns/pytek/. The primary author is Brian Mearns: you can contact Brian through bitbucket at https://bitbucket.org/bmearns.

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2.2 pytek module

This is the top level module of the *PyTek* package. It provides classes for interfacing with various Tektronix oscilloscopes over a serial interface.

Most classes in this module are based on a specific series of devices, based on the serial interface supported by the devices. There is currently only one class provided, TDS3k which supports the TDS 3000 series of devices.

Note: Serial Port not Included

pytek relies on a thirdparty serial port for communications, specifically one that matches the pyserial API. It is recommended that you simply use pyserial itself.

---

class pytek.**TDS3k**(*port*)

Bases: pytek.util.Configurable

The TDS3k class provides functions for interacting with the TDS 3000 series of DPO's from Tektronix. Documentation on this interface is available from Tektronix at this link.

Instances of this class are instantiated by passing in a serial port object, which supports the pyserial interface. This is the port that the object will use for interacting with the device. Configuration of this port depends on your device and your serial port implementation. Typical settings for RS232 are 9600 baud.

Example:

```
#Import class
from pytek import TDS3k

#Import pyserial
import serial

port = serial.Serial("COM1", 9600, timeout=1)
tds = TDS3k(port)

# ... do stuff with the tds object.

#Closes the object's port.
tds.close()
```

> **Warning:** Serial Port Timeout
> It is **very important** that you specify a timeout on your serial port. The get_response method (used by things like screenshot and get_curve) continue to read data until a read timesout, so if there is no timeout, it will never return.

ID_REGEX = <_sre.SRE_Pattern object at 0x1bb0df0>

The regular expression used to match the start of the identify string, for sanity_check.

```
r'^TEKTRONIX,TDS 3\d{3},'
```

close()

Closes the object's port by invoking it's close method.

The object itself is not affected by this so if you call any methods that try to communicate over the port, it will be trying to communicate over a closed port.

send_command(*command*[, *arg1*[, *arg2*[, ...]]])

Sends a command and any number of arguments to the device. Does not wait for response.

See also:

- send_query - To send a query and get a one-line response.

send_query(*query*)
Sends a query to the device and reads back one line, returning that line (stripped of trailing whitespace).

A '?' and a linebreak are automatically appended to the end of what you send.

E.g.:

```
>>> tek.send_query("*IDN")
'TEKTRONIX,TDS 3034,0,CF:91.1CT FV:v2.11 TDS3GM:v1.00 TDS3FFT:v1.00 TDS3TRG:v1.00'
>>>
```

Warning: This method turns off header echoing from the device. I.e., it sends "HEADER OFF" before anything else (through the headers_off method). If you're expecting headers to be on subsequently, you will need to turn them on with "HEADER ON", or with the headers_on method.

query_quoted_string(*query*)
Like send_query, but expects a quoted string as a response, and strips the quotes off the response before returning. Raises a ValueError if the response is not quoted.

get_response()
Simply reads data from the object's port, one byte at a time until the port timesout on read. Returns the data as a str.

Waits indefinitely for the first byte.

headers_off()
Sends the "HEADER OFF" command to the device, to disable echoing of headers (command names) in query responses from the device. Most methods that query the device will cause this to be sent. You can turn it back on with headers_on, or by sending the "HEADER ON" command.

headers_on()
Sends the "HEADER ON" command to the device. See headers_off for details.

identify()
Convenience function for sending the "*IDN" query, with send_query, and returning the response from the device. This provides information about the device including model number, options, application modules, and firmware version.

See also:

- sanity_check uses the response from this method to determine if the connected device appears to a supported model.

sanity_check()
Does a sanity check on the device to make sure that the way it identifies itself matches the expected response. Returns True if the sanity check passes, otherwise False.

The device does not actually enforce this test, and will not perform it automatically (i.e., only if you call this method). This is for your sake so you don't waste time on a device that isn't compatible.

See also:

- identify
- force_sanity

force_sanity()
Does the sanity_check on the device, and raises an Exception if the check fails.

acquire_state([*val*])
Configures or queries the value of the ACQUIRE:STATE setting on the device. If a value is given, then the setting is configured to the given value. If the value is None (the default), then the setting is queried and the value is returned.

For *queries*, return True or False:

- True if the device replies with any of the following: "1", "ON", "RUN"
- False otherwise.

For *configuring*, if val evaluates as True, causes "1" to be sent to the device. Any other value for val causes "0" to be sent.

The ACQUIRE:STATE setting is related to the "RUN / STOP" button on the device, and it basically configures whether the device is actually acquiring data or not.

acquire_single([*val*])
Configures or queries the value of the ACQUIRE:STOPAFTER setting on the device. If a value is given, then the setting is configured to the given value. If the value is None (the default), then the setting is queried and the value is returned.

For *queries*, return True or False:

- True if the device replies with any of the following: "SEQ", "SEQUENCE"
- False otherwise.

For *configuring*, if val evaluates as True, causes "SEQ" to be sent to the device. Any other value for val causes "RUN" to be sent.

The ACQUIRE:STOPAFTER setting is related to the "single sequence" button on the device. If True, then when the device is set to acquire (e.g., by passing True to acquire_state), it will only acquire a single sequence, and then stop automatically. Otherwise, it will continue to acquire until it is stopped.

trigger()
Force the device to trigger, assuming it is in READY state (see trigger_state).

This sends the TRIGGER FORCE command to the device.

trigger_auto([*val*])
The TRIGGER:A:MODE is related to the "AUTO" and "NORMAL" selections in the Trigger menu. If set to True, the trigger is in "AUTO (Untriggered roll)" mode, in which the device automatically generates a trigger if none is detected.

Otherwise, the device is in "NORMAL" mode, in which the device waits for a valid trigger.

val = 'trigger'

trigger_state()
Returns a string indicating the current trigger state of the device. This queries the TRIGGER:STATE setting on the device.

The following list gives the possible return values:

- **auto** - indicates that the oscilloscope is in auto mode and acquires data even in the absence of a trigger (see trigger_auto).
- **armed** - indicates that the oscilloscope is acquiring pretrigger information. All triggers are ignored in this state.
- **ready** - indicates that all pretrigger information has been acquired and the oscilloscope is waiting for a trigger.
- **save** - indicates that acquisition is stopped or that all channels are off.

•**trigger** - indicates that the oscilloscope has seen a trigger and is acquiring the posttrigger information.

get_waveform_preamble()

Queries the waveform preamble from the device, which details how a waveform or curve will be transferred from the device based on the current settings (as with `get_curve` or `get_waveform`, though note that both of those functions alter settings based on provided parameters, before retrieving the data).

Returns a dictionary of preamble values.

Example:

```
>>> wfm_preamble = tds.get_waveform_preamble()
>>> for k, v in wfm_preamble.iteritems():
...     print k, ":", repr(v)
...
byte_order : 'MSB'
binary_format : 'RP'
x_incr : 1e-06
y_scale : 0.08
number_of_points : 10000
y_unit : '"V"'
encoding : 'BIN'
y_zero : 0.0
point_format : 'Y'
waveform_id : '"Ch1, DC coupling, 2.0E0 V/div, 1.0E-3 s/div, 10000 points, Sample mode"'
x_units : '"s"'
y_offset : 128.0
bits_per_sample : 8
bytes_per_sample : 1
pt_offset : 0
xzero : -0.0045
>>>
```

get_curve(*source='CH1'*, *double=True*, *start=1*, *stop=10000*, *preamble=False*, *timing=False*)

Queries a curve (waveform) from the device and returns it as a set of data points. Note that the points are simply unsigned integers over a fixed range (depending on the `double` parameter), they are not voltage values or similar. Use `get_waveform` to get scaled values in the proper units.

> **Warning:** Note that this method will set waveform preamble and data parameters on the device, which have a persistent effect which could alter the behavior of future commands.

If `preamble` or `timing` are `True`, returns a tuple: `(preamble_data, data, timing_data)`, where the `preamble_data` and `timing_data` are only present if the corresponding flag is set.

If neither `preamble` nor `timing` is `True`, then just returns `data` as the sole argument (i.e., `data`, not `(data,)`).

In either case, `data` will be a sequence of data points for the curve. If the `double` parameter is `True` (the default), data points are each double-byte wide, in the range from 0 through 65535 (inclusive). This gives you maximum resolution on your data, but takes longer to transfer. Also note that the device does not necessarily have 16 bits of precision in measurement, but data will be left-aligned to the most significant bits.

If `double` is `False`, then the data points are single-byte each, in the range from 0 through 255 (inclusive).

Regardless of `double`, the minimum value corresponds to one vertical division *below* the bottom of the screen, and the maximum value corresponds to one vertical division *above* the top of the screen.

Parameters

- **source** (*str*) – Optional, specify the channel to copy the waveform from. Default is `"CH1"`.

- **double** (*bool*) – Optional, if `True` (the default), data points are transferred 16-bits per point, otherwise they are transferred 8-bits per point, which may cut off least significant bits but will transfer faster.
- **start** (*int*) – Optional, the data point to start at. The waveforms contains up to 10,000 data points, the first point is 1. The default value is 1. If you set this param to `None`, it has the same effect as a 1.
- **stop** (*int*) – Optional, the data point to stop at. See `start` for details. The default value is 10,000 to transfer the entire waveform. If you set this to `None`, it has the same effect as 10,000.
- **preamable** (*bool*) – Controls whether or not the curve's preamble is included in the return value. The curve's preamble is not the same as the waveform preamble that configures the data. The curve's preamble is a string that is transmitted prior to the curve's data points. I'm honestly not sure what it is, but it contains a number which seems to increase with the number of data points transferred.
- **timing** (*bool*) – Controls whether or not timing information is included in the return value. Timing gives the number of seconds it took to transfer the data, as a floating point value.

get_waveform(*source='CH1'*, *double=True*, *start=1*, *stop=10000*, *preamble=False*, *timing=False*)

Similar to `get_curve`, but uses `waveform premable` data to properly scale the received data.

If `preamble` or `timing` are `True`, returns a tuple: `(preamble_data, data, timing_data)`, where the `preamble_data` and `timing_data` are only present if the corresponding flag is set.

If neither `preamble` nor `timing` is `True`, then just returns `data` as the sole argument (i.e., `data`, not `(data,)`).

`data` is a sequence of two tuples, giving the X and Y value for each point, in order across the X-acis from left to right. These are properly scaled based on the waveform settings, Giving, for instance, a value in Volts versus Seconds. Check `x_units` and `y_units` to get the actual units.

get_num_points()

Queries the number of points that will be sent in a waveform or curve query, based on the current settings.

This is relevant to functions like `get_waveform` and `get_curve`, but note that those functions set the `DATA:START` and `DATA:STOP` configuration options on the device based on provided parameters, thereby effecting the number of points.

y_units()

Returns a string giving the units of the Y axis based on the current waveform settings.

Example:

```
>>> tds.y_units()
'V'
>>>
```

x_units()

Returns a string giving the units of the X axis based on the current waveform settings. Possible values include `'s'` for seconds and `'Hz'` for Hertz.

Example:

```
>>> tds.x_units()
's'
>>>
```

screenshot(*ofile=None*, *fmt='RLE'*, *inksaver=True*, *landscape=False*)

Grabs a hardcopy/screenshot from the device.

If `ofile` is `None` (the default), simply returns the data as a string. Otherwise, it writes the data to the given output stream.

Parameters

- **fmt** (*str*) – Optional, specify the format for the image. Valid values will vary by device, but will be a subset of those listed below. The default is "RLE" which gives a Windows Bitmap file.
- **inksaver** (*bool*) – Optional, if `True` (the default), puts the device into hardcopy-inksaver mode, in which the background of the graticular is white, instead of black. If `False`, sets the device to not be in inksaver mode.
- **landscape** (*bool*) – Optional, if `False` (the default), the image will be in portrait mode, which is probably what you want. If `True`, it will be in landscape mode, which generally means the image will be rotated 90 degrees.

Possible supported formats:

The following is a list of the formats that may be supported, but individual devices will only support a subset of these. To see if your device supports a format, use `check_img_format`.

•**TDS3PRT** - For the TDS3000B series only, sets format for the TDS3PRT plug-in thermal printer.

•**BMP** - Grayscale bitmap. This is uncompressed, and very large and slow to transfer.

•**BMPColor** - Colored bitmap. Uncompressed, very large and slow to transfer.

•**DESKJET** - For the TDS3000B and TDS3000C series only, formatted for HP monochrome inkjet printers.

•**DESKJETC** - For the TDS3000B and TDS3000C series only, formatted for HP *color* inkjet printers.

•**EPSColor** - Colored Encapsulated PostScript.

•**EPSMono** - Monochrome Encapsulated PostScript.

•**EPSON** - For the TDS3000B and TDS3000C series only, supports Epson 9-pin and 24-pin dot matrix printers.

•**INTERLEAF** - Interleaf image object format.

•**LASERJET** - For the TDS3000B and TDS3000C series only, supports HP monochrome laser printers.

•**PCX** - PC Paintbrush monochrome image format.

•**PCXcolor** - PC Paintbrush color image format.

•**RLE** - Colored Windows bitmap (uses run length encoding for smaller file and faster transfer).

•**THINKJET** - For the TDS3000B and TDS3000C series only, supports HP monochrome inkjet printers.

•**TIFF** - Tag Image File Format.

•**DPU3445** - Seiko DPU-3445 thermal printer format.

•**BJC80** - For the TDS3000B and TDS3000C series only, supports Canon BJC-50 and BJC-80 color printers.

•**PNG** - Portable Network Graphics.

Note: The fatest transfer seems to be **RLE**, with **TIFF** close behind (transfer times are less than one minute at 9600 baud). **BMP** and **BMPColor** take a very long time (more than five minutes at 9600 baud).

---

check_img_format (*fmt*)
Tests if a hardcopy image format is supported by the device. This simply sets the HARDCOPY:FORMAT configuration value to the given format, and checks to see if it comes back as the same format.

Return True if the format is supported, False otherwise.

Resets the HARDCOPY:FORMAT back to where it was before returning.

See also:

screenshot

k = 'trig'

seq = ['trigger', 'trig']

pytek.**TDS3xxx**
alias of TDS3k

2.3 pytek.util module

class pytek.util.**Configurator**(*name*, *get=None*, *set=None*, *doc=None*)
Bases: object

The Configurator class creates helper objects that can be used to easily add methods to a class to configure and query a particular setting on the device.

The easiest way to understand it is by example. First, a stripped down usage example:

```
class MyDevice(object):

    __metaclass__ = Configurator.ConfigurableMeta

    @Configurator.config("FOO:BAR")
    def foobar(self, val):
        return val.lower()

    @foobar.setter
    def foobar(self, val):
        return val.upper()


    @Configurator.config
    def frobbed(self, val):
        return (val == "ON")

    @frobbed.setter
    def frobbed(self, val):
        return "ON" if val else "OFF"
```

And now, a more thorough example, expanded from this:

```
class MyDevice(object):

    #Make sure it uses the ConfigurableMeta class as its metaclass,
    # so Configurator objects in the class definition get replaced with
    # appropriate methods.
    __metaclass__ = Configurator.ConfigurableMeta

    #Just some ordinary instance attributes, which we will be the target of
```

```
# our setting configuring and querying.
__foobar = "TAZ"
__frobbed = "OFF"

#This is where the class actually implements sending command and queries.
# The Configurator objects will call these methods.

def send_command(self, name, arg):
    print "~~~> %s %s" % (name, arg)
    if name == "FOO:BAR":
        if not isinstance(arg, str):
            raise TypeError()
        if arg != arg.upper():
            raise ValueError()
        self.__foobar = arg

    elif name == "FROBBED":
        if arg not in ("ON", "OFF"):
            raise ValueError()
        self.__frobbed = arg

    else:
        raise KeyError()


def send_query(self, name):
    print "???? %s" % name
    if name == "FOO:BAR":
        val = self.__foobar
    elif name == "FROBBED":
        val = self.__frobbed
    else:
        raise KeyError()
    print "    <<<< %s" % val
    return val


#Now, define Configurators for each of our configurable settings.


#First, for the FOO:BAR setting, which will be accessed through a
# function called `foobar`.

@Configurator.config("FOO:BAR")
def foobar(self, val):
    #Translate a value returned by `send_query` into a value to return
    # to the calling code.
    return val.lower()

@foobar.setter
def foobar(self, val):
    #Translate a value provided by the calling code into a value that
    # will be passed to `send_command`.
    return val.upper()


#Now, the FROBBED setting. We can use implicit named in the decorator
# for this one.
```

```
    @Configurator.config
    def frobbed(self, val):
        '''
        +++
        Querying returns True for "ON", and False for "OFF".
        '''
        if val == "ON":
            return True
        if val == "OFF":
            return False
        raise ValueError(val)

    @frobbed.setter
    def frobbed(self, val):
        '''
        +++
        Valid values for configuring are True and False, or synonomously
        "ON" and "OFF".
        '''
        if val is True or val == "ON":
            return "ON"
        elif val is False or val == "OFF":
            return "OFF"
        raise ValueError()
```

With the above code, you could then do the following:

```
>>> dev = MyDevice()
>>> dev.foobar()
???? FOO:BAR
    <<<< TAZ
'taz'
>>>
>>> dev.foobar('razzle-dazzle')
~~~> FOO:BAR RAZZLE-DAZZLE
>>>
>>> dev.foobar()
???? FOO:BAR
    <<<< RAZZLE-DAZZLE
'razzle-dazzle'
>>>
>>>
>>> dev.frobbed()
???? FROBBED
    <<<< OFF
False
>>> dev.frobbed(True)
~~~> FROBBED ON
>>> dev.frobbed()
???? FROBBED
    <<<< ON
True
>>>
>>> dev.frobbed(False)
~~~> FROBBED OFF
>>> dev.frobbed()
???? FROBBED
    <<<< OFF
```

```
False
>>>
>>> dev.frobbed("ON")
~~~> FROBBED ON
>>> dev.frobbed()
???? FROBBED
    <<<< ON
True
>>>
>>> dev.frobbed("???")
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "src\pytek\util.py", line 125, in config
    return self(device, val)
  File "src\pytek\util.py", line 116, in __call__
    self.configure(device, self.name, self.set(device, val))
  File "temp.py", line 94, in frobbed
    raise ValueError()
ValueError
>>>
>>>
>>> help(dev.foobar)
Help on method foobar in module pytek.util:

foobar(device, val=None) method of temp.MyDevice instance
    Configures or queries the value of the ``FOO:BAR`` setting on the device.
    If a value is given, then the setting is configured to the given value.
    If the value is `None` (the default), then the setting is queried and the value
    is returned.

>>>
>>> help(dev.frobbed)
Help on method frobbed in module pytek.util:

frobbed(device, val=None) method of temp.MyDevice instance
    Configures or queries the value of the ``FROBBED`` setting on the device.
    If a value is given, then the setting is configured to the given value.
    If the value is `None` (the default), then the setting is queried and the value
    is returned.


    Querying returns True for "ON", and False for "OFF".


    Valid values for configuring are True and False, or synonomously
    "ON" and "OFF".

>>>
>>>
```

Parameters

- **name** – Specifies the name of the setting accessed by this object. Should be either a `callable` object with a `__name__` attribute, or a string. Strings will be used directly, callables will be filtered through `func_to_name`.
- **get** (*callable*) – Optional: if given, passed to `getter`.
- **set** (*callable*) – Optional: if given, passed to `setter`.

- **doc** (*callable*) – Optional: if given, used as the value of the `doc` attribute.

DEFAULT_DOCTSTR = '\nConfigures or queries the value of the ``%(NAME)s`` setting on the device.\nIf a value is given,
A string used for default value of the `doc` attribute.

classmethod configure(*device*, *name*, *val*)
The final method in this object used to configure the setting, given the raw value to be sent to the device. This is called by the `__call__` method when appropriate.

This delegates to the `send_command` method of the given `device`.

Parameters

- **device** – The object on which the `send_command` will be invoked.
- **name** (*str*) – The name of the setting, usually the value of the `name` attribute. This is the first arguments passed to `send_command`.
- **val** (*str*) – The raw value to configure the setting to. This is the second argument passed to `send_command`.

classmethod query(*device*, *name*)
The final method in this object used to query the setting, returning the raw value from the device. This is called by the `__call__` method when appropriate.

This delegates to the `send_query` method of the given `device`.

Parameters

- **device** – The object on which the `send_query` will be invoked.
- **name** (*str*) – The name of the setting, usually the value of the `name` attribute. This is the only arguments passed to `send_query`.

create_method(*name*)
Creates a method with the given name which can be installed in a class to delegate to this object's `__call__` method. Sets the name of the method to `name`, and sets the docstr (`__doc__`) to the value of this object's `doc` attribute.

This is used by `ConfigurableMeta` to replace Configurator instances in the classes dictionary with functions.

update_doc(*func*)
If the given function has a docstrig (`__doc__`), then this object's `doc` attribute is updated with it. Otherwise, it does nothing.

If `func`'s docstr begins with `'+++'` alone on a line (any amount of leading and trailing whitespace), then the remainder of the docstring is *appended* to the existing docstring, instead of replacing it.

classmethod func_to_name(*func*)
Derives a setting name from a function. The implementation here just uses the `__name__` attribute of the given `func`, and then uses `str.upper()` to make it all upper case.

This is used in `__init__` if the name is a `callable` object.

classmethod boolean(*arg*, ***kwargs*)
A function decorator utility used to create a `Configurator` object which handles boolean settings. This ends up delegating to `set_boolean` to actually set up the `get` and `set` filters based on responses from the decorated function. All keyword arguments passed to this function are forwarded to `set_boolean`.

Similar to `config`, you can invoke this with *implicit arguments* or *explicit arguments*

For **implicit arguments**, you use this method as a function decorator directly, and the `name` to use is derived from the decorated function with `func_to_name`. In this mode, you can't specify any additional arguments to pass to `set_boolean`.

For **explicit arguments**, you invoke this method directly, and it returns a function decorator. This allows you to pass in a string as the first argument to specify the `name` to use, as well as additional keyword arguments to be forwarded on to `set_boolean`.

classmethod `config`(*arg*)

A function decorator utility used to create a `Configurator` object and a function decorator to configure its `getter`.

There are two way to invoke this, using *implicit naming* or *explicit naming*.

For **implicit naming***, simply pass a function in directly, or use this function directly as a decorator. For instance:

```
@Configurator.config
def foobar(self, val):
    return val
```

The above code will create a new instance of `cls` (i.e., a Configurator object), and will pass the given function `foobar` in as the `name` parameter to the constructor. This in turn will use `func_to_name` to derive a value for the instance's `name` attribute from the function, by default (i.e., in the base `Configurator` class), this is just the name of the function in all uppercase.

The function will also be passed to the instance's `getter` method so that the `foobar` function becomes the instance's `get` filter.

This method will then return the Configurator object itself, *not* the wrapped function.

The alternative is **explicit naming**, in which this function is not used *as* a function wrapper, but invoked to *return* a function wrapper. This gives you some added flexibility such as explitictly giving the `name` to use for the Configurator object. Otherwise, the behavior is essentially the same.

For instance:

```
@Configurator.config('BAZ:RUFFLE')
def foobar(self, val):
    return val
```

In this case, even though the wrapped function has the same name, `"foobar"`, the created Configurator object will have a `name` of `"BAZ:RUFFLE"`. Other than that, the effects are the same.

In either case, when code like this appears in a class definition, it means that class will have an attribute named `foobar` whose value is a Configurator object. If this class is using the `ConfigurableMeta` metaclass, then this attribute will be replaced by a proper method generated by the Configurator's `create_method` method.

Also note that when the wrapped function is passed to the Configurator's `getter` method, this method will also pass it to `update_doc`, so if the wrapped function has a docstring, the Configurator object's `doc` attribute will be set accordingly. When the `ConfigurableMeta` gets a hold of it, the corresponding method it adds to the class will receive this docstr from the Configurator object.

Note that for the remainder of the class definition, you can use the generated Configurator object. For instance, you can follow up either of the above examples with the following:

```
@foobar.setter
def foobar(self, val):
    if val is False:
        return "OFF"
    return "ON"
```

Since at this point the `foobar` symbol is actually a Configurator object, you can use its other decorators such as `setter` and `getter`.

setter (*func*)
A function wrapper which sets this object's `set` attribute to the given function and passes the function to `update_doc`, then returns `self`.

The given function should take two arguments and return a string. The first argument will be the device on which the `send_command` method is invoked, the second argument will be the client supplied value they want to configure the setting to. The function should return a corresponding string which will actually be sent to the device.

getter (*func*)
Like `setter`, but sets the object's `get` attribute, used for querying the setting from the device.

This is a function wrapper which sets this object's `get` attribute to the given function and passes the function to `update_doc`, then returns `self`.

The given function should take two arguments and return a string. The first argument will be the device on which the `send_query` method is invoked, the second argument will be the value returned from the device by `send_query`. The function should return a corresponding value which will be returned to the user to reflect the string returned by the device.

set_boolean (*func*, *strict=False*, *default=False*, *nocase=False*)
Configures the objects `set` and `get` filters based on a boolean setting.

A boolean setting means the setting has a set of possible values that are partitioned into two subsets: true values and false values. On the python side, any value in these subsets corresponds to a value of `True` or `False`, respectively.

This method sets up the object to filter values accordingly, so that querying the setting always returns `True` or `False`, and configuring the setting can be done with `True` or `False`.

To do so, you have to pass in a function which can be evaluated immediately to get the set of true values and the set of false values. The function should take a single boolean argument, if the argument value is `True`, return the set of true values, otherwise, return the set of false values. The method will then create appropriate set and get filters based on these values and the other parameters passed into this function (see below).

The sets of true values and false values returned by `func` must be sequences. The first value in each sequence will be used as the *canonical* value, meaning the ones that will actually be passed to the device for the corresponding value. All other values in the sets will be acceptable responses from the device for queries, and will result in the corresponding boolean value being returned to the caller.

See also:

`boolean`

Parameters

- **func** (*callable*) – This function will be called twice, immediately. Once with a value of `True`, which should return a sequence of true values; and once with a value of `False`, which should return a sequence of false values.
- **strict** (*bool*) – Optional, default is `False`. If `True`, then the generated `set` and `get` filters will be strict about values. The `set` filter will only accept boolean values, and will raise a `TypeError` otherwise. The `get` filter will only accept values from the true- and false- value sets, and will raise a `ValueError` if the device returns anything else.

  If the value of the parameter is `False`, the generated functions are not as strict, and will not raise exceptions for unrecognized values (the way it handles unrecognized values

depends on the value of the `default` parameter). For the non-strict `set` filter, values are simply evaluated as bools to choose which value to send.

- **default** (*bool*) – Optional, default value is `False`. This is only used if `strict` is `False`, in which case it determines the *default* value when an unrecognized value is encountered.
- **nocase** (*bool*) – Optional, default value is `False`. If `True`, then values are considered case-insensitive.

class `ConfigurableMeta`

Bases: `type`

This is a meta class that can be added to classes to more easily support the use of `Configurator` objects as pseudo-methods.

The meta class extends the `__new__` function to find all instances of `Configurator` in the class's dictionary, and replace it with a method created by the Configurator's `create_method` method.

See the example code in the documentation for `Configurator` for an example.

x.__init__(...) initializes x; see help(type(x)) for signature

class `pytek.util.Configurable`

Bases: `object`

Just a simple base classes that uses `ConfigurableMeta` as the metaclass.

x.__init__(...) initializes x; see help(type(x)) for signature

2.4 `pytek.version` module

The `version` module provides version numbering for the entire *PyTek* package.

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2.4.1 Versioning

The PyTek packages uses a five part version number, plus an incremental release number. Either the version number or the release number can be used to identify a released version of the code.

Version Number

The version number is a four part dotted number, with an optional tag on the end. Formally, a version number looks like:

```
version number  ::=  <Major>.<minor>[.<patch>[.<semantic>]][-[x-]<tag>]
```

With each new released version of the code, exactly one of the four numbers will increase, and any numbers to its right will reset to 0.

The easiest way to understand version numbers is from the perspective of someone who has written *client code*: i.e., code that makes use of a particular version of the *PyTek* library. From this perspective, the version number indicates whether or not your client code can be expected to work with different versions of *PyTek*.

Major Version

The `<Major>` component is the **major version number**, and it describes *backward compatibility*. Going to a *newer* version of *PyTek*, your code should continue to work as long as the major version doesn't change.

The major version is changed only when something is removed from the *PyTek* public interface. For instance, if a function is no longer supported, the major version number would have to increase, because client code which relied on that function would no longer work.

The major version number can be accessed through the `MAJOR` member of this module.

Minor Version

The `<minor>` component is the **minor version number**, and it describes *forward compatibility*: Going to an *older* version of *PyTek*, your code will continue to work as long as the minor version doesn't change. (As before, your code will also work for *newer* versions of *PyTek*, as long as the major version number hasn't changed).

The minor version number is changed only when something is added to the *PyTek* public interface, for instance a new function is added. Such a change maintains *backward* compatibility (as described above), but *loses forward compatibility*, because any client code written again this new version may not work with an older version.

The minor version number can be accessed through the `MINOR` member of this module.

Patch Version

The `<patch>` component is the **patch number**, and it describes changes that *do not affect compatibility*, either forwards or backwards. Your client code will continue to work with an older or newer version of *PyTek* as long as the major and minor version numbers are the same, regardless of the patch number.

Patch changes are code changes that do not effect the interface, for instance bug-fixes or performance enhancements. (although some bugs effect the interface and may therefore cause a higher version number to change).

The patch number can be accessed through the `PATCH` member of this module.

Semantic Version

The `<semantic>` component is the **semantic version number**, and it describes changes that do not affect how the code runs at all. Ths generally means that documentation or other auxilliary files included in the package have changed.

The semantic version number can be accessed through the `SEMANTIC` member of this module.

Compatibility Summary

The following table summarizes compatibility for a hypothetical client application built against released *PyTek* version `M.n.p.s`:

Component	Compatibile (all)	Incompatible (any)
Major	M	!= M
minor	>= n	< n
patch	any	
semantic	any	

Version Tag

The `<tag>` component is the **version tag**, which is used only for non-released code. The tag has one of the following forms:

```
version tag  ::=   << empty >>
                   dev[-<rev>]
                   blood-<branch>[-<rev>]
```

The first form is an empty tag, and is reserved for released (tagged) code only.

The second form, `"dev"`, is for non-released code in the *trunk*. This is the main line of development. Dev code may not be completely functional, and may even break the existing interface.

The third form, `"blood-..."`, if for non-released code on a *branch*. The `<branch>` component of this form should be the name of the branch. This is considered *bleeding-edge* code and may be highly unstable.

The optional `<rev>` component on both the second and third forms can be used to specify a specific revision for comitted development code. This must be an globally unambiguous identifier for the revision, for instance the change set id.

Development code

A non-empty version tag indicates a *development version* of the code. In this case, the four version numbers remain *unchanged* until the code is released (in which case it is no longer development code, and the tag is changed to empty).

In other words, anytime you see a non-empty version tag, the version numbers shown refer to version from which the development code is derived. This is done because it is not generally known until release what the next released version number will be, since it is not known what types of changes will be included in it.

Specifying a version number

When specifying a version number, the major and minor version numbers should always be included. Additionally, all non-zero version numbers should be included, and any version number to the left of a non-zero version number should be included.

The tag should always be included in the version number, with the indicated hyphen separating the semantic version number and the tag. The only exception is for released code, in which case the tag is empty and should be omitted, along with the joining hyphen.

The optional `"x-"` shown preceding the tag in the version number is for compatibility with setup-tools so that versions compare correctly.

The above rules will unambiguously describe any released version of the package.

Interface Version

Because any change to the public interface requires a change to either the major or minor version numbers, the interface can be specified by a shortened two part version:

```
interface version  ::=  <Major>.<minor>
```

Note that this only applies for released versions: development versions may modify the public interface prior to changing the version numbers.

Release Number

The release number is a simple integer which increments by one for every public release of the code. It does not convey any information about compatibility with other versions, but it does provide a simple alternative to identifying released versions.

The release number should be written with a leading `"r"` or `"rel"`. For instance, the first release was `"r1"`.

For release code, the release number may be used in place of the tag in the version number. This is optional because the version number and the release number are synonymous. However, including them both in the version string is a useful way to provide both pieces of information.

This alternative form of the version number is:

```
alt. version number  ::=  <Major>.<minor>[.<patch>[.<semantic>]]-r<release>
```

2.4.2 Module Contents

`pytek.version.`**`RELEASE`** **= 5**
The current Release Number.

`pytek.version.`**`MAJOR`** **= 1**
The current *major version number*.

`pytek.version.`**`MINOR`** **= 1**
The current *minor version number*.

`pytek.version.`**`PATCH`** **= 1**
The current *patch version number*.

`pytek.version.`**`SEMANTIC`** **= 0**
The current *semantic version number*.

`pytek.version.`**`TAG`** **= 'dev'**
The current Version Tag.

Tag options are `None`, `"dev"`, and `"blood-"`

- `None` means this is a released/tagged version.
- `"dev"` means this is a development version from the trunk/mainline.
- `"blood-"` means it's on a branch. After the dash, fill in the name of the branch.

Dev and blood versions are still numbered for the *previous* version, because we may not know what the next version will be until we're finished.

pytek.version.**COPYRIGHT = 2014**
The copyright year for the *PyTek* code.

pytek.version.**YEAR = 2014**
The year in which the code was released.

See also:

- MONTH
- DAY
- datestr

pytek.version.**MONTH = 4**
The month in which the code was released. This is 1 indexed, in [1, 12].

See also:

- YEAR
- DAY
- datestr
- MONTH_NAMES

pytek.version.**DAY = 13**
The day of the month on which the code was released.

See also:

- YEAR
- MONTH
- datestr

pytek.version.**MONTH_NAMES = ['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul', 'Aug', 'Sep', 'Oct', 'Nov', 'Dec']**
A sequence giving the names of months, for use by datestr. Standard values are three-letter English-language abbreviations for the months of the Gregorian calendar.

pytek.version.**setuptools_string**()
Returns the version string used by setuptools. This takes one of two forms:

```
setuptools_string  ::=   <Major>.<minor>.<patch>.<semantic>-x-<tag>
                         <Major>.<minor>.<patch>.<semantic>-r<release>
```

The first form is used for development code (i.e., when TAG is not None), and the second it used for released code.

This is similar to string, except for the additional x- for development versions, which is used to ensure that setuptools sorts versions correctly. (specifically, so that released versions are earler than development versions which are derived from them).

pytek.version.**tag_name**()
Returns the tag name for the most recent release.

pytek.version.**short_string**()
Returns a string describing the Interface Version (i.e., <Major>.<minor>).

pytek.version.**string**()
Like setuptools_string, except leaves out the x- for development versions.

pytek.version.**datestr**()
Returns a simple string giving the date of release. Format of this string is unspecified, it intended to be human readable, not machine parsed. For machine processing, use the individual variables, as listed below.

See also:

- YEAR
- MONTH
- DAY
- MONTH_NAMES

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(1) assert copyright on the software, and (2) offer you this License
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For the developers' and authors' protection, the GPL clearly explains
that there is no warranty for this free software. For both users' and
authors' sake, the GPL requires that modified versions be marked as
changed, so that their problems will not be attributed erroneously to
authors of previous versions.

Some devices are designed to deny users access to install or run
modified versions of the software inside them, although the manufacturer
can do so. This is fundamentally incompatible with the aim of
protecting users' freedom to change the software. The systematic
pattern of such abuse occurs in the area of products for individuals to
use, which is precisely where it is most unacceptable. Therefore, we
have designed this version of the GPL to prohibit the practice for those
products. If such problems arise substantially in other domains, we
stand ready to extend this provision to those domains in future versions
of the GPL, as needed to protect the freedom of users.

Finally, every program is threatened constantly by software patents.
States should not allow patents to restrict development and use of
software on general-purpose computers, but in those that do, we wish to
avoid the special danger that patents applied to a free program could
make it effectively proprietary. To prevent this, the GPL assures that
patents cannot be used to render the program non-free.

The precise terms and conditions for copying, distribution and
modification follow.

TERMS AND CONDITIONS

0. Definitions.

"This License" refers to version 3 of the GNU General Public License.

"Copyright" also means copyright-like laws that apply to other kinds of
works, such as semiconductor masks.

"The Program" refers to any copyrightable work licensed under this
License. Each licensee is addressed as "you". "Licensees" and
"recipients" may be individuals or organizations.

To "modify" a work means to copy from or adapt all or part of the work
in a fashion requiring copyright permission, other than the making of an
exact copy. The resulting work is called a "modified version" of the
earlier work or a work "based on" the earlier work.

A "covered work" means either the unmodified Program or a work based
on the Program.

To "propagate" a work means to do anything with it that, without
permission, would make you directly or secondarily liable for
infringement under applicable copyright law, except executing it on a
computer or modifying a private copy. Propagation includes copying,
distribution (with or without modification), making available to the
public, and in some countries other activities as well.

```
  To "convey" a work means any kind of propagation that enables other
parties to make or receive copies.  Mere interaction with a user through
a computer network, with no transfer of a copy, is not conveying.

  An interactive user interface displays "Appropriate Legal Notices"
to the extent that it includes a convenient and prominently visible
feature that (1) displays an appropriate copyright notice, and (2)
tells the user that there is no warranty for the work (except to the
extent that warranties are provided), that licensees may convey the
work under this License, and how to view a copy of this License.  If
the interface presents a list of user commands or options, such as a
menu, a prominent item in the list meets this criterion.

  1. Source Code.

  The "source code" for a work means the preferred form of the work
for making modifications to it.  "Object code" means any non-source
form of a work.

  A "Standard Interface" means an interface that either is an official
standard defined by a recognized standards body, or, in the case of
interfaces specified for a particular programming language, one that
is widely used among developers working in that language.

  The "System Libraries" of an executable work include anything, other
than the work as a whole, that (a) is included in the normal form of
packaging a Major Component, but which is not part of that Major
Component, and (b) serves only to enable use of the work with that
Major Component, or to implement a Standard Interface for which an
implementation is available to the public in source code form.  A
"Major Component", in this context, means a major essential component
(kernel, window system, and so on) of the specific operating system
(if any) on which the executable work runs, or a compiler used to
produce the work, or an object code interpreter used to run it.

  The "Corresponding Source" for a work in object code form means all
the source code needed to generate, install, and (for an executable
work) run the object code and to modify the work, including scripts to
control those activities.  However, it does not include the work's
System Libraries, or general-purpose tools or generally available free
programs which are used unmodified in performing those activities but
which are not part of the work.  For example, Corresponding Source
includes interface definition files associated with source files for
the work, and the source code for shared libraries and dynamically
linked subprograms that the work is specifically designed to require,
such as by intimate data communication or control flow between those
subprograms and other parts of the work.

  The Corresponding Source need not include anything that users
can regenerate automatically from other parts of the Corresponding
Source.

  The Corresponding Source for a work in source code form is that
same work.

  2. Basic Permissions.

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```

```
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in force.  You may convey covered works to others for the sole purpose
of having them make modifications exclusively for you, or provide you
with facilities for running those works, provided that you comply with
the terms of this License in conveying all material for which you do
not control copyright.  Those thus making or running the covered works
for you must do so exclusively on your behalf, under your direction
and control, on terms that prohibit them from making any copies of
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  Conveying under any other circumstances is permitted solely under
the conditions stated below.  Sublicensing is not allowed; section 10
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modification of the work as a means of enforcing, against the work's
users, your or third parties' legal rights to forbid circumvention of
technological measures.

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receive it, in any medium, provided that you conspicuously and
appropriately publish on each copy an appropriate copyright notice;
keep intact all notices stating that this License and any
non-permissive terms added in accord with section 7 apply to the code;
keep intact all notices of the absence of any warranty; and give all
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and you may offer support or warranty protection for a fee.

  5. Conveying Modified Source Versions.

  You may convey a work based on the Program, or the modifications to
produce it from the Program, in the form of source code under the
terms of section 4, provided that you also meet all of these conditions:

    a) The work must carry prominent notices stating that you modified
```

```
    it, and giving a relevant date.

    b) The work must carry prominent notices stating that it is
    released under this License and any conditions added under section
    7.  This requirement modifies the requirement in section 4 to
    "keep intact all notices".

    c) You must license the entire work, as a whole, under this
    License to anyone who comes into possession of a copy.  This
    License will therefore apply, along with any applicable section 7
    additional terms, to the whole of the work, and all its parts,
    regardless of how they are packaged.  This License gives no
    permission to license the work in any other way, but it does not
    invalidate such permission if you have separately received it.

    d) If the work has interactive user interfaces, each must display
    Appropriate Legal Notices; however, if the Program has interactive
    interfaces that do not display Appropriate Legal Notices, your
    work need not make them do so.

  A compilation of a covered work with other separate and independent
works, which are not by their nature extensions of the covered work,
and which are not combined with it such as to form a larger program,
in or on a volume of a storage or distribution medium, is called an
"aggregate" if the compilation and its resulting copyright are not
used to limit the access or legal rights of the compilation's users
beyond what the individual works permit.  Inclusion of a covered work
in an aggregate does not cause this License to apply to the other
parts of the aggregate.

  6. Conveying Non-Source Forms.

  You may convey a covered work in object code form under the terms
of sections 4 and 5, provided that you also convey the
machine-readable Corresponding Source under the terms of this License,
in one of these ways:

    a) Convey the object code in, or embodied in, a physical product
    (including a physical distribution medium), accompanied by the
    Corresponding Source fixed on a durable physical medium
    customarily used for software interchange.

    b) Convey the object code in, or embodied in, a physical product
    (including a physical distribution medium), accompanied by a
    written offer, valid for at least three years and valid for as
    long as you offer spare parts or customer support for that product
    model, to give anyone who possesses the object code either (1) a
    copy of the Corresponding Source for all the software in the
    product that is covered by this License, on a durable physical
    medium customarily used for software interchange, for a price no
    more than your reasonable cost of physically performing this
    conveying of source, or (2) access to copy the
    Corresponding Source from a network server at no charge.

    c) Convey individual copies of the object code with a copy of the
    written offer to provide the Corresponding Source.  This
    alternative is allowed only occasionally and noncommercially, and
    only if you received the object code with such an offer, in accord
```

```
    with subsection 6b.

    d) Convey the object code by offering access from a designated
    place (gratis or for a charge), and offer equivalent access to the
    Corresponding Source in the same way through the same place at no
    further charge.  You need not require recipients to copy the
    Corresponding Source along with the object code.  If the place to
    copy the object code is a network server, the Corresponding Source
    may be on a different server (operated by you or a third party)
    that supports equivalent copying facilities, provided you maintain
    clear directions next to the object code saying where to find the
    Corresponding Source.  Regardless of what server hosts the
    Corresponding Source, you remain obligated to ensure that it is
    available for as long as needed to satisfy these requirements.

    e) Convey the object code using peer-to-peer transmission, provided
    you inform other peers where the object code and Corresponding
    Source of the work are being offered to the general public at no
    charge under subsection 6d.

  A separable portion of the object code, whose source code is excluded
from the Corresponding Source as a System Library, need not be
included in conveying the object code work.

  A "User Product" is either (1) a "consumer product", which means any
tangible personal property which is normally used for personal, family,
or household purposes, or (2) anything designed or sold for incorporation
into a dwelling.  In determining whether a product is a consumer product,
doubtful cases shall be resolved in favor of coverage.  For a particular
product received by a particular user, "normally used" refers to a
typical or common use of that class of product, regardless of the status
of the particular user or of the way in which the particular user
actually uses, or expects or is expected to use, the product.  A product
is a consumer product regardless of whether the product has substantial
commercial, industrial or non-consumer uses, unless such uses represent
the only significant mode of use of the product.

  "Installation Information" for a User Product means any methods,
procedures, authorization keys, or other information required to install
and execute modified versions of a covered work in that User Product from
a modified version of its Corresponding Source.  The information must
suffice to ensure that the continued functioning of the modified object
code is in no case prevented or interfered with solely because
modification has been made.

  If you convey an object code work under this section in, or with, or
specifically for use in, a User Product, and the conveying occurs as
part of a transaction in which the right of possession and use of the
User Product is transferred to the recipient in perpetuity or for a
fixed term (regardless of how the transaction is characterized), the
Corresponding Source conveyed under this section must be accompanied
by the Installation Information.  But this requirement does not apply
if neither you nor any third party retains the ability to install
modified object code on the User Product (for example, the work has
been installed in ROM).

  The requirement to provide Installation Information does not include a
requirement to continue to provide support service, warranty, or updates
```

```
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CHAPTER 3

Indices and tables

- *genindex*
- *modindex*
- *search*

CHAPTER 4

Version

This documentation is for PyTek 1.1 (v1.1.1.0-x-dev).

CHAPTER 5

Project Resources

- PyTek project homepage (bitbucket)
- PyTek on pypi
- **Online documentation:**
  - Read The Docs (.org)
  - Python Hosted (.org)

CHAPTER 6

External References

- TDS3000, TDS3000B & TDS3000C Series Programmer Manual (Tektronix.com)

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