Lantz Documentation

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Lantz is an automation and instrumentation toolkit with a clean, well-designed and consistent interface. It provides a core of commonly used functionalities for building applications that communicate with scientific instruments allowing rapid application prototyping, development and testing. Lantz benefits from Python's extensive library flexibility as a glue language to wrap existing drivers and DLLs.

Lantz aim to provide a library of curated and well documented instruments drivers. We have some already, let us know if you cannot find yours.

CHAPTER

ONE

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1.1 About

Lantz is an automation and instrumentation toolkit with a clean, well-designed and consistent API. It provides a core of commonly used functionalities enabling rapid prototyping and development of applications that communicate with scientific instruments.

Lantz provides out of the box a large set of instrument drivers. It additionally provides a complete set of base classes to write new drivers compatible with the toolkit. Lantz benefits from Python's flexibility as a glue language to wrap existing drivers and DLLs.

Lantz wraps common widgets for instrumentation, allowing to build responsive, event-driven user interfaces.

Lantz explains itself by contextually displaying documentation. Core functionalities, widgets and drivers adhere to a high documentation standard that allows the user to know exactly what the program is doing and the purpose of each parameter.

Lantz works well with Linux, Mac and Windows. It is written in Python and Qt4 for the user interface.

Lantz profits from Python's batteries-included philosophy and it's extensive library in many different fields from text parsing to database communication.

Lantz builds on the giant shoulders. By using state-of-the art libraries, it delivers tested robustness and performance.

Lantz speaks many languages. It is built with an international audience from the start thereby allowing translations to be made easily.

Lantz is free as in beer and free as in speech. You can view, modify and distribute the source code as long as you keep a reference to the original version and distribute your changes. It is distributed using the BSD License. See LICENSE for more details

1.2 Overview

A minimal script to control a function generator using Lantz might look like this:

```
from lantz import Q_

from lantz.drivers.aeroflex import A2023aSerial

fungen = A2023aSerial('COM1')
fungen.initialize()

print(fungen.idn)
fungen.frequency = Q_(20, 'MHz')
print(fungen.amplitude)
fungen.sweep()

fungen.finalize()
```

The code is basically self explanatory, and does not differ too much of what you would write if you write a driver from scratch. But there are a few important things going under the hood that makes Lantz useful for instrumentation. Let's take a look!

1.2.1 Logging

While building and running your program it is invaluable to monitor its state. Lantz gives to all your drivers automatic logging.

The default level is logging.INFO, but if you prepend the following lines to the previous example:

```
import logging
from lantz import log_to_screen
log_to_screen(logging.DEBUG)
```

You will see the instance initializing and how and when each property is accessed. Loggers are organized by default with the following naming convention:

```
lantz.<class name>.<instance name>
```

which for this case becomes:

```
lantz.A2023aSerial.A2023aSerial0
```

because no name was given. If you want to specify a name, do it at object creation:

```
fungen = A2023aSerial('COM1', name='white')
```

Separation into multiple loggers makes finding problems easier and enables fine grained control over log output.

By the way, if you are running your program from an IDE or you don't want to clutter your current terminal, you can log to a socket and view the log output in another window (even in another computer, but we leave this for latter). Open first another terminal and run:

```
$ lantzmonitor.py -l 1
```

(If you want a nicer user interface with filtering and searching capabilities, try LogView http://code.google.com/p/logview/)

To your python program, replace the logging lines by:

```
import logging
from lantz import log_to_socket
log_to_socket(logging.DEBUG)
```

When you run it, you will see the log appearing in the logging window.

By the way, *lantzmonitor* is more than log to screen dumper. Tailored for lantz, it can display instrument specific messages as well as an on-line summary indicating the current value for each property. Hopefully, you will never need to add a print statement in your program any more!

1.2.2 Timing

Basic statistics of instrument related function calls are kept to facilitate bottleneck identification. While this is not as powerful as python profiler, its much easier to use within your application. You can obtain the statistics for a particular operation using:

```
fungen.timing.stats('set_frequency')
```

This will return a named tuple with the following fields:

```
- last: Execution time of last set operation
- count: Number of times the setter was called
- mean: Mean execution time of all set operations
- std: Standard deviation of the execution time of all set operations
- min: Minimum execution time of all set operations
- max: Maximum execution time of all set operations
```

Similarly, you can obtain timing statistics of the getter calling:

```
fungen.timing.stats('get_frequency')
```

1.2.3 Cache

Setting and getting drivers properties always does it in the instrument. However, accessing the instrument is time consuming and many times you just want to a way to recall the last known value. Lantz properties carry their own cache, which can be accessed with the recall method:

```
>>> fungen.recall('amplitude')
20 V
```

You can also access multiple elements:

```
>>> fungen.recall(('amplitude', 'voltage'))
{'frequency': 20 MHz, 'amplitude': 20 V}
```

Using recall without arguments gets all defined feats

```
>>> fungen.recall()
{'frequency': 20 MHz, 'amplitude': 20 V, 'ac_mode': True }
```

1.2.4 Prevent unnecessary set

The internal cache also prevents unnecessary communication with the instrument:

```
>>> fungen.amplitude = 20 # The amplitude will be changed to 20
>>> fungen.amplitude = 20 # The amplitude is already 20, so this will be ignored.
```

If you are not sure that the current state of the instrument matches the cached value, you can force a setting change as will be described below.

1.2.5 Getting and setting multiple values in one line

You can use the refresh method to obtain multiple values from the instrument:

```
>>> print(fungen.refresh('amplitude')) # is equivalent to print(fungen.amplitude)
20 V

>>> print(fungen.refresh(('frequency', 'amplitude'))) # You can refresh multiple properties at once
{'frequency': 20 MHz, 'amplitude': 20 V}

>>> print(fungen.refresh()) # You can refresh all properties at once
{'frequency': 20 MHz, 'amplitude': 20 V, 'ac_mode': True }
```

The counterpart of refresh is the update method that allows you to set multiple values in a single line:

```
>>> fungen.update(ac_mode=True) # is equivalent to fungen.ac_mode = True

>>> fungen.update({'ac_mode': True})  # Can be also used with a dictionary

>>> fungen.update(ac_mode=True, amplitude=Q(42, 'V')) # if you want to set many, just do

>>> fungen.update({'ac_mode': True, 'amplitude': Q(42, 'V')}) # or this
```

The cache is what allows to Lantz to avoid unnecessary communication with the instrument. You can overrule this check using the update method:

```
>>> fungen.amplitude = Q(42, 'V')

>>> fungen.amplitude = Q(42, 'V') # No information is set to the instrument as is the value already s

>>> fungen.update(amplitude=Q(42, 'V'), force=True) # The force true argument ignores cache checking
```

This can be useful for example when the operator might change the settings using the manual controls.

1.2.6 Effortless asynchronous get and set

Lantz also provides out of the box asynchronous capabilities for all methods described before. For example:

```
>>> fungen.update_async({'ac_mode': True, 'amplitude': Q(42, 'V')})
>>> print('I am not blocked!')
```

will update *ac_mode* and *amplitude* without blocking, so the print statement is executed even if the update has not finished. This is useful when updating multiple independent instruments. The state of the operation can be verified using the returned `concurrent.futures.Future` object:

```
>>> result1 = fungen.update_async({'ac_mode': True, 'amplitude': Q(42, 'V')})
>>> result2 = another_fungen.update_async({'ac_mode': True, 'amplitude': Q(42, 'V')})
>>> while not result1.done() and not result2.done()
...     DoSomething()
```

Just like *update_async*, you can use *refresh_async* to obtain the value of one or more features. The result is again a `concurrent.futures.Future` object whose value can be queried using the result method `concurrent.futures.Future.result()`

```
>>> fut = obj.refresh_async('eggs')
>>> DoSomething()
>>> print(fut.result())
```

Async methods accept also a callback argument to define a method that will be used

Under the hood

Single thread for the instrument

1.2.7 Context manager

If you want to send a command to an instrument only once during a particular script, you might want to make use of the context manager syntax. In the following example, the driver will be created and initialized in the first line and finalized when the *with* clause finishes even when an unhandled exception is raised:

```
with A2023aSerial('COM1') as fungen:

    print(fungen.idn)
    fungen.frequency = Q_(20, 'MHz')
    print(fungen.amplitude)
    fungen.sweep()
```

1.2.8 Units

Instrumentation software need to deal with physical units, and therefore you need to deal with them. Keeping track of the units of each variable in time consuming and error prone, and derives into annoying naming practices such as *freq_in_KHz*. Lantz aims to reduce the burden of this by incorporating units using the Quantities package. The Quantity object si abbreviated withing Lantz as *Q_* and can be imported from the root:

```
from lantz import Q_

mv = Q_(1, 'mV') # we define milivolt
value = 42 * mv # we can use the defined units like this
thesame = Q_(42, 'mv') # or like this
```

This makes the code a little more verbose but is worth the effort. The code is more explicit and less error prone. It also allows you to do thing like this:

```
from lantz import Q_

from lantz.drivers.example import OneFunGen as FunGen
# In OneFunGen, the amplitude of this function generator must be set in Volts.

with FunGen('COM1') as fungen:

    fungen.frequency = Q_(0.05, 'V')
```

Later you decide to change the function generator by a different one, with a different communication protocol:

```
from lantz import Q_

from lantz.drivers.example import AnotherFunGen as FunGen
# In AnotherFunGen, the amplitude of this function generator must be set in milivolts.

with FunGen('COM1') as fungen:

    fungen.frequency = Q_(0.05, 'V') # the value is converted from volts to mV inside the driver.
```

Apart from the import, nothing has changed. In a big code base this means that you can easily replace one instrument by another.

You might want to use the value obtained in one instrument to set another. Or you might want to use the same value in two different instruments without looking into their specific details:

```
from lantz import Q_

from lantz.drivers.example import FrequenceMeter
from lantz.drivers.aeroflex import A2023aSerial
from lantz.drivers.standford import SR844

with FrequenceMeter('COM1') as fmeter, \
     A2023aSerial('COM2') as fungen, \
     SR844('COM3') as lockin:

    freq = fmeter.frequency

    fungen.frequency = freq
    lockin.frequency = freq
```

In case you are not convinced, a small technical note:

Note: The MCO MIB has determined that the root cause for the loss of the MCO spacecraft was the failure to use metric units in the coding of a ground software file, "Small Forces," used in trajectory models. Specifically, thruster performance data in English units instead of metric units was used in the software application code titled SM_FORCES (small forces). The output from the SM_FORCES application code as required by a MSOP Project Software Interface Specification (SIS) was to be in metric units of Newtonseconds (N-s). Instead, the data was reported in English units of pound-seconds (lbf-s). The Angular Momentum Desaturation (AMD) file contained the output data from the SM_FORCES software. The SIS, which was not followed, defines both the format and units of the AMD file generated by ground-based computers. Subsequent processing of the data from AMD file by the navigation software algorithm therefore, underestimated the effect on the spacecraft trajectory by a factor of 4.45, which is the required conversion factor from force in pounds to Newtons. An erroneous trajectory was computed using this incorrect data.

Mars Climate Orbiter Mishap Investigation Phase I Report PDF

1.2.9 User interface

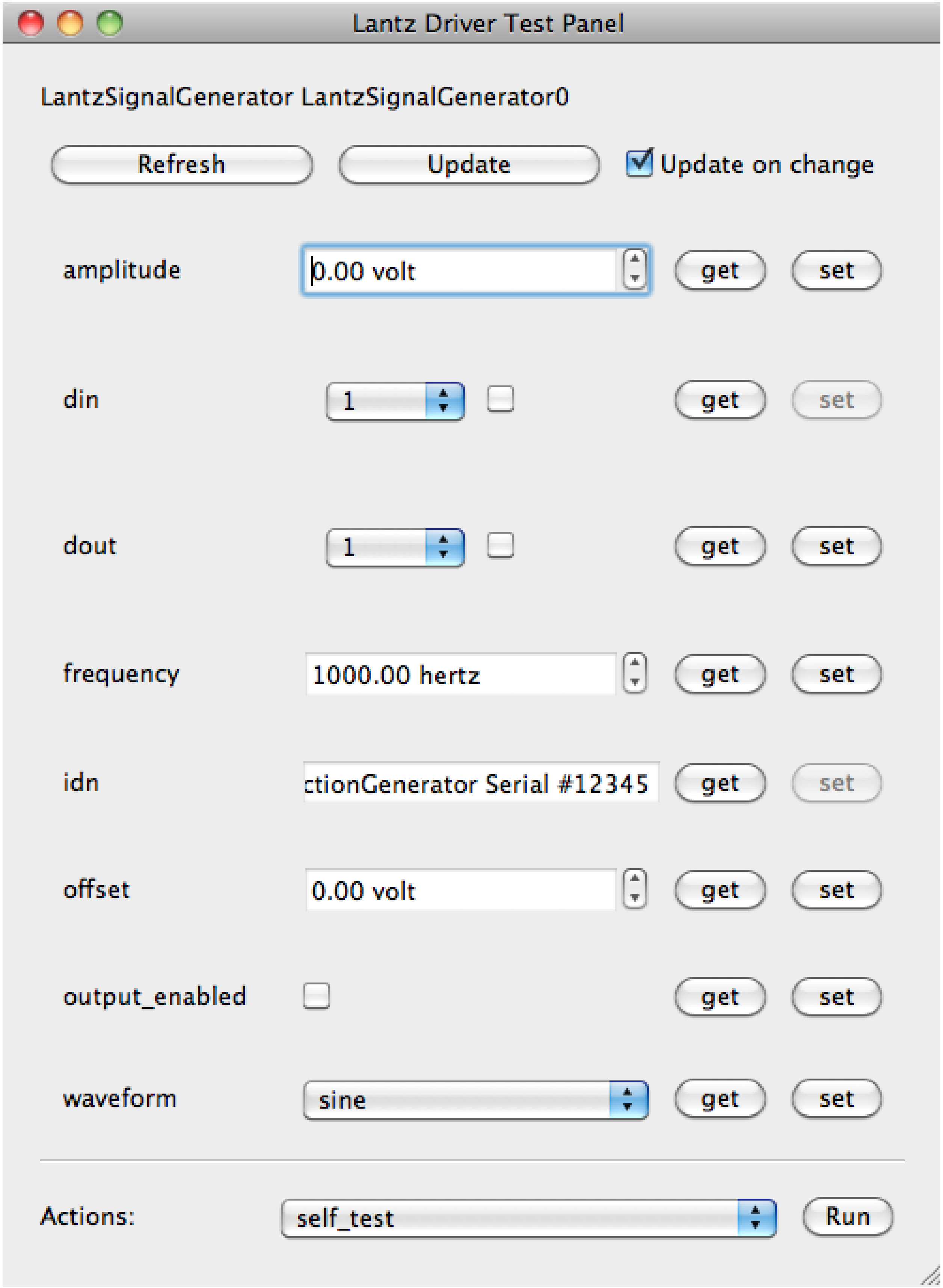
Providing a powerful GUI is an important aspect of developing an application for end user. Lantz aims to simplify the UI development by allowing you to correctly connect to *Lantz* Feats and Actions to widgets without any effort. For example, if you generate a GUI using Qt Designer:

```
# imports not shown

main = loadUi('connect_test.ui') # Load the GUI

with LantzSignalGeneratorTCP() as fungen: # Instantiate the instrument

    connect_driver(main, fungen) # All signals and slots are connected here!

    # Do something
```

Additionally it provides automatic generation of Test Panels, a very useful feature when you are building or debugging a new driver:

```
# imports not shown

with LantzSignalGeneratorTCP() as fungen: # Instantiate the instrument
    start_test_app(inst)                # Create
```

and you get:


Lantz Driver Test Panel
LantzSignalGenerator LantzSignalGenerator0
Refresh
Update
Update on change
amplitude
0.00 volt
get
set
din
1
dout
frequency
1000.00 hertz
idn
ctionGenerator Serial #12345
offset
0.00 volt
output_enabled
waveform
sine
Actions:
self_test
Run

Check out the *Tutorials* to get started!

1.3 Tutorials

If you haven't install *Lantz* yet, checkout *Installing*

1.3.1 Using lantz drivers

In this tutorial, you will learn how to use Lantz drivers to control an instrument. Lantz is shipped with drivers for common laboratory instruments. Each instrument has different capabilities, and these reflect in the drivers being different. However, all Lantz drivers share a common structure and learning about it allows you to use them in a more efficient way.

Following a tutorial about using a driver to communicate with an instrument that you do not have is not much fun. That's why we have created a virtual version of this instrument. From the command line, run the following command:

```
$ sim-fungen.py tcp
```

This will start an application (i.e. your instrument) that listens for incoming TCP packages (commands) on port 5678 from *localhost*. In the screen you will see the commands received and sent by the instrument.

Your program and the instrument will communicate by exchanging text commands via TCP. But having a Lantz driver already built for your particular instrument releases you for the burden of sending and receiving the messages. Let's start by finding the driver. Lantz drivers are organized inside packages, each package named after the manufacturer. So the *Coherent Argon Laser Innova* 300C driver is in *lantz.drivers.coherent* under the name *ArgonInnova300C*. We follow Python style guide (PEP8) to name packages and modules (lowercase) and classes (CamelCase).

Our simulated device is under the company *examples* and is named *LantzSignalGeneratorTCP*. Create a python script named *test_fungen.py* and type:

```
from lantz.drivers.examples import LantzSignalGeneratorTCP

inst = LantzSignalGeneratorTCP('localhost', 5678)
inst.initialize()
print(inst.idn)
inst.finalize()
```

Let's look at the code line-by-line. First we import the class into our script:

```
from lantz.drivers.examples import LantzSignalGeneratorTCP
```

Then we create an instance of the class, setting the address to localhost and port to 5678:

```
inst = LantzSignalGeneratorTCP('localhost', 5678)
```

This does not connects to the device. To do so, you call the *initialize* method:

```
inst.initialize()
```

All Lantz drivers have an *initialize* method. Drivers that communicate through a port (e.g. a Serial port) will open the port in this call. Then we query the instrument for it's identification and we print it:

```
print(inst.idn)
```

At the end, we call the *finalize* method to clean up all resources (e.g. close ports):

```
inst.finalize()
```

Just like the *initialize* method, all Lantz drivers have a *finalize*. Save the python script and run it by:

```
$ python test_fungen.py
```

and you will get the following output:

```
FunctionGenerator Serial #12345
```

In the window where *sim-fungen.py* is running you will see the message exchange. You normally don't see this in real instruments. Having a simulated instrument allow us to peek into it and understand what is going on: when we called *inst.idn*, the driver sent message (*?IDN*) to the instrument and it answered back (*FunctionGenerator Serial #12345*). Notice that end of line characters were stripped by the driver.

> To find out which other properties and methods are available checkout the documentation. A nice feature of Lantz (thanks to sphinx) is that useful documentation is generated from the driver itself. *idn* is a *Feat* of the driver. Think of a *Feat* as a pimped property. It works just like python properties but it wraps its call with some utilities (more on this later). *idn* is a read-only and as the documentation states it gets the identification information from the device. As *idn* is read-only, the following code will raise an exception:
>
> ```python
> from lantz.drivers.examples import LantzSignalGeneratorTCP
>
> inst = LantzSignalGeneratorTCP('localhost', 5678)
> inst.initialize()
> inst.idn = 'A new identification' # <- This will fail as idn is read-only
> inst.finalize()
> ```

The problem is that finalize will never be called possibly leaving resources open. You need to wrap your possible failing code into a try-except-finally structure:

```python
from lantz.drivers.examples import LantzSignalGeneratorTCP

inst = LantzSignalGeneratorTCP('localhost', 5678)
inst.initialize()
try:
    inst.idn = 'A new identification' # <- This will fail as idn is read-only
except Exception as e:
    pass
finally:
    inst.finalize()
```

All lantz drivers are also context managers and there fore you can write this in a much more compact way:

```python
from lantz.drivers.examples import LantzSignalGeneratorTCP

with LantzSignalGeneratorTCP('localhost', 5678) as inst:
    inst.idn = 'A new identification' # <- This will fail as idn is read-only
```

The with statement will create an instance, assign it to *inst* and call *initialize*. The *finalize* will be called independently if there is an exception or not.

Lantz Feat in depth

Let's query all parameters and print them state:

```python
from lantz.drivers.examples import LantzSignalGeneratorTCP
```

```
with LantzSignalGeneratorTCP('localhost', 5678) as inst:
    print('idn: {}'.format(inst.idn))
    print('frequency: {}'.format(inst.frequency))
    print('amplitude: {}'.format(inst.amplitude))
    print('offset: {}'.format(inst.offset))
    print('output_enabled: {}'.format(inst.output_enabled))
    print('waveform: {}'.format(inst.waveform))
    for channel in range(1, 9):
        print('dout[{}]: {}'.format(channel, inst.dout[channel]))
    for channel in range(1, 9):
        print('din[{}]: {}'.format(channel, inst.din[channel]))
```

If you run the program you will get something like:

```
idn: FunctionGenerator Serial #12345
frequency: 1000.0 hertz
amplitude: 0.0 volt
offset: 0.0 volt
output_enabled: False
waveform: sine
dout[1]: False
dout[2]: False
dout[3]: False
dout[4]: False
dout[5]: False
dout[6]: False
dout[7]: False
dout[8]: False
din[1]: False
din[2]: False
din[3]: False
din[4]: False
din[5]: False
din[6]: False
din[7]: False
din[8]: False
```

Multiple queries

You can actually make it simpler. All lantz feats of a given instrument are registered within the driver. You can call the *refresh* method to get them all at once:

```
from lantz.drivers.examples import LantzSignalGeneratorTCP

with LantzSignalGeneratorTCP('localhost', 5678) as inst:
    state = inst.refresh()
    for key, value in state.items():
        if isinstance(value, dict):
            for k, v in value.items():
                print('{}[{}]: {}'.format(key, k, v))
        else:
            print('{}: {}'.format(key, value))
```

1.3.2 Building your own drivers

The instrument

In this tutorial, we are going to build the driver of hypothetical signal generator with the following characteristics:

- 1 Analog output
  - Frequency range: 1 Hz to 100 KHz
  - Amplitude (0-Peak): 0 V to 10 V
  - Offset: -5V to 5V
  - Waveforms: sine, square, triangular, ramp
- 8 Digital outputs
- 8 Digital inputs

Your program will communicate with the instrument communicates exchanging messages via TCP protocol over ethernet. Messages are encoding in ASCII and line termination is `LF` (Line feed, 'n', 0x0A, 10 in decimal) for both sending and receiving.

The following commands are defined:

Command	Description	Example command	Example response
?IDN	Get identification	?IDN	LSG Serial #1234
?FRE	Get frequency [Hz]	?FRE	233.34
?AMP	Get amplitude [V]	?AMP	8.3
?OFF	Get offset [V]	?OFF	1.7
?OUT	Get output enabled state	?OUT	1
?WVF *W*	Get waveform	?WVF	2
?DOU *D*	Get digital output state	?DOU 4	0
?DIN *D*	Get digital input state	?DIN 19	ERROR
!FRE *F*	Set frequency [Hz]	!FRE 20.80	OK
!AMP *F*	Set amplitude [V]	!AMP 11.5	ERROR
!OFF *F*	Set offset [V]	!OFF -1.2	OK
!WVF *W*	Set waveform	!WVF 3	OK
!OUT *B*	Set output enabled state	!OUT 0	OK
!DOU *D B*	Set digital output state	!DOU 4 1	OK
!CAL	Calibrate system	!CAL	OK

As shown in the table, commands used to get the state of the instrument start with **?** and commands used to set the state start with **!**. In the **Command** column:

- *D* is used to indicate the digital input or output channel being addressed (1-8)
- *F* is the value of a float parameter. The actual valid range for each parameter depends on the command itself.
- *W* is used to indicate the desired waveform (0: sine, 1:square, 2:triangular, 3: ramp)
- *B* is the state of the digital input or output channel (0 is off/low, 1 is on/high), or the state of the analog ourput (0 off/disabled, 1 on/enabled)

The response to successful **GET** commands is the requested value. The response to successful **SET** commands is the string OK. If the command is invalid or an occurs in the instrument, the instrument will respond with the string ERROR. For example, the command `?DIS 19` is invalid because the parameter *B* should be in [1, 8].

One more thing, following a tutorial about building a driver to communicate with an instrument that you do not have is not much fun. That's why we have created a virtual version of this instrument. From the command line, run the following command:

$ sim-fungen.py tcp

This will start an application that listens for incoming TCP packages on port 5678 from *localhost*.

A basic driver

Having look at the instrument, we will now create the driver. First create a python file named *tutorial.py* in your folder of choice and edit it to look like this:

```
from lantz import Feat
from lantz.network import TCPDriver

class SignalGenerator(TCPDriver):
    """Lantz Signal Generator.
    """

    ENCODING = 'ascii'

    RECV_TERMINATION = '\n'
    SEND_TERMINATION = '\n'

    @Feat()
    def idn(self):
        return self.query('?IDN')


if __name__ == '__main__':
    with SignalGenerator('localhost', 5678) as inst:
        print('The identification of this instrument is : ' + inst.idn)
```

The code is straight forward. We first import TCPDriver from lantz.network (the Lantz module for network related functions). TCPDriver is a base class (derived from Driver) that implements methods to communicate via TCP protocol. Our driver will derive from this.

We also import Feat from lantz. Feat is the Lantz pimped property and you use Feat just like you use *property*. By convention Feats are named using nouns or adjectives. Inside the method (in this case is a getter) goes the code to communicate with the instrument. In this case we use *query*, a function present in all based classes for message drivers (TCPDriver, SerialDriver, etc). *query* sends a message to the instrument, waits for a response and returns it. The argument is the command to be sent to the instrument. Lantz takes care of formatting (encoding, endings) and transmitting the command appropriately. That's why we define ENCODING, RECV_TERMINATION, SEND_TERMINATION at the beginning of the class.

Finally, inside the *__name__* == '*__main__*' we instantiate the SignalGenerator specifying host and port (these are arguments of the TCPDriver constructor, more on this later) and we print the identification.

If you have *sim-fungen.py* running in your computer, you can test your new driver. From the command line, cd into your working directory and then run the following command:

```
$ python tutorial.py
```

You should see *LSG Serial #1234*.

Lantz uses the python logging module. Let's see what's its going on under the hood by logging to screen in debug mode:

```
from lantz.log import log_to_screen, DEBUG  # <-- This is new

from lantz import Feat
from lantz.network import TCPDriver
```

```
class SignalGenerator(TCPDriver):
    """Lantz Signal Generator.
    """

    ENCODING = 'ascii'

    RECV_TERMINATION = '\n'
    SEND_TERMINATION = '\n'

    @Feat()
    def idn(self):
        """Identification.
        """
        return self.query('?IDN')


if __name__ == '__main__':
    log_to_screen(DEBUG)
    with SignalGenerator('localhost', 5678) as inst:
        print('The identification of this instrument is : ' + inst.idn)
```

You can adjust the level of information provided by changing the LOGGING_LEVEL. You can also display the logging in another window to avoid cluttering but this comes later.

Let's allow our driver to control the instruments amplitude:

```
from lantz import Feat
from lantz.network import TCPDriver

class LantzSignalGeneratorTCP(TCPDriver):
    """Lantz Signal Generator.
    """

    ENCODING = 'ascii'

    RECV_TERMINATION = '\n'
    SEND_TERMINATION = '\n'

    @Feat()
    def idn(self):
        """Identification.
        """
        return self.query('?IDN')


    @Feat()
    def amplitude(self):
        """Amplitude (0 to peak) in volts.
        """
        return float(self.query('?AMP'))

    @amplitude.setter
    def amplitude(self, value):
        self.query('!AMP {:.1f}'.format(value))


if __name__ == '__main__':
    from time import sleep
```

```python
from lantz.log import log_to_screen, DEBUG

log_to_screen(DEBUG)
with SignalGenerator('localhost', 5678) as inst:
    inst = SignalGenerator('localhost', 5678)
    print('The identification of this instrument is : ' + inst.idn)
    print('Setting amplitude to 3')
    inst.amplitude = 3
    sleep(2)
    inst.amplitude = 5
    print('Current amplitude: {}'.format(inst.amplitude))
```

We have defined another Feat, now with a getter and a setter. The getter sends *?AMP* and waits for the answer which is converted to float and returned to the caller. The setter send *!AMP* concatenated with the float formatted to string with two decimals. Run the script. Check also the window running *sim-fungen.py*. You should see the amplitude changing!.

In the current version of this driver, if we try to set the amplitude to 20 V the command will fill in the instrument but the driver will not know. Lets add some error checking:

```python
@amplitude.setter
def amplitude(self, value):
    if self.query('!AMP {:.2f}'.format(value)) != "OK":
        raise Exception
```

Is that simple. We just check the response. If different from *OK* we raise an Exception. Change the script to set the amplitude to 20 and run it one more time. You should something like this:

```
Exception: While setting amplitude to 20.
```

We do not know why the command has failed but we know which command has failed. Lantz has filled the description of the exception to say that the driver failed while setting the amplitude to 20.

Because all commands should be checked for *ERROR*, we will override query to do it. Add the following import to the top of the file, and the query function to the class:

```python
from lantz.errors import InstrumentError

def query(self, command, *, send_args=(None, None), recv_args=(None, None)):
    answer = super().query(command, send_args=send_args, recv_args=recv_args)
    if answer == 'ERROR':
        raise InstrumentError
    return answer
```

Putting units to work

Hoping that the Mars Orbiter story convinced you that using units is worth it, let's modify the driver to use them:

```python
from lantz import Feat
from lantz.network import TCPDriver
from lantz.errors import InstrumentError

class LantzSignalGeneratorTCP(TCPDriver):
    """Lantz Signal Generator.
    """

    ENCODING = 'ascii'

    RECV_TERMINATION = '\n'
```

```
    SEND_TERMINATION = '\n'

    def query(self, command, *, send_args=(None, None), recv_args=(None, None)):
        answer = super().query(command, send_args=send_args, recv_args=recv_args)
        if answer == 'ERROR':
            raise InstrumentError
        return answer

    @Feat()
    def idn(self):
        return self.query('?IDN')


    @Feat(units='V')
    def amplitude(self):
        """Amplitude (0 to peak)
        """
        return float(self.query('?AMP'))

    @amplitude.setter
    def amplitude(self, value):
        self.query('!AMP {:.1f}'.format(value))


if __name__ == '__main__':
    from time import sleep
    from lantz import Q_
    from lantz.log import log_to_screen, DEBUG

    volt = Q_(1, 'V')
    milivolt = Q_(1, 'mV')

    log_to_screen(DEBUG)
    with SignalGenerator('localhost', 5678) as inst:
        print('The identification of this instrument is : ' + inst.idn)
        print('Setting amplitude to 3')
        inst.amplitude = 3 * volt
        sleep(2)
        inst.amplitude = 1000 * milivolt
        print('Current amplitude: {}'.format(inst.amplitude))
```

We have just added in the Feat definition that the units is Volts. Lantz uses the quantities package to manage units. We now import *Q_* which is a shortcut for *quantities.Quantity* and we declare the volt and the milivolt. We now set the amplitude to 3 Volts and 1000 milivolts.

Run the script and notice how Lantz will do the conversion for you. This allows to use the output of one instrument as the output of another without handling the unit conversion. Additionally, it allows you to replace this signal generator by another that might require the amplitude in different units without changing your code.

Limits

When the communication round-trip to the instrument is too long, you might want to catch some of the errors before hand. You can use *limits* to check:

```
from lantz import Feat,
from lantz.network import TCPDriver
from lantz.errors import InstrumentError
```

```
class LantzSignalGeneratorTCP(TCPDriver):
    """Lantz Signal Generator
    """

    ENCODING = 'ascii'

    RECV_TERMINATION = '\n'
    SEND_TERMINATION = '\n'

    def query(self, command, *, send_args=(None, None), recv_args=(None, None)):
        answer = super().query(command, send_args=send_args, recv_args=recv_args)
        if answer == 'ERROR':
            raise InstrumentError
        return answer

    @Feat()
    def idn(self):
        return self.query('?IDN')

    @Feat(units='V', limits=(10,)) # This means 0 to 10
    def amplitude(self):
        """Amplitude.
        """
        return float(self.query('?AMP'))

    @amplitude.setter
    def amplitude(self, value):
        self.query('!AMP {:.1f}'.format(value))

    @Feat(units='V', limits=(-5, 5, .01)) # This means -5 to 5 with step 0.01
    def offset(self):
        """Offset
        """
        return float(self.query('?OFF'))

    @offset.setter
    def offset(self, value):
        self.query('!OFF {:.1f}'.format(value))

    @Feat(units='Hz', limits=(1, 1e+5)) # This means 1 to 1e+5
    def frequency(self):
        """Frequency
        """
        return float(self.query('?FRE'))

    @frequency.setter
    def frequency(self, value):
        self.query('!FRE {:.2f}'.format(value))
```

If you try to set a value outside the valid range, a ValueErorr will be raised and the command will never be sent to the instrument.

Mapping values

We will define offset and frequency like we did with amplitude, and we will also define output enabled and waveform:

```
from lantz import Feat, DictFeat
from lantz.network import TCPDriver
from lantz.errors import InstrumentError

class LantzSignalGeneratorTCP(TCPDriver):
    """Lantz Signal Generator
    """

    ENCODING = 'ascii'

    RECV_TERMINATION = '\n'
    SEND_TERMINATION = '\n'

    def query(self, command, *, send_args=(None, None), recv_args=(None, None)):
        answer = super().query(command, send_args=send_args, recv_args=recv_args)
        if answer == 'ERROR':
            raise InstrumentError
        return answer

    @Feat()
    def idn(self):
        return self.query('?IDN')

    @Feat(units='V', limits=(10,))
    def amplitude(self):
        """Amplitude.
        """
        return float(self.query('?AMP'))

    @amplitude.setter
    def amplitude(self, value):
        self.query('!AMP {:.1f}'.format(value))

    @Feat(units='V', limits=(-5, 5, .01))
    def offset(self):
        """Offset.
        """
        return float(self.query('?OFF'))

    @offset.setter
    def offset(self, value):
        self.query('!OFF {:.1f}'.format(value))

    @Feat(units='Hz', limits=(1, 1e+5))
    def frequency(self):
        """Frequency.
        """
        return float(self.query('?FRE'))

    @frequency.setter
    def frequency(self, value):
        self.query('!FRE {:.2f}'.format(value))

    @Feat(values={True: 1, False: 0})
    def output_enabled(self):
        """Analog output enabled.
        """
        return int(self.query('?OUT'))
```

```
    @output_enabled.setter
    def output_enabled(self, value):
        self.query('!OUT {}'.format(value))

    @Feat(values={'sine': 0, 'square': 1, 'triangular': 2, 'ramp': 3})
    def waveform(self):
        return int(self.query('?WVF'))

    @waveform
    def waveform(self, value):
        self.query('!WVF {}'.format(value))

if __name__ == '__main__':
    from time import sleep
    from lantz import Q_
    from lantz.log import log_to_screen, DEBUG

    volt = Q_(1, 'V')
    milivolt = Q_(1, 'mV')
    Hz = Q_(1, 'Hz')

    log_to_screen(DEBUG)
    with SignalGenerator('localhost', 5678) as inst:
        print('The identification of this instrument is : ' + inst.idn)
        print('Setting amplitude to 3')
        inst.amplitude = 3 * volt
        inst.offset = 200 * milivolt
        inst.frequency = 20 * Hz
        inst.output_enabled = True
        inst.waveform = 'sine'
```

We have provided *output_enabled* a mapping table through the *values* argument. This has two functions:

- Restricts the input to True or False.
- For the setter converts True and False to 1 and 0; and vice versa for the getter.

This means that we can write the body of the getter/setter expecting a instrument compatible value (1 or 0) but the user actually sees a much more friendly interface (True or False). The same happens with *waveform*. Instead of asking the user to memorize which number corresponds to 'sine' or implement his own mapping, we provide this within the feat.

Properties with items: DictFeat

It is quite common that scientific equipment has many of certain features (such as axes, channels, etc). For example, this signal generator has 8 digital outputs. A simple solution would be to access them as feats named dout1, dout2 and so on. But this is not elegant (consider a DAQ with 32 digital inputs) and makes coding to programatically access to channel N very annoying. To solve this Lantz provides a dictionary like feature named `DictFeat`. Let's see this in action:

```
@DictFeat(values={True: 1, False: 0})
def dout(self, key):
    """Digital output state.
    """
    return int(self.query('?DOU {}'.format(key)))

@dout.setter
def dout(self, key, value):
    self.query('!DOU {} {}'.format(key, value))
```

In the driver definition, very little has changed. `DictFeat` acts like the standard Feat decorator but operates on a method that contains one extra parameter for the get and the set in the second position.

You will use this in the following way:

```
inst.dout[4] = True
```

By default, any key (in this case, channel) is valid and Lantz leaves to the underlying instrument to reject invalid ones. In some cases, for example when the instrument does not deal properly with unexpected parameters, you might want to restrict them using the optional parameter *keys*

```
@DictFeat(values={True: 1, False: 0}, keys=list(range(1,9)))
def dout(self, key):
    """Digital output state.
    """
    return int(self.query('?DOU {}'.format(key)))

@dout.setter
def dout(self, key, value):
    self.query('!DOU {} {}'.format(key, value))
```

Remember that range(1, 9) excludes 9. In this way, Lantz will Raise an exception without talking to the instrument when the following code:

```
>>> inst.dout[10] = True
Traceback:
    ...
KeyError: 10 is not valid key for dout [1, 2, 3, 4, 5, 6, 7, 8]
```

We will create now a read-read only DictFeat for the digital input:

```
@DictFeat(values={True: 1, False: 0}, keys=list(range(1,9)))
def din(self, key):
    """Digital input state.
    """
    return int(self.query('?DIN {}'.format(key)))
```

Drivers methods: Action

Bound methods that will trigger interaction with the instrument are decorated with `Action`:

```
from lantz import Feat, DictFeat, Action
```

and within the class we will add:

```
@Action()
def calibrate(self):
    self.query('!CAL')
```

1.4 Guides

1.4.1 Installing

This guide describes Lantz requirements and provides platform specific installation guides. Examples are given for Python 3.2, installing all optional requirements as site-packages and Lantz in a virtual environment using pip and git

Requirements

Lantz core requires only Python 3.2+.

Optional requirements

Some lantz subpackages have other requirements which are listed below together with a small explanation of where are used. Short installation instructions are given, but we refer you to the package documentation for more information. For some packages, a link to the binary distribution is given.

- Colorama is used to colorize terminal output. It is optional when logging to screen and mandatory if you want to use *lantz-monitor*, the text-based log viewer. You can install it using:

  ```
  $ pip install colorama
  ```

- Sphinx is used generate the documentation. It is optional and only needed if you want to generate the documentation yourself. You can install it using:

  ```
  $ pip install sphinx
  ```

- Docutils is used to transform the RST documentation to HTML which is then provided as tooltips in the GUI. It is optional. If not installed, unformatted documentation will be shown as tooltips. It will be already installed if you install Sphinx. To install it independently:

  ```
  $ pip install docutils
  ```

- pySerial it is to communicate via serial port. It is optional and only needed if you are using a driver that uses lantz.serial. You can install it using:

  ```
  $ pip install pyserial
  ```

  Or use the PySerial binaries

- Qt4 is used to generate the graphical user interfaces. Due to a license issue there are two python bindings for Qt: PyQt and PySide. Both are compatible with Lantz. To install pyQt:

  ```
  $ pip install pyqt
  ```

  or use the PyQt binaries

  > $ pip install pyside

  or use the PySide binaries

- NumPy is used by many drivers to perform numerical calculations. You can install it using:

  ```
  $ pip install numpy
  ```

  or use the NumPy binaries

- VISA National Instruments Library for communicating via GPIB, VXI, PXI, Serial, Ethernet, and/or USB interfaces

Linux

Most linux distributions provide packages for Python 3.2, NumPy, PyQt (or PySide) and git. Install them.

Download and install VISA.

Open a terminal to install pip and virtualenv:

```
$ curl http://python-distribute.org/distribute_setup.py | python3.2
$ curl https://raw.github.com/pypa/pip/master/contrib/get-pip.py | python3.2
```

Using pip, install all other optional dependencies:

```
$ pip-3.2 install virtualenv colorama sphinx pyserial
```

Change to the folder where you will create your virtual environment. In this case, we have chosen the home directory:

```
$ cd ~
$ virtualenv -p python3.2 --system-site-packages lantzenv
$ cd lantzenv
$ source bin/activate
```

and then install an editable package:

```
$ pip install -e git+gitolite@glugcen.dc.uba.ar:lantz.git#egg=lantz
```

or from Lantz at Github:

```
$ pip install -e git+git://github.com/hgrecco/lantz.git#egg=lantz
```

You will find the code in *~/lantzenv/src/lantz*.

The folder is a normal git repository from where you can pull and push to keep the repo in sync.

Mac

Download and install Python, NumPy binaries, PyQt binaries, VISA and git binaries

Open a terminal to install pip and virtualenv:

```
$ curl http://python-distribute.org/distribute_setup.py | python3.2
$ curl https://raw.github.com/pypa/pip/master/contrib/get-pip.py | python3.2
```

Using pip, install all other optional dependencies:

```
$ pip-3.2 install virtualenv colorama sphinx pyserial
```

Change to the folder where you will create your virtual environment. In this case, we have chosen the home directory:

```
$ cd ~
$ virtualenv -p python3.2 --system-site-packages lantzenv
$ cd lantzenv
$ source bin/activate
```

and then install an editable package:

```
$ pip install -e git+gitolite@glugcen.dc.uba.ar:lantz.git#egg=lantz
```

or from Lantz at Github:

```
$ pip install -e git+git://github.com/hgrecco/lantz.git#egg=lantz
```

You will find the code in *~/lantzenv/src/lantz*.

The folder is a normal git repository from where you can pull and push to keep the repo in sync.

Windows

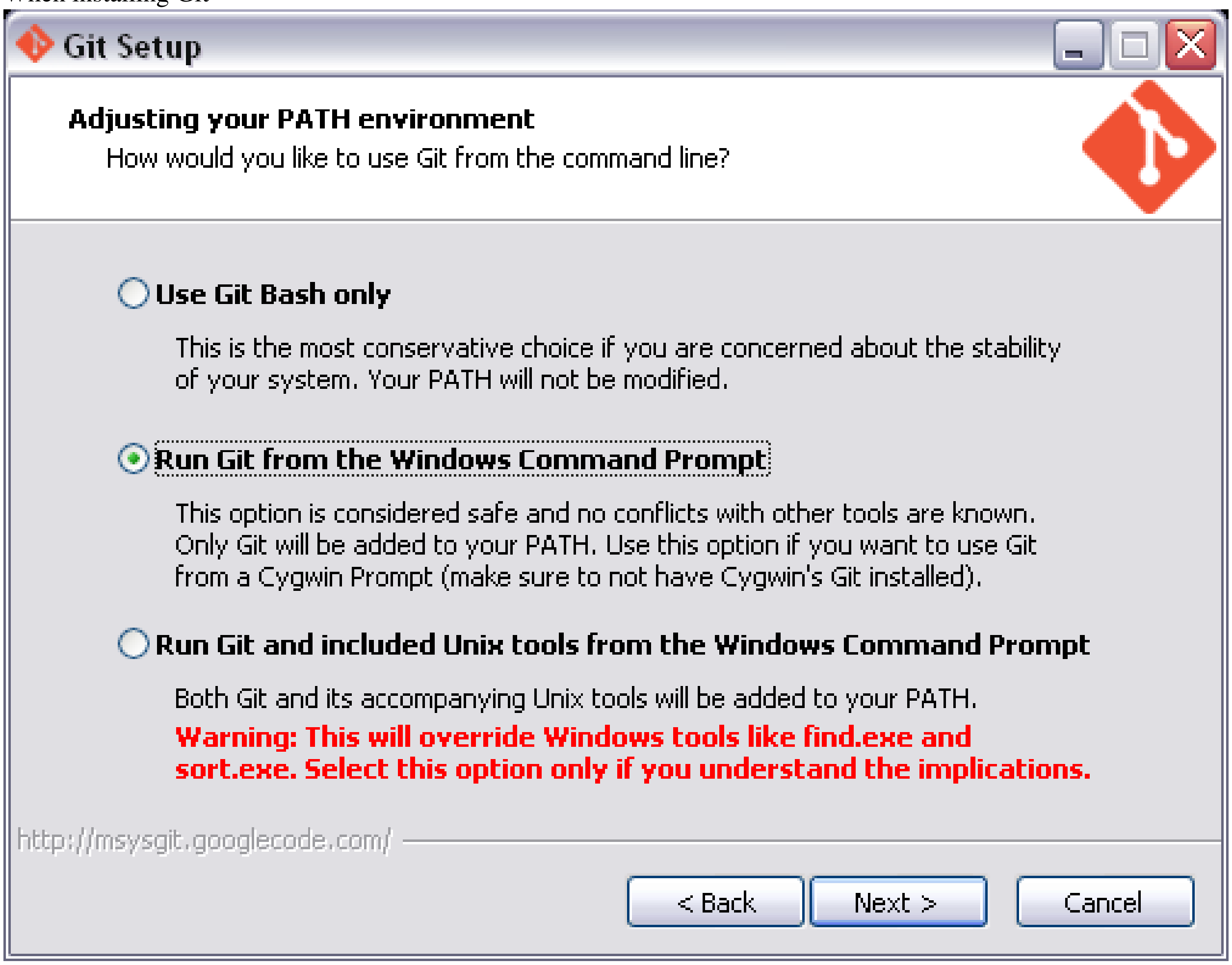
Note: We provide a simple script to run all the steps provided below. Download get-lantz to the folder in which you want to create the virtual environment. The run the sript using a 32 bit version of Python 3.2+.

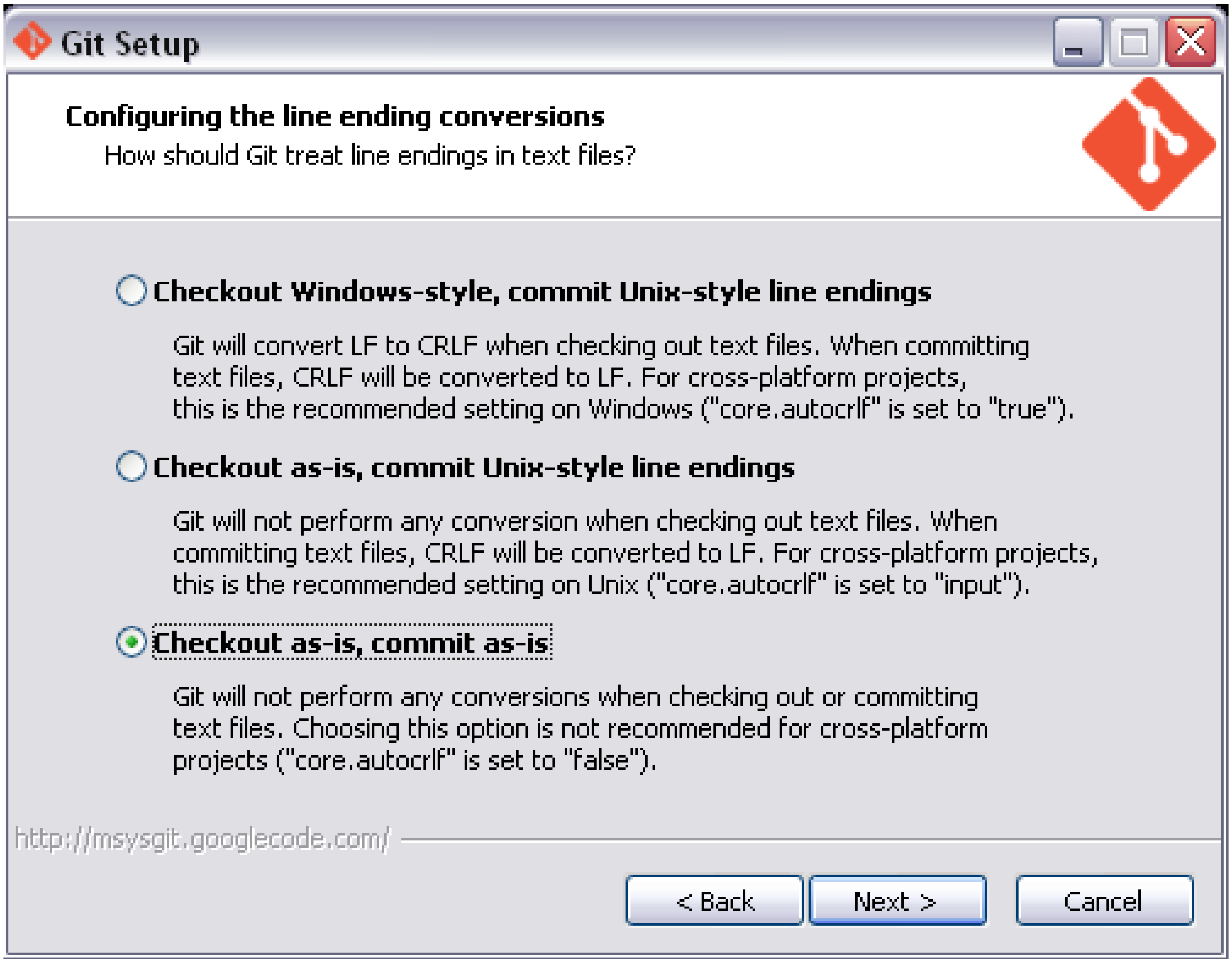
In some of the steps, an installer application will pop-up. Just select all default options except when installing git. There you must choose the options shown in the images below.

As the script will download and install only necessary packages, it does not need a clean Python to start.

Install Python, NumPy binaries, PyQt binaries, VISA and git binaries.

When installing Git





Download and run with Python 3.2:

```
- http://python-distribute.org/distribute_setup.py
- https://raw.github.com/pypa/pip/master/contrib/get-pip.py
```

In the command prompt install using pip all other optional dependencies:

```
$ C:\Python3.2\Scripts\pip install virtualenv colorama sphinx pyserial
```

Open a command windows and change to the folder where you will create your virtual environment. In this case, we have chosen the desktop:

```
cd  %USERPROFILE%\Desktop
C:\Python32\Scripts\virtualenv --system-site-packages lantzenv
cd lantzenv\Scripts
activate
```

and then install an editable package:

```
pip install -e git+gitolite@glugcen.dc.uba.ar:lantz.git#egg=lantz
```

or from Lantz at Github:

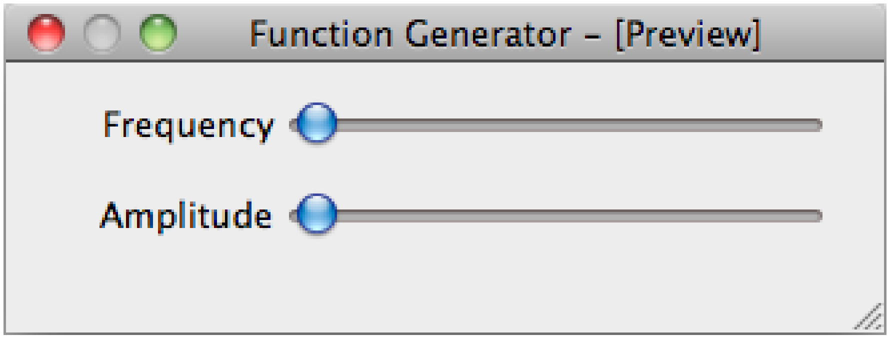
```
$ pip install -e git+git://github.com/hgrecco/lantz.git#egg=lantz
```

You will find the code in *%USERPROFILE%\Desktop\lantzenv\src\lantz*.

The folder is a normal git repository from where you can pull and push to keep the repo in sync.

1.4.2 Connecting a custom UI to a driver

While the test widget is very convenient is not good enough for visually attractive applications. You can design you own custom user interface using Qt Designer and then connect it to your driver in a very simple way. Consider the following interace for our custom signal generator.



You can set the frequency and amplitude using sliders. The sliders are named *frequency* and *amplitude*.

The long way

You can connect each relevant driver Feat to the corresponding widget:

```
import sys

# Import lantz.ui register an import hook that will replace calls to Qt by PyQt4 or PySide ...
import lantz.ui

# and here we just use Qt and will work with both bindings!
from Qt.QtGui import QApplication, QWidget
from Qt.uic import loadUi

# From lantz we import the driver ...
from lantz.drivers.examples.fungen import LantzSignalGeneratorTCP

# and a function named connect_feat that does the work.
from lantz.ui.qtwidgets import connect_feat

app = QApplication(sys.argv)

# We load the UI from the QtDesigner file. You can also use pyuic4 to generate a class.
main = loadUi('connect_test.ui')

# We get a reference to each of the widgets.
frequency_widget = main.findChild((QWidget, ), 'frequency')
amplitude_widget = main.findChild((QWidget, ), 'amplitude')

with LantzSignalGeneratorTCP('localhost', 5678) as inst:

    # We connect each widget to each feature
    # The syntax arguments are widget, target (driver), Feat name
    connect_feat(frequency_widget, inst, 'frequency')
    connect_feat(amplitude_widget, inst, 'amplitude')
```

```
    main.show()
    exit(app.exec_())
```

and that is all. Under the hood *connect_feat* is:

> 1.- Wrapping the widget to make it Lantz compatible.
>
> 2.- If applicable, configures minimum, maximum, steps and units.
>
> 3.- Add a handler such as when the widget value is changed, the Feat is updated.
>
> 4.- Add a handler such as when the Feat value is changed, the widget is updated.

The short way

If you have named the widgets according to the Feat name as we have done, you can save some typing (not so much here but a lot in big interfaces):

```
import sys

# Import lantz.ui register an import hook that will replace calls to Qt by PyQt4 or PySide ...
import lantz.ui

# and here we just use Qt and will work with both bindings!
from Qt.QtGui import QApplication, QWidget
from Qt.uic import loadUi

# From lantz we import the driver ...
from lantz.drivers.examples.fungen import LantzSignalGeneratorTCP

# and a function named connect_feat that does the work.
from lantz.ui.qtwidgets import connect_feat

app = QApplication(sys.argv)

# We load the UI from the QtDesigner file. You can also use pyuic4 to generate a class.
main = loadUi('connect_test.ui')

with LantzSignalGeneratorTCP('localhost', 5678) as inst:

    # We connect the parent widget (main) to the instrument.
    connect_driver(main, inst)
    main.show()
    exit(app.exec_())
```

Notice that now we do not need a reference to the widgets (only to the parent widget, here named main). And we call *connect_driver* (instead of *connect_feat*) without specifying the feat name. Under the hood, *connect_driver* is iterating over all widgets and checking if the driver contains a Feat with the widget name. If it does, it executes *connect_feat*.

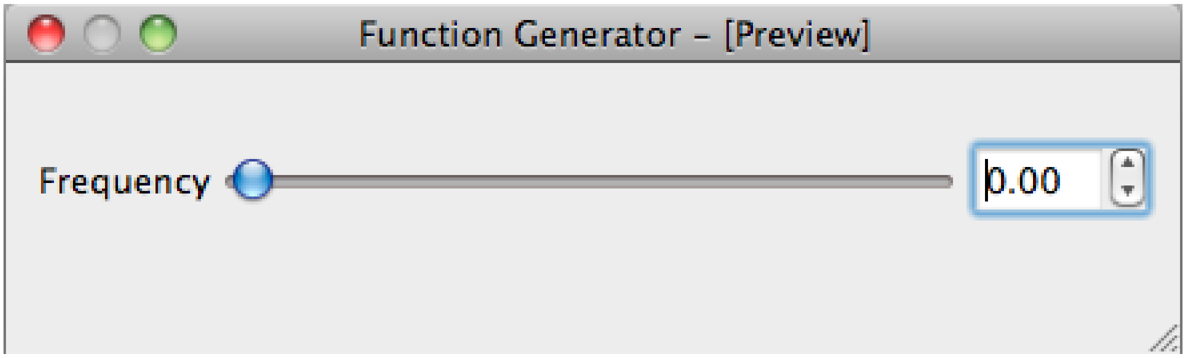
See Also:

Connecting two (or more) widgets to the same feat

Connecting two (or more) drivers

1.4.3 Connecting two (or more) widgets to the same feat

In many cases you want to have multiple widgets (e.g. different kind) connected to the same Feat. When the two widgets are together you could create a custom widget, but with Lantz it is not necessary. Consider the following UI:



You can set the frequency using the slider or the double spin box. The slider is named *frequency__slider* and the spin is named *frequency*.

The long way

You can connect each relevant driver Feat to the corresponding widget:

```
import sys

# Import lantz.ui register an import hook that will replace calls to Qt by PyQt4 or PySide ...
import lantz.ui

# and here we just use Qt and will work with both bindings!
from Qt.QtGui import QApplication, QWidget
from Qt.uic import loadUi

# From lantz we import the driver ...
from lantz.drivers.examples.fungen import LantzSignalGeneratorTCP

# and a function named connect_feat that does the work.
from lantz.ui.qtwidgets import connect_feat

app = QApplication(sys.argv)

# We load the UI from the QtDesigner file. You can also use pyuic4 to generate a class.
main = loadUi('connect_test.ui')

# We get a reference to each of the widgets.
slider = main.findChild((QWidget, ), 'frequency__slider')
spin = main.findChild((QWidget, ), 'frequency')

with LantzSignalGeneratorTCP('localhost', 5678) as inst:

    # We connect each widget to each feature
    # The syntax arguments are widget, target (driver), Feat name
    connect_feat(slider, inst, 'frequency')
    connect_feat(spin, inst, 'frequency')
    main.show()
    exit(app.exec_())
```

and that is all. Try it out and see how when you change one control the other one is updated.

The short way

If you have named the widgets according to the Feat and you have use a suffix in at least one of them, you can use *connect_driver*:

```
import sys

# Import lantz.ui register an import hook that will replace calls to Qt by PyQt4 or PySide ...
import lantz.ui

# and here we just use Qt and will work with both bindings!
from Qt.QtGui import QApplication, QWidget
from Qt.uic import loadUi

# From lantz we import the driver ...
from lantz.drivers.examples.fungen import LantzSignalGeneratorTCP

# and a function named connect_feat that does the work.
from lantz.ui.qtwidgets import connect_feat

app = QApplication(sys.argv)

# We load the UI from the QtDesigner file. You can also use pyuic4 to generate a class.
main = loadUi('connect_test.ui')

with LantzSignalGeneratorTCP('localhost', 5678) as inst:

    # We connect the parent widget (main) to the instrument.
    connect_driver(main, inst)
    main.show()
    exit(app.exec_())
```

Notice that now we do not need a reference to the widgets (only to the parent widget, here named main). And we call *connect_driver* (instead of *connect_feat*) without specifying the feat name. Under the hood, *connect_driver* is iterating over all widgets and checking if the driver contains a Feat with the widget name stripped from the suffix. If it does, it executes *connect_feat*.

In this example, we have use the double underscore __ to separate the suffix. This is a good choice and also the default as can be used in Qt and Python variable names. If you want have used another separator, you can specify it by passing the *sep* keyword argument:

```
connect_driver(main, inst, sep='_o_')
```

There is no limit in the number of widgets that you can connect to the same feat.

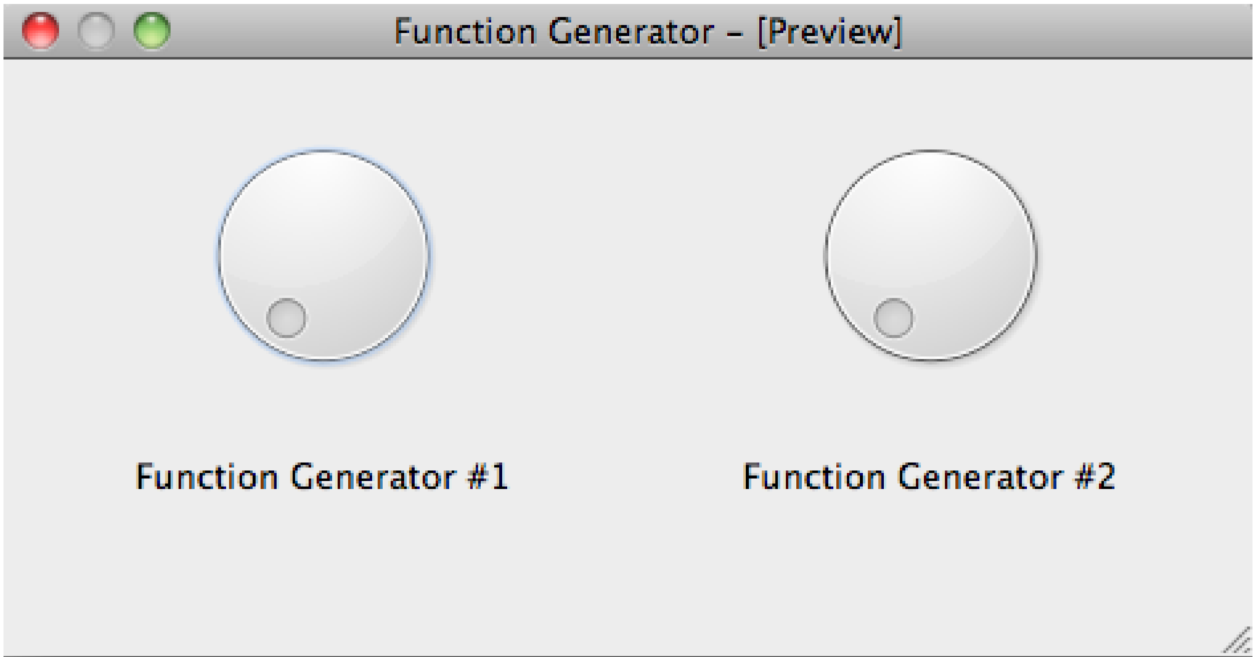
See Also:

Connecting a custom UI to a driver

Connecting two (or more) drivers

1.4.4 Connecting two (or more) drivers

Real application consists not only of a single instrument but many. In a custom UI, you can connect different drivers to different widgets. Consider the following interace for two signal generators.



(We use twice the same kind for simplicity, but it is not necessary).

The widgets are named *fungen1__frequency* and *fungen2__frequency*.

The long way

Get a reference to each widget and connect them manually:

```
import sys

# Import lantz.ui register an import hook that will replace calls to Qt by PyQt4 or PySide ...
import lantz.ui

# and here we just use Qt and will work with both bindings!
from Qt.QtGui import QApplication, QWidget
from Qt.uic import loadUi

# From lantz we import the driver ...
from lantz.drivers.examples.fungen import LantzSignalGeneratorTCP

# and a function named connect_feat that does the work.
from lantz.ui.qtwidgets import connect_feat

app = QApplication(sys.argv)

# We load the UI from the QtDesigner file. You can also use pyuic4 to generate a class.
main = loadUi('ui-two-drivers.ui')

# We get a reference to each of the widgets.
freq1 = main.findChild((QWidget, ), 'fungen1__frequency')
freq2 = main.findChild((QWidget, ), 'fungen2__frequency')

with LantzSignalGeneratorTCP('localhost', 5678) as inst1, \
     LantzSignalGeneratorTCP('localhost', 5679) as inst2:
```

```
    # We connect each widget to each feature
    # The syntax arguments are widget, target (driver), Feat name
    connect_feat(freq1, inst1, 'frequency')
    connect_feat(freq2, inst2, 'frequency')
    main.show()
    exit(app.exec_())
```

The not so long way

If you have use a prefix to solve the name collision you can use it and connect the driver:

```
import sys

# Import lantz.ui register an import hook that will replace calls to Qt by PyQt4 or PySide ...
import lantz.ui

# and here we just use Qt and will work with both bindings!
from Qt.QtGui import QApplication, QWidget
from Qt.uic import loadUi

# From lantz we import the driver ...
from lantz.drivers.examples.fungen import LantzSignalGeneratorTCP

# and a function named connect_feat that does the work.
from lantz.ui.qtwidgets import connect_feat

app = QApplication(sys.argv)

# We load the UI from the QtDesigner file. You can also use pyuic4 to generate a class.
main = loadUi('ui-two-drivers.ui')

with LantzSignalGeneratorTCP('localhost', 5678) as inst1, \
     LantzSignalGeneratorTCP('localhost', 5679) as inst2:

    # We connect each widget to each feature
    # The syntax arguments are widget, target (driver), Feat name
    connect_driver(main, inst1, prefix='fungen1')
    connect_driver(main, inst2, prefix='fungen1')
    main.show()
    exit(app.exec_())
```

This does not look like too much saving but if more than one Feat per driver to connect, *connect_driver* will do them all for you. Under the hood, *connect_driver* is iterating over all widgets and checking if the driver contains a Feat with the widget name prefixed by *prefix*. Note that we have used *fungen1* instead of *fungen1__* as the prefix. That is because *connect_driver* uses the double underscore as a separator by default. You can change it by passing the *sep* keyword argument.

The short way

If you have named the widgets according to the Feat name and added a prefix corresponding to the feat:

```
import sys

# Import lantz.ui register an import hook that will replace calls to Qt by PyQt4 or PySide ...
import lantz.ui
```

```
# and here we just use Qt and will work with both bindings!
from Qt.QtGui import QApplication, QWidget
from Qt.uic import loadUi

# From lantz we import the driver ...
from lantz.drivers.examples.fungen import LantzSignalGeneratorTCP

# and a function named connect_feat that does the work.
from lantz.ui.qtwidgets import connect_feat

app = QApplication(sys.argv)

# We load the UI from the QtDesigner file. You can also use pyuic4 to generate a class.
main = loadUi('ui-two-drivers.ui')

# Notice that now we specify the instrument name!
with LantzSignalGeneratorTCP('localhost', 5678, name='fungen1') as inst1, \
     LantzSignalGeneratorTCP('localhost', 5679, name='fungen2') as inst2:

    # We connect the whole main widget, and we give a list of drivers.
    connect_setup(main, [inst1, inst2])
    main.show()
    exit(app.exec_())
```

Under the hood, *connect_setup* iterates over all drivers in the second argument and executes *connect_driver* using the driver name.

See Also:

Connecting a custom UI to a driver

Connecting two (or more) widgets to the same feat

1.5 FAQs

1.5.1 Why building an instrumentation toolkit?

Instrumentation and experiment automation became a cornerstone of modern science. Most of the devices that we use to quantify and perturb natural processes can or should be computer controlled. Moreover, the ability to control and synchronize multiple devices, enables complex experiments to be accomplished in a reproducible manner.

This toolkit emerges from my frustration with existing languages, libraries and frameworks for instrumentation:

- Domain specific languages that make extremely difficult to achieve things that are trivial in most general-purpose languages.
- Lots of boilerplate code to achieve consistent behaviour across an application.
- Inability to use existing libraries.

Lantz aims to reduce the burden of writing a good instrumentation software by providing base classes from which you can derive your own. These classes provide the boilerplate code that enables advanced functionality, allowing you to concentrate in the program logic.

1.5.2 Why not using LabVIEW/LabWindows/Matlab?

LabVIEW is a development environment for a graphical programming language called "G" in which the flow of information in the program is determined by the connections between functions. While this concept is clear for non programmers, it quickly becomes a burden in big projects. Common procedures for source control, maintainable documentation, testing, and metaprogramming are cumbersome or just unavailable.

On the other hand, Matlab is a text based programming language with focus in numerical methods. It provides a set of additional function via its instrumentation toolbox.

Common to these two plataforms is that they have *evolved* a full fledged programming language from domain specific one while trying to maintain backwards compatibility. Many of the weird ways of doing things in these languages arise from this organic growth.

Unlike LabVIEW, LabWindows/CVI is ANSI C plus a set of convenient libraries for instrumentation. It brings all the goodies of C but it also all the difficulties such as memmory management.

Last but not least, these languages are propietary and expensive locking your development. We need a free, open source toolkit for instrumentation build using a proven, mature, cross-plataform and well-though programming language.

1.5.3 But ... there are a lot of drivers already available for these languages

It is true, but many of these drivers are contributed by the users themselves. If a new toolkit emerges with enough momentum, many of those users will start to contribute to it. And due to the fact that building good drivers in Lantz is much easier than doing it in any of the other language we expect that this happens quite fast.

By the way, did you know we already have some *Drivers*. If your instrument is not listed, let us know!

1.5.4 Why Python?

Python is an interpreted, general-purpose high-level programming language. It combines a clear syntax, an excelent documentation and a large and comprehensive standard library. It is an awesome glue language that allows you to call already existing code in other languages. Finally, it is available in many platforms and is free.

1.5.5 Isn't Python slow?

In instrumentation software the communication with the instrument is (by far) the rate limiting step. Sending a serial command that modifies the instrument function and receiving a response can easily take a few miliseconds and frequently much longer. While this might be fast in human terms, is an eternity for a computer. For this reason rapid prototyping, good coding practices and maintainability are more important for an instrumentation toolkit than speed.

1.5.6 But I do a lot of mathematical operations!

Slow operations such as numerical calculations are done using libraries such as NumPy and SciPy. This puts Python in the same line as Matlab and similar languages.

1.5.7 How do I start?

Getting started is a good place.

1.5.8 I want to help. What can I do?

Please send comments and bug reports allowing us to make the code and documentation better.

If you want to contribute with code, the drivers are a good place to start. If you have a programmed a new driver o improved an existing one, let us know.

If you have been using Lantz for a while, you can also write or clarify documentation helping people to use the toolkit.

The user interface also can use some help. We aim to provide widgets for common instrumentation scenarios.

Finally, talk to us if you have an idea that can be added to the core. We aim to keep the core small, robust and easy to maintain. However, patterns that appear recurrently when we work on drivers are factored out to the core after proven right.

1.5.9 Where does the name comes from?

It is a tribute to friend, Maximiliano Lantz. He was passionate scientist, teacher and science popularizer. We dreamt many times about having an instrumentation software simple to be used for teaching but powerful to be used for research. I hope that this toolkit fulfills these goals.

1.6 Drivers

1.6.1 lantz.drivers.aa

company AA Opto Electronic.

description Radio frequency and acousto-optic devices, Laser based sub-systems.

website http://opto.braggcell.com/

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class `lantz.drivers.aa.`**`MDSnC`**(*port=1*, *timeout=1*, *write_timeout=1*, ***kwargs*)

Bases: `lantz.serial.SerialDriver`

MDSnC synthesizer for AOTF.nC

`CHANNELS` **= [0, 1, 2, 3, 4, 5, 6, 7]**

`enabled`

Keys [0, 1, 2, 3, 4, 5, 6, 7]

Enable single channels.

`frequency`

Keys [0, 1, 2, 3, 4, 5, 6, 7]

RF frequency for a given channel.

`main_enabled`

Enable the

Values {False: 0, True: 1}

power

Keys [0, 1, 2, 3, 4, 5, 6, 7]

Power for a given channel (in digital units).

Limits (0, 1023, 1)

powerdb

Keys [0, 1, 2, 3, 4, 5, 6, 7]

Power for a given channel (in db).

1.6.2 lantz.drivers.aeroflex

company Aeroflex

description Test and measurement equipment and microelectronic solutions.

website http://www.aeroflex.com/

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class `lantz.drivers.aeroflex.`**`A2023a`**(*port=1*, *timeout=1*, *write_timeout=1*, ***kwargs*)

Bases: `lantz.serial.SerialDriver`

Aeroflex Test Solutions 2023A 9 kHz to 1.2 GHz Signal Generator.

clear_status_async(**args*, ***kwargs*)

expose_async(**args*, ***kwargs*)

local_lockout(*value*)

remote(*value*)

reset_async(**args*, ***kwargs*)
(Async) Set the instrument functions to the factory default power up state.

self_test_async(**args*, ***kwargs*)
(Async) Is the interface and processor are operating?

software_handshake(*value*)

trigger_async(**args*, ***kwargs*)
(Async) Equivalent to Group Execute Trigger.

wait_async(**args*, ***kwargs*)
(Async) Inhibit execution of an overlapped command until the execution of the preceding operation has been completed.

RECV_TERMINATION = 256

SEND_TERMINATION = '\n'

amplitude
RF amplitude.

Units V

clear_status = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1595810>>, None)

event_status_enabled
Standard event enable register.

event_status_reg
Standard event enable register.

expose = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1595930>>, None)

fitted_options
Fitted options.

frequency
Carrier frequency.

Units Hz

frequency_standard
Get internal or external frequency standard.

Values {'INT', 'EXT10IND', 'EXTIND', 'EXT10DIR', 'INT10OUT'}

idn
Instrument identification.

offset
Offset amplitude.

Units V

output_enabled
Enable or disable the RF output

Values {False: 'DISABLED', True: 'ENABLED'}

phase
Phase offset

Units deg

reset = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x15956f0>>, None)

rflimit
Set RF output level max.

rflimit_enabled

Values {False: 'DISABLED', True: 'ENABLED'}

self_test = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1595730>>, None)

service_request_enabled
Service request enable register.

status_byte
Status byte, a number between 0-255.

time

Values {False: 'off', True: 'on'}

trigger = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1595770>>, None)

wait = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1595750>>, None)

1.6.3 lantz.drivers.andor

company Andor

description Scientific cameras.

website http://www.andor.com/

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class `lantz.drivers.andor.Andor`(**args*, ***kwargs*)
Bases: `lantz.foreign.LibraryDriver`

`close_async`(**args*, ***kwargs*)
(Async) Close camera self.AT_H.

`command`(*strcommand*)
Run command.

`finalize`()
Finalise Library. Concluding function.

`flush`()

`getbool`(*strcommand*)
Run command and get Bool return value.

`getenumerated`(*strcommand*)
Run command and set Enumerated return value.

`getfloat`(*strcommand*)
Run command and get Int return value.

`getint`(*strcommand*)
Run command and get Int return value.

`initialize`()
Initialise Library.

`is_implemented`(*strcommand*)
Checks if command is implemented.

`is_writable`(*strcommand*)
Checks if command is writable.

`open_async`(**args*, ***kwargs*)
(Async) Open camera self.AT_H.

`queuebuffer`(*bufptr*, *value*)
Put buffer in queue.

`setbool`(*strcommand*, *value*)
Set command with Bool value parameter.

`setenumerated`(*strcommand*, *value*)
Set command with Enumerated value parameter.

`setenumstring`(*strcommand*, *item*)
Set command with EnumeratedString value parameter.

setfloat (*strcommand*, *value*)
Set command with Float value parameter.

setint (*strcommand*, *value*)
SetInt function.

waitbuffer (*ptr*, *bufsize*)
Wait for next buffer ready.

LIBRARY_NAME = 'atcore.dll'

close = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x15a1af0>>, None)

open = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x15a1990>>, None)

class lantz.drivers.andor.**Neo** (**args*, ***kwargs*)
Bases: lantz.drivers.andor.andor.Andor

Neo Andor CMOS Camera

initialize ()

take_image_async (**args*, ***kwargs*)
(Async) Image acquisition with circular buffer.

clock_rate
Pixel clock rate

Values {200: '200 MHz', 280: '280 MHz', 100: '100 MHz'}

exposure_time
Get exposure time.

fan_peed
Fan speed.

pixel_encoding
Pixel encoding.

Values {32: 'Mono32', 64: 'Mono64'}

roi
Set region of interest

sensor_size

sensor_temp
Sensor temperature.

take_image = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x19beff0>>, None)

1.6.4 lantz.drivers.coherent

company Coherent Inc.

description Lasers and Lasers Systems.

website http://www.coherent.com/

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class `lantz.drivers.coherent.`**`Innova300C`**(*port=1*, *baudrate=1200*, ***kwargs*)

Bases: `lantz.serial.SerialDriver`

Innova300 C Series.

`center_powertrack_async`(**args*, ***kwargs*)

(Async) Center PowerTrack and turn it off.

`initialize`()

`query`(*command*, *send_args*, *recv_args*)

Send query to the laser and return the answer, after handling possible errors.

Parameters

- **command** (*string*) – command to be sent to the instrument
- **send_args** – (termination, encoding) to override class defaults
- **recv_args** – (termination, encoding) to override class defaults

`recalibrate_powertrack_async`(**args*, ***kwargs*)

(Async) Recalibrate PowerTrack. This will only execute if PowerTrack is on and light regulation is off

`ENCODING` **= 'ascii'**

`RECV_TERMINATION` **= '\r\n'**

`SEND_TERMINATION` **= '\r\n'**

`analog_enabled`

Analog Interface input state.

Values {False: 0, True: 1}

`analog_relative`

Analog Interface input mode.

Values {False: 0, True: 1}

`auto_light_cal_enabled`

Automatic light regulation calibration flag.

Values {False: 0, True: 1}

`autofill_delta`

Tube voltage minus the autofill setting.

Units V

`autofill_mode`

Autofill mode.

Values {'disabled': 0, 'enabled until next autofill': 2, 'enabled': 1}

`autofill_needed`

Is the autofill needed (wheter fill is enabled or not)

Values {False: 0, True: 1}

`baudrate`

RS-232/422 baud rate, the serial connection will be reset after.

Values {19200, 9600, 300, 110, 1200, 2400, 4800}

`cathode_current`

Laser cathode current (AC).

Units A

cathode_voltage
Laser cathode voltage (AC).

Units V

center_powertrack = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x19d5d30>>, No

control_pin_high
State of the input pin 10 of the Analog Interface.

Values {False: 0, True: 1}

current
Current regulation mode.

Units A

current_change_limit
Percent tube change before an automatic light regulation recalibration becomes necessary.

Limits (5, 100, 1)

current_range
Current corresponding to 5 Volts at the input or output lines of the Analog Interface.

Units A

Limits (10, 100, 1)

current_setpoint
Current setpoint when using the current regulation mode.

Units A

Limits (0, 50, 0.01)

echo_enabled
Echo mode of the serial interface.

Values {False: 0, True: 1}

etalon_mode
Etalon mode.

Values {'modetune': 2, 'manual': 0, 'modetrack': 1}

etalon_temperature
Etalon temperature.

Units degC

etalon_temperature_setpoint
Setpoint for the etalon temperature.

Units degC

Limits (51.5, 54, 0.001)

faults
List of all active faults.

head_software_rev
Software revision level in the laser head board.

idn
Laser identification, should be I300.

is_in_start_delay
Laser is in start delay (tube not ionized)

laser_enabled
Energize the power supply.

Values {False: 0, True: 2}

magnet_current
Laser magnet current.

Units A

magnetic_field_high
Magnetic field.

Values {False: 0, True: 1}

magnetic_field_setpoint_high
Setpoint for magnetic field setting.

Values {False: 0, True: 1}

operating_mode
Laser operating mode.

Values {'current regulation': 0, 'standard light regulation': 2, 'reduced bandwidth light regulation': 1, 'current regulation, light regulation out of range': 3}

output_pin_high
State of the output pin 24 and 25 of the Analog Interface.

Values {(False, True): 2, (True, False): 1, (False, False): 0, (True, True): 3}

power
Current power output.

Units A

power_setpoint
Setpoint for the light regulation.

Units W

Limits (0, 50, 0.0001)

powertrack_mode_enabled
PowerTrack.

Values {False: 0, True: 1}

powertrack_position

Keys ('A', 'B')

Relative position of the PowerTrack solenoids.

Limits (0, 255)

recalibrate_powertrack = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x19d5cf0

remaining_time
Number of hours remaining before the laser will shut down automatically.

Units hour

software_rev
Software revision level in the power supply.

time_to_start
Timer countdown during the start delay cycle.

Units second

tube_time
Number of operating hours on the plasma tube.

Units hour

tube_voltage
Laser tube voltage.

Units V

water_flow
Water flow.

Units gallons/minute

water_resistivity
Resistivity of the incoming water to the power supply.

Units kohm*cm

water_temperature
Temperature of the incoming water to the power supply.

class lantz.drivers.coherent.**ArgonInnova300C**(*port=1*, *baudrate=1200*, ***kwargs*)
Bases: lantz.drivers.coherent.innova.Innova300C

Argon Innova 300C.

wavelength
Wavelength for the internal power meter calibration

Values {496, 514, 454, 488, 457, 364, 1090, 'MLUV', 528, 465, 'MLVS', 501, 472, 476, 'MLDUV', 351}

class lantz.drivers.coherent.**KryptonInnova300C**(*port=1*, *baudrate=1200*, ***kwargs*)
Bases: lantz.drivers.coherent.innova.Innova300C

Krypton Innova 300C.

wavelength
Wavelength for the internal power meter calibration

Values {482, 676, 647, 'MLVI', 'MLBG', 530, 'MLUV', 752, 520, 'MLVS', 'MLIR', 568, 'MLRD', 476}

1.6.5 lantz.drivers.examples

company Lantz Examples.

description Example drivers for simulated instruments.

website

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class `lantz.drivers.examples.`**`LantzSignalGenerator`**
Bases: `builtins.object`

Lantz Signal Generator

`query` (*command*, *send_args*, *recv_args*)

`ENCODING` = **'ascii'**

`RECV_TERMINATION` = **'\n'**

`SEND_TERMINATION` = **'\n'**

`amplitude`
Amplitude.

Units V

Limits (10,)

`calibrate` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1ade8f0>>, None)**

`din`

Keys [1, 2, 3, 4, 5, 6, 7, 8]

Digital input state.

Values {False: '0', True: '1'}

`dout`

Keys [1, 2, 3, 4, 5, 6, 7, 8]

Digital output state.

Values {False: '0', True: '1'}

`frequency`
Frequency.

Units Hz

Limits (1, 100000.0)

`idn`

`offset`
Offset.

Units V

Limits (-5, 5, 0.01)

`output_enabled`
Analog output enabled.

Values {False: 0, True: 1}

`self_test` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1ade910>>, None)**

`waveform`

Values {'ramp': '3', 'sine': '0', 'square': '1', 'triangular': '2'}

class `lantz.drivers.examples.`**`LantzSignalGeneratorTCP`**(*host='localhost'*, *port=9997*, **args*, ***kwargs*)

Bases: `lantz.drivers.examples.fungen.LantzSignalGenerator`, `lantz.network.TCPDriver`

`calibrate_async`(**args*, ***kwargs*)
(Async) Calibrate.

`self_test_async`(**args*, ***kwargs*)
(Async) Reset to .

class `lantz.drivers.examples.`**`LantzSignalGeneratorSerial`**(*port=1*, *timeout=1*, *write_timeout=1*, ***kwargs*)

Bases: `lantz.drivers.examples.fungen.LantzSignalGenerator`, `lantz.serial.SerialDriver`

`calibrate_async`(**args*, ***kwargs*)
(Async) Calibrate.

`self_test_async`(**args*, ***kwargs*)
(Async) Reset to .

class `lantz.drivers.examples.`**`LantzSignalGeneratorSerialVisa`**(*resource_name*, **args*, ***kwargs*)

Bases: `lantz.drivers.examples.fungen.LantzSignalGenerator`, `lantz.visa.SerialVisaDriver`

`calibrate_async`(**args*, ***kwargs*)
(Async) Calibrate.

`self_test_async`(**args*, ***kwargs*)
(Async) Reset to .

class `lantz.drivers.examples.`**`LantzVoltmeterTCP`**(*host='localhost'*, *port=9997*, **args*, ***kwargs*)

Bases: `lantz.network.TCPDriver`

Lantz Signal Generator

`auto_range_async`(**args*, ***kwargs*)
(Async) Autoselect a range.

`calibrate_async`(**args*, ***kwargs*)
(Async) Calibrate.

`query`(*command*, *send_args*, *recv_args*)

`self_test_async`(**args*, ***kwargs*)
(Async) Self test

`ENCODING` = **'ascii'**

`RECV_TERMINATION` = **'\n'**

`SEND_TERMINATION` = **'\n'**

`auto_range` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1ae6390>>, None)**

`calibrate` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1ae63b0>>, None)**

`idn`

`range`

Keys (0, 1)

Values {1000: '4', 1: '1', 10: '2', 0.1: '0', 100: '3'}

self_test = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1ae63d0>>, None)

voltage

Keys (0, 1)

Measure the voltage.

Units V

1.6.6 lantz.drivers.kentech

company Kentech Instruments Ltd.

description Manufacturers of specialised and custom built electronics and imaging equipment.

website http://www.kentech.co.uk/

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class `lantz.drivers.kentech.HRI`(*port=1*, *timeout=1*, *write_timeout=1*, ***kwargs*)

Bases: `lantz.serial.SerialDriver`

Kentech High Repetition Rate Image Intensifier.

clear_async(**args*, ***kwargs*)

(Async) Clear the buffer.

query(*command*, *send_args*, *recv_args*)

Send query to the instrument and return the answer. Set remote mode if needed.

query_expect(*command*, *recv_termination=None*, *expected='ok'*)

ENCODING = 'ascii'

RECV_TERMINATION = '\n'

SEND_TERMINATION = '\r'

average_voltage

Cathode potential bias with respect of MCP.

Units volt

Limits (-50, 50)

clamp_voltage

Most negative value of the gate pulse.

Units volt

Limits (-50, 50)

clear = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1aec410>>, None)

enabled

MCP Enabled

Values {False, True}

mcp
MCP Voltage.

Units volt

Limits (0, 1700)

mode
Gain modulation mode.

HRI Machine Modes and Mode Indices None Mode 0 INHIBIT 2-10 COMB modes 200 ps to 1 ns inclusive (High rate operation) 11-20 COMB modes 100 ps to 3 ns inclusive (Low rate (+GOI) operation) 21 RF 22 logic low duty cycle (LDC) 23 logic high duty cycle 24 DC 25-28 user modes 1 to 4

Values {'ldc': 22, 'inhibit': 0, 'hdc': 23, 'user3': 27, 'user1': 25, 'user2': 26, 'rf': 21, 'user4': 28, 'dc': 24}

remote
Remote or local.

Values {False, True}

revision
Revision.

rfgain
RF Gain.

status
Get status.

temperature
Temperature.

trigger_ecl_level
Trigger level for ECL logic, mode level.

Units centivolt

Limits (-40, 40, 1)

trigger_ecl_mode
Trigger mode for ECL logic.

Values {'log': 'LOGTRIG}', 'level': 'LVLTRIG'}

trigger_edge
Trigger on rising or falling edge.

Values {'falling': '-VETRIG}', 'rising': '+VETRIG'}

trigger_logic
Trigger logic.

Values {'ecl': 'ECLTRIG', 'ttl': 'TTLTRIG'}

trigger_ttl_termination
Trigger termination for TTL logic (for ECL is fixed to 50 ohm).

Values {'high': 'HITRIG', '50ohm': '50TRIG}'}

1.6.7 lantz.drivers.ni

company National Instruments

description

website http://www.ni.com/

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1.6.8 lantz.drivers.olympus

company Olympus.

description Research and clinical microscopes.

website http://www.microscopy.olympus.eu/microscopes/

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class `lantz.drivers.olympus.`**`IX2`**(*port=1, baudrate=19200, bytesize=8, parity='Even', stopbits=1, flow=0, timeout=None, write_timeout=None, *args, **kwargs*)

Bases: `lantz.drivers.olympus.ixbx.IXBX`

Olympus IX2 Body

`bottom_port_closed`
Bottom port

Values {False: 'OUT', True: 'IN'}

`camera_port_enabled`
Prism position

Values {False: '2', True: '1'}

`condensor`
Condensor position

Get procs

- <class 'int'>:set procs: - <class 'str'>

`filter_wheel`
Filter wheel position

Get procs

- <class 'int'>:set procs: - <class 'str'>

`mirror_unit`
Mirror unit position

Get procs

- <class 'int'>:set procs: - <class 'str'>

shutter1_closed
Shutter

Values {False: 'OUT', True: 'IN'}

shutter2_closed
Shutter

Values {False: 'OUT', True: 'IN'}

class `lantz.drivers.olympus.`**BX2A**(*port=1*, *baudrate=19200*, *bytesize=8*, *parity='Even'*, *stopbits=1*, *flow=0*, *timeout=None*, *write_timeout=None*, **args*, ***kwargs*)

Bases: `lantz.drivers.olympus.ixbx.IXBX`

Olympus BX2A Body

aperture_stop_diameter
Aperture stop diameter (DIA AS UCD)

Get procs

- <class 'int'>:set procs: - <class 'str'>

condenser_top_lens_enabled
Condenser top lens (UCD)

Values {False: 'OUT', True: 'IN'}

configure_filterwheel
Configure filterwheel

Get procs

- <class 'int'>:set procs: - <class 'str'>

cube
Cube position (RFAA/RLAA)

Get procs

- <class 'int'>:set procs: - <class 'str'>

shutter_closed
Shutter RFAA

Values {False: 'OUT', True: 'IN'}

turret
Turret position (UCD)

Get procs

- <class 'int'>:set procs: - <class 'str'>

class `lantz.drivers.olympus.`**IXBX**(*port=1*, *baudrate=19200*, *bytesize=8*, *parity='Even'*, *stopbits=1*, *flow=0*, *timeout=None*, *write_timeout=None*, **args*, ***kwargs*)

Bases: `lantz.serial.SerialDriver`

IX or BX Olympus microscope body.

init_origin()
Init origin

lamp_status()

move_relative_async (**args*, ***kwargs*)

query (*command*, *send_args*, *recv_args*)
Query the instrument and parse the response.

Raises InstrumentError

stop ()
Stop any currently executing motion

RECV_TERMINATION = '\r\n'

SEND_TERMINATION = '\r\n'

body_locked
Turn the currently selected lamp on and off

Values {False: 'OFF', True: 'ON'}

fluo_shutter
External shutter for the fluorescent light source

Values {False: '0', True: '1'}

focus_locked
Turn the currently selected lamp on and off

Values {False: 'OFF', True: 'ON'}

idn
Microscope identification

jog_dial
Jog selection (Handle/BLA) ???

Values {False: 'FRM', True: 'FH'}

jog_enabled
Jog enabled

Values {False: 'OFF', True: 'ON'}

jog_limit_enabled
Jog limit enabled

Values {False: 'OFF', True: 'ON'}

jog_sensitivity
Jog sensitivity

Get procs

- <class 'int'>:set procs: - <class 'str'>

lamp_enabled
Turn the currently selected lamp onf and off

Values {False: 'OFF', True: 'ON'}

lamp_epi_enabled
Illumination source lamp.

Values {False: 'DIA', True: 'EPI'}

lamp_intensity
Transmitted light intensity

Get procs

- <class 'int'>:set procs: - <class 'str'>

move_relative = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b43e30>>, None)

move_to_start_enabled
Sets / cancels returning operation to the start position after initializing the origin.

Values {False: 'OFF', True: 'ON'}

movement_status

objective
Objective nosepiece position

Get procs

- <class 'int'>:set procs: - <class 'str'>

soft_limits

Units (<Quantity(0.01, 'micrometer')>, <Quantity(0.01, 'micrometer')>)

z
Position of the objective.

Units 0.01 micrometer

1.6.9 lantz.drivers.pco

company PCO.

description High performance CCD-, CMOS- and sCMOS camera systems.

website http://www.pco.de

—

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class lantz.drivers.pco.**Sensicam**(*board*, **args*, ***kwargs*)
Bases: lantz.foreign.LibraryDriver

PCO Sensicam

expose_async(**args*, ***kwargs*)
(Async) Expose.

Parameters **exposure** – exposure time.

finalize()

initialize()

read_out_async(**args*, ***kwargs*)
(Async) Readout image from the CCD.

Return type NumPy array

run_coc_async(**args*, ***kwargs*)

stop_coc_async(**args*, ***kwargs*)

take_image_async (**args*, ***kwargs*)
(Async) Take image.

Parameters **exposure** – exposure time.

Return type NumPy array

LIBRARY_NAME = 'senntcam.dll'

bel_time

Units microseconds

binning
Binning in pixels as a 2-element tuple (horizontal, vertical).

coc
Command Operation Code

coc_time

Units microseconds

delay_time

Units microseconds

exp_time

Units microseconds

expose = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b50850>>, None)

exposure_time
Exposure time.

Units ms

image_size
Image size in pixels (width, height).

image_status
Image status

mode
Imaging mode as a 3-element tuple (type, gain and submode).

read_out = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1595ed0>>, None)

roi
Region of interest in pixels as a 4-element tuple (x1, x2, y1, y2).

run_coc = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b50730>>, None)

status

stop_coc = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b50710>>, None)

table
COC table

take_image = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1595ef0>>, None)

trigger
Triger mode.

1.6.10 lantz.drivers.sutter

company Sutter Instrument.

description Biomedical and scientific instrumentation.

website http://www.sutter.com/

—

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class `lantz.drivers.sutter.`**`Lambda103`**(*port=11*, *baudrate=9600*, *timeout=1*, **args*, ***kwargs*)
Bases: `lantz.serial.SerialDriver`

High performance, microprocessor-controlled multi-filter wheel system for imaging applications requiring up to 3 filter wheels.

`flush`()
Flush.

`motorsON_async`(**args*, ***kwargs*)
(Async) Power on all motors.

`reset_async`(**args*, ***kwargs*)
(Async) Reset the controller.

`status_async`(**args*, ***kwargs*)

`RECV_TERMINATION` = ''

`SEND_TERMINATION` = ''

`motorsON` = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b5c4d0>>, None)

`open_A`
Open shutter A.

Values {False: '¬', True: 'ª'}

`position`

Keys {'A': 0, 'B': 1}

Set filter wheel position and speed.

w = 0 -> Filter wheels A and C w = 1 -> Fliter wheel B

`remote`
Set Local-Mode.

Values {False: 'ï', True: 'î'}

`reset` = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b5c550>>, None)

`status` = functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b5c510>>, None)

1.6.11 lantz.drivers.tektronix

company Tektronix.

description Test and Measurement Equipment.

website http://www.tek.com/

—

class `lantz.drivers.tektronix.`**`TDS2024`**(*port*)

Bases: `lantz.visa.VisaDriver`

Tektronix TDS2024 200 MHz 4 Channel Digital Real-Time Oscilloscope

`initialize`()

initiate.

`acqparams` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b63070>>, None)**

`autoconf` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b61f50>>, None)**

`curv` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b630d0>>, None)**

`dataencoding` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b630b0>>, None)**

`datasource` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b63050>>, None)**

`forcetrigger` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b63030>>, None)**

`idn`

IDN.

`measure_frequency` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b630f0>>, No**

`measure_max` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b63130>>, None)**

`measure_mean` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b63150>>, None)**

`measure_min` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b63110>>, None)**

`trigger`

Trigger state.

`triggerlevel` = **functools.partial(<bound method Action.call of <lantz.action.Action object at 0x1b61ff0>>, None)**

`AA Opto Electronic.`

- `MDSnC synthesizer for AOTF.nC`

`Aeroflex`

- `Aeroflex Test Solutions 2023A 9 kHz to 1.2 GHz Signal Generator.`

`Andor`

- `Andor`
- `Neo Andor CMOS Camera`

`Coherent Inc.`

- `Argon Innova 300C.`
- `Innova300 C Series.`
- `Krypton Innova 300C.`

`Lantz Examples.`

- `LantzSignalGeneratorSerial`
- `LantzSignalGeneratorSerialVisa`

- `LantzSignalGeneratorTCP`
- `Lantz Signal Generator`

`Kentech Instruments Ltd.`

- `Kentech High Repetition Rate Image Intensifier.`

`National Instruments`

`Olympus.`

- `Olympus BX2A Body`
- `Olympus IX2 Body`
- `IX or BX Olympus microscope body.`

`PCO.`

- `PCO Sensicam`

`Sutter Instrument.`

- `High performance, microprocessor-controlled multi-filter wheel system`

`Tektronix.`

1.7 API

1.7.1 General

class `lantz.`**`Driver`**

Base class for all drivers.

Params name easy to remember identifier given to the instance for logging purposes

`add_on_changed`(*feat_name*, *func*, *key=MISSING*)

Add callback to be triggered when a Feat/DictFeat value changes.

Parameters

- **feat_name** – name of the Feat/DictFeat.
- **func** – callback that takes a single value
- **key** – (optional) For DictFeat, indicates the key to be monitored. Use None to trigger the callback when any key us changed.

`del_on_changed`(*feat_name*, *func*, *key=MISSING*)

Delete callback. See add_on_changed.

Parameters

- **feat_name** – name of the Feat/DictFeat.
- **func** – callback that takes a single value
- **key** – (optional) For DictFeat, indicates the key to be monitored. Use None to trigger the callback when any key us changed.

`log`(*level*, *msg*, **args*, ***kwargs*)

Log with the integer severity 'level' on the logger corresponding to this instrument.

Parameters

- **level** – severity level for this event.
- **msg** – message to be logged (can contain PEP3101 formatting codes)

log_critical (*msg*, **args*, ***kwargs*)
Log with the severity 'CRITICAL' on the logger corresponding to this instrument.

Parameters **msg** – message to be logged (can contain PEP3101 formatting codes)

log_debug (*msg*, **args*, ***kwargs*)
Log with the severity 'DEBUG' on the logger corresponding to this instrument.

Parameters **msg** – message to be logged (can contain PEP3101 formatting codes)

log_error (*msg*, **args*, ***kwargs*)
Log with the severity 'ERROR' on the logger corresponding to this instrument.

Parameters **msg** – message to be logged (can contain PEP3101 formatting codes)

log_info (*msg*, **args*, ***kwargs*)
Log with the severity 'INFO' on the logger corresponding to this instrument.

Parameters **msg** – message to be logged (can contain PEP3101 formatting codes)

log_warning (*msg*, **args*, ***kwargs*)
Log with the severity 'WARNING' on the logger corresponding to this instrument.

Parameters **msg** – message to be logged (can contain PEP3101 formatting codes)

recall (*keys=None*)
Return the last value seen for a feat or a collection of feats.

Parameters **keys** (*str, list, tuple, dict.*) – a string or list of strings with the properties to refresh. Default None all properties. If keys is a string, returns the value. If keys is a list, returns a dictionary.

refresh (*keys=None*)
Refresh cache by reading values from the instrument.

Parameters **keys** (*str or list or tuple or dict*) – a string or list of strings with the properties to refresh. Default None, meaning all properties. If keys is a string, returns the value. If keys is a list/tuple, returns a tuple. If keys is a dict, returns a dict.

refresh_async (*keys*, *callback=None*)
Asynchronous refresh cache by reading values from the instrument.

Parameters **keys** (*str or list or tuple or dict*) – a string or list of strings with the properties to refresh Default None, meaning all properties. If keys is a string, returns the value. If keys is a list, returns a dictionary.

Return type concurrent.future.

update (*newstate*, *force=None*, ***kwargs*)
Update driver.

Parameters

- **newstate** (*dict.*) – a dictionary containing the new driver state.
- **force** – apply change even when the cache says it is not necessary.
- **force** – boolean.

Raises ValueError if called with an empty dictionary.

update_async (*newstate*, *force*, *callback=None*, ***kwargs*)
Asynchronous update driver.

Parameters

- **newstate** (*dict.*) – driver state.
- **force** (*boolean.*) – apply change even when the cache says it is not necessary.
- **callback** (*callable.*) – Called when the update finishes.

Return type concurrent.future

Raises ValueError if called with an empty dictionary.

class lantz.**Feat** (*fget*, *fset*, *doc*, *values*, *units*, *limits=MISSING*, *procs=None*, *read_once=None*)
Pimped Python property for interfacing with instruments. Can be used as a decorator.

Processors can registered for each arguments to modify their values before they are passed to the body of the method. Two standard processors are defined: *values* and *units* and others can be given as callables in the *procs* parameter.

If a method contains multiple arguments, use a tuple. None can be used as *do not change*.

Parameters

- **fget** – getter function.
- **fset** – setter function.
- **doc** – docstring, if missing fget or fset docstring will be used.
- **values** – A dictionary to map key to values. A set to restrict the values. If a list/tuple instead of a dict is given, the value is not changed but only tested to belong to the container.
- **units** – *Quantity* or string that can be interpreted as units.
- **procs** – Other callables to be applied to input arguments.

class lantz.**DictFeat** (*fget*, *fset=MISSING*, *doc=None*, *keys=None*, ***kwargs*)
Pimped Python property with getitem access for interfacing with instruments. Can be used as a decorator.

Takes the same parameters as *Feat*, plus:

Parameters **keys** – List/tuple restricts the keys to the specified ones.

class lantz.**Action** (*func*, *values*, *units*, *limits*, *procs=None*)
Wraps a Driver method with Lantz. Can be used as a decorator.

Processors can registered for each arguments to modify their values before they are passed to the body of the method. Two standard processors are defined: *values* and *units* and others can be given as callables in the *procs* parameter.

If a method contains multiple arguments, use a tuple. None can be used as *do not change*.

Parameters

- **func** – driver method to be wrapped.
- **values** – A dictionary to values key to values. If a list/tuple instead of a dict is given, the value is not changed but only tested to belong to the container.
- **units** – *Quantity* or string that can be interpreted as units.
- **procs** – Other callables to be applied to input arguments.

1.7.2 Interfacing to instruments

lantz.serial

Implements base classes for drivers that communicate with instruments via serial or parallel port.

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class `lantz.serial.`**`SerialDriver`**(*port=1*, *timeout=1*, *write_timeout=1*, ***kwargs*)
Bases: `lantz.driver.TextualMixin`, `lantz.driver.Driver`

Base class for drivers that communicate with instruments via serial or parallel port using pyserial

Parameters

- **port** – Device name or port number
- **baudrate** – Baud rate such as 9600 or 115200
- **bytesize** – Number of data bits. Possible values = (5, 6, 7, 8)
- **parity** – Enable parity checking. Possible values = ('None', 'Even', 'Odd', 'Mark', 'Space')
- **stopbits** – Number of stop bits. Possible values = (1, 1.5, 2)
- **xonoff** – xonoff flow control enabled.
- **rtscts** – rtscts flow control enabled.
- **dsrdtr** – dsrdtr flow control enabled
- **timeout** – value in seconds, None or negative to wait for ever or 0 for non-blocking mode
- **write_timeout** – see timeout

`finalize`()
Close port

`initialize`()
Open port

`raw_recv`(*size*)
Receive raw bytes to the instrument.

Parameters **size** – number of bytes to receive

Returns received bytes

Return type bytes

If a timeout is set, it may return less bytes than requested. If size == -1, then the number of available bytes will be read.

`raw_send`(*data*)
Send raw bytes to the instrument.

Parameters

- **data** – bytes to be sent to the instrument
- **data** – bytes

`BAUDRATE` **= 9600**
communication parameters

RECV_CHUNK = -1
-1 is mapped to get the number of bytes pending.

RTSCTS = False
flow control flags

lantz.network

Implements a base class for drivers that communicate with instruments via TCP.

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class `lantz.network.`**`TCPDriver`**(*host='localhost'*, *port=9997*, **args*, ***kwargs*)
Bases: `lantz.driver.TextualMixin`, `lantz.driver.Driver`

Base class for drivers that communicate with instruments via TCP.

Parameters

- **host** – Address of the network resource
- **port** – Port number

`raw_recv`(*size*)
Receive raw bytes to the instrument.

Parameters **size** – number of bytes to receive.

Returns received bytes.

Return type bytes.

`raw_send`(*data*)
Send raw bytes to the instrument.

Parameters

- **data** – bytes to be sent to the instrument.
- **data** – bytes.

lantz.foreign

Implements classes and methods to interface to foreign functions.

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class `lantz.foreign.`**`Library`**(*library*, *prefix=''*, *wrapper=None*)
Bases: `builtins.object`

Library wrapper

Parameters

- **library** – ctypes library
- **wrapper** – callable that takes two arguments the name of the function and the function itself. It should return a callable.

class `lantz.foreign.`**`LibraryDriver`**(**args*, ***kwargs*)
Bases: `lantz.driver.Driver`

Base class for drivers that communicate with instruments calling a library (dll or others)

To use this class you must override LIBRARY_NAME

`LIBRARY_NAME` **= ''**
Name of the library

lantz.visa

Implements base classes for drivers that communicate with instruments using visalib.

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class `lantz.visa.`**`MessageVisaDriver`**(*resource_name*, **args*, ***kwargs*)
Bases: `lantz.driver.TextualMixin`, `lantz.driver.Driver`

Base class for drivers that communicate with instruments via serial or parallel port using pyserial

Parameters **resource_name** – name or alias of the resource to open.

`finalize`()
Close port

`initialize`()
Open port

`raw_send`(*data*)
Send raw bytes to the instrument.

Parameters

- **data** – bytes to be sent to the instrument
- **data** – bytes

class `lantz.visa.`**`SerialVisaDriver`**(*resource_name*, **args*, ***kwargs*)
Bases: `lantz.visa.MessageVisaDriver`

Base class for drivers that communicate with instruments via serial port using visa.

Parameters **resource_name** – the visa resource name or alias (e.g. 'ASRL1::INSTR')

`raw_recv`(*size*)
Receive raw bytes to the instrument.

Parameters **size** – number of bytes to receive

Returns received bytes

Return type bytes

If a timeout is set, it may return less bytes than requested. If size == -1, then the number of available bytes will be read.

`BAUDRATE` **= 9600**
communication parameters

`RTSCTS` **= False**
flow control flags

1.7.3 UI

lantz.ui.qtwidgets

Implements UI widgets based on Qt widgets. To achieve functionality, instances of QtWidgets are patched.

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class `lantz.ui.qtwidgets.`**`ChildrenWidgets`**(*parent*)
Convenience class to iterate children.

Parameters **parent** – parent widget.

class `lantz.ui.qtwidgets.`**`DictFeatWidget`**(*parent*, *target*, *feat*)
Widget to show a DictFeat.

Parameters

- **parent** – parent widget.
- **target** – driver object to connect.
- **feat** – DictFeat to connect.

`setReadOnly`(*value*)
Set read only s

`setValue`(*value*)
Set widget value.

`value`()
Get widget value.

`lantz_target`
Driver connected to this widget.

`readable`
If the Feat associated with the widget can be read (get).

`writable`
If the Feat associated with the widget can be written (set).

class `lantz.ui.qtwidgets.`**`DriverTestWidget`**(*parent*, *target*)
Widget that is automatically filled to control all Feats of a given driver.

Parameters

- **parent** – parent widget.
- **target** – driver object to map.

`update_on_change`(*new_state*)
Set the 'update_on_change' flag to new_state in each writable widget within this widget. If True, the driver will be updated after each change.

`widgets_values_as_dict`()
Return a dictionary mapping each writable feat name to the current value of the widget.

`lantz_target`
Driver connected to this widget.

class `lantz.ui.qtwidgets.`**`FeatWidget`**
Widget to show a Feat.

Parameters

- **parent** – parent widget.
- **target** – driver object to connect.
- **feat** – Feat to connect.

class `lantz.ui.qtwidgets.`**`LabeledFeatWidget`**(*parent*, *target*, *feat*)

Widget containing a label, a control, and a get a set button.

Parameters

- **parent** – parent widget.
- **target** – driver object to connect.
- **feat** – Feat to connect.

`label_width`

Width of the label

`lantz_target`

Driver connected to this widget.

`readable`

If the Feat associated with the widget can be read (get).

`writable`

If the Feat associated with the widget can be written (set).

class `lantz.ui.qtwidgets.`**`SetupTestWidget`**(*parent*, *targets*)

Widget to control multiple drivers.

Parameters

- **parent** – parent widget.
- **targets** – iterable of driver object to map.

class `lantz.ui.qtwidgets.`**`UnitInputDialog`**(*units*, *parent=None*)

Dialog to select new units. Checks compatibility while typing and does not allow to continue if incompatible.

Returns None if cancelled.

Parameters

- **units** – current units.
- **parent** – parent widget.

```
>>> new_units = UnitInputDialog.get_units('ms')
```

static **`get_units`**(*units*)

Creates and display a UnitInputDialog and return new units.

Return None if the user cancelled.

class `lantz.ui.qtwidgets.`**`WidgetMixin`**

Mixin class to provide extra functionality to QWidget derived controls.

Derived class must override _WRAPPED to indicate with which classes it can be mixed.

To wrap an existing widget object use:

```
>>> widget = QComboBox()
>>> WidgetMixin.wrap(widget)
```

If you want lantz to provide an appropriate wrapped widget for a given feat:

```
>>> widget = WidgetMixin.from_feat(feat)
```

In any case, after wrapping a widget you need to bind it to a feat:

```
>>> feat = driver._lantz_feat[feat_name]
>>> widget.bind_feat(feat)
```

Finally, you need to

```
>>> widget.lantz_target = driver
```

classmethod **`from_feat`** (*feat*, *parent=None*)
Return a widget appropriate to represent a lantz feature.

Parameters

- **feat** – a lantz feature, the result of inst._lantz_feat[feat_name].
- **parent** – parent widget.

`keyPressEvent` (*event*)
When 'u' is pressed, request new units. When 'r' is pressed, get new value from the driver.

`on_feat_value_changed` (*value*)
When the driver value is changed, update the widget if necessary.

`on_widget_value_changed` (*new_value*)
When the widget is changed by the user, update the driver with the new value.

`setReadOnly` (*value*)
Set read only s

`setValue` (*value*)
Set widget value.

`value` ()
Get widget value.

`value_from_feat` ()
Update the widget value with the current Feat value of the driver.

`value_to_feat` ()
Update the Feat value of the driver with the widget value.

`feat_key`
Key associated with the DictFeat.

`lantz_target`
Driver connected to the widget.

`readable`
If the Feat associated with the widget can be read (get).

`writable`
If the Feat associated with the widget can be written (set).

`lantz.ui.qtwidgets.`**`connect_driver`** (*parent*, *target*, *prefix*, *sep*)
Connect all children widgets to their corresponding lantz feature matching by name. Non-matching names are ignored.

Parameters

- **parent** – parent widget.

- **target** – the driver.
- **prefix** – prefix to be prepended to the lantz feature (default = ‘’)
- **sep** – separator between prefix, name and suffix

`lantz.ui.qtwidgets.`**`connect_feat`**(*widget*, *target*, *feat_name=None*, *feat_key=MISSING*)
Connect a feature from a given driver to a widget. Calling this function also patches the widget is necessary.

If applied two times with the same widget, it will connect to the target provided in the second call. This behaviour can be useful to change the connection target without rebuilding the whole UI. Alternative, after connect has been called the first time, widget will have a property *lantz_target* that can be used to achieve the same thing.

Parameters

- **widget** – widget instance.
- **target** – driver instance.
- **feat_name** – feature name. If None, connect using widget name.
- **feat_key** – For a DictFeat, this defines which key to show.

`lantz.ui.qtwidgets.`**`connect_setup`**(*parent*, *targets*, *prefix*, *sep*)
Connect all children widget to their corresponding

Parameters

- **parent** – parent widget.
- **targets** – iterable of drivers.
- **prefix** – prefix to be prepended to the lantz feature name if None, the driver name will be used (default) if it is a dict, the driver name will be used to obtain he prefix.

`lantz.ui.qtwidgets.`**`register_wrapper`**(*cls*)
Register a class as lantz wrapper for QWidget subclasses.

The class must contain a field (_WRAPPERS) with a tuple of the QWidget subclasses that it wraps.

`lantz.ui.qtwidgets.`**`request_new_units`**(*current_units*)
Ask for new units using a dialog box and return them.

Parameters **current_units** (*Quantity*) – current units or magnitude.

`lantz.ui.qtwidgets.`**`start_test_app`**(*target*, *width=500*, **args*)
Start a single window test application with a form automatically generated for the driver.

Parameters

- **target** – a driver object or a collection of drivers.
- **width** – to be used as minimum width of the window.
- **args** – arguments to be passed to QApplication.

1.7.4 Support

lantz.stats

Implements an statistical accumulator

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class `lantz.stats.`**`RunningState`**(*value=None*)

Accumulator for events.

Parameters **value** – first value to add.

`add`(*value*)

Add to the accumulator.

Parameters **value** – value to be added.

class `lantz.stats.`**`RunningStats`**

Accumulator for categorized event statistics.

`add`(*key*, *value*)

Add an event to a given accumulator.

Parameters

- **key** – category to which the event should be added.
- **value** – value of the event.

`stats`(*key*)

Return the statistics for the current accumulator.

Return type Stats.

class `lantz.stats.`**`Stats`**

Data structure

`count`

Alias for field number 1

`last`

Alias for field number 0

`max`

Alias for field number 5

`mean`

Alias for field number 2

`min`

Alias for field number 4

`std`

Alias for field number 3

`lantz.stats.`**`stats`**(*state*)

Return the statistics for given state.

Parameters **state** (*RunningState*) – state

Returns statistics

Return type Stats named tuple

lantz.processors

class `lantz.processors.`**`FromQuantityProcessor`**

Processor to convert the units the function arguments.

The syntax is equal to *Processor* except that strings are interpreted as units.

```
>>> conv = FromQuantityProcessor('ms')
>>> conv(Q_(1, 's'))
1000.0
```

class `lantz.processors.`**`MapProcessor`**

Processor to map the function parameter values.

The syntax is equal to *Processor* except that a dict is used as mapping table.

Examples:

```
>>> conv = MapProcessor({True: 42})
>>> conv(True)
42
```

class `lantz.processors.`**`ParseProcessor`**

Processor to convert/parse the function parameters.

The syntax is equal to *Processor* except that strings are interpreted as a :class:Parser expression.

```
>>> conv = ParseProcessor('spam {:s} eggs')
>>> conv('spam ham eggs')
'ham'

>>> conv = ParseProcessor(('hi {:d}', 'bye {:s}'))
>>> conv(('hi 42', 'bye Brian'))
(42, 'Brian')
```

class `lantz.processors.`**`Processor`**

Processor to convert the function parameters.

A *callable* argument will be used to convert the corresponding function argument.

For example, here *x* will be converted to float, before entering the function body:

```
>>> conv = Processor(float)
>>> conv
<class 'float'>
>>> conv('10')
10.0
```

The processor supports multiple argument conversion in a tuple:

```
>>> conv = Processor((float, str))
>>> type(conv)
<class 'lantz.processors.Processor'>
>>> conv(('10', 10))
(10.0, '10')
```

class `lantz.processors.`**`RangeProcessor`**

Processor to convert the units the function arguments.

The syntax is equal to *Processor* except that iterables are interpreted as (low, high, step) specified ranges. Step is optional and max is included

```
>>> conv = RangeProcessor(((1, 2, .5), ))
>>> conv(1.7)
1.5
```

class `lantz.processors.`**`ReverseMapProcessor`**

Processor to map the function parameter values.

The syntax is equal to *Processor* except that a dict is used as mapping table.

Examples:

```
>>> conv = ReverseMapProcessor({True: 42})
>>> conv(42)
True
```

class `lantz.processors.`**`ToQuantityProcessor`**

Decorator to convert the units the function arguments.

The syntax is equal to *Processor* except that strings are interpreted as units.

```
>>> conv = ToQuantityProcessor('ms')
>>> conv(Q_(1, 's'))
<Quantity(1000.0, 'millisecond')>
>>> conv(1)
<Quantity(1.0, 'millisecond')>
```

`lantz.processors.`**`check_membership`**(*container*)

Parameters **container** –

Returns

```
>>> checker = check_membership((1, 2, 3))
>>> checker(1)
1
>>> checker(0)
Traceback (most recent call last):
...
ValueError: 0 not in (1, 2, 3)
```

`lantz.processors.`**`check_range_and_coerce_step`**(*low*, *high*, *step=None*)

Parameters

- **low** –
- **high** –
- **step** –

Returns

```
>>> checker = check_range_and_coerce_step(1, 10)
>>> checker(1), checker(5), checker(10)
(1, 5, 10)
>>> checker(11)
Traceback (most recent call last):
...
ValueError: 11 not in range (1, 10)
>>> checker = check_range_and_coerce_step(1, 10, 1)
>>> checker(1), checker(5.4), checker(10)
(1, 5, 10)
```

`lantz.processors.`**`convert_to`**(*units*, *on_dimensionless='warn'*, *on_incompatible='raise'*, *return_float=False*)

Return a function that convert a Quantity to to another units.

Parameters

- **units** – string or Quantity specifying the target units
- **on_dimensionless** – how to proceed when a dimensionless number number is given. 'raise' to raise an exception, 'warn' to log a warning and proceed, 'ignore' to silently proceed
- **on_incompatible** – how to proceed when source and target units are incompatible. Same options as *on_dimensionless*

Raises

ValueError if the incoming value cannot be properly converted

```
>>> convert_to('mV')(Q_(1, 'V'))
<Quantity(1000.0, 'millivolt')>
>>> convert_to('mV', return_float=True)(Q_(1, 'V'))
1000.0
```

lantz.processors.**getitem**(*a*, *b*)
Return a[b] or if not found a[type(b)]

lantz.visalib

Wraps Visa Library in a Python friendly way.

This wrapper originated while porting pyvisa to Python 3 and therefore is heavily influenced by it. There are a few important differences:

- There is no visa_library singleton object and the library path can be specified.
- Similar functions for different data width (In8, In16, etc) have been grouped within the same function. The extended versions are also grouped.
- VISA functions dealing with strings have been dropped as can be easily replaced by Python functions.
- types, status codes, attributes, events and constants are defined within a class (not a module).
- Prefixes in types (*vi*), status codes (*VI_*), attributes (*VI_ATTR*), events (*VI_EVENT*) and constants (*VI_*) have been dropped for clarity. As this constants are defined within a RichEnum class, prefixed names are still usable.

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class lantz.visalib.**Attributes**
Enumeration of VISA Attributes with their corresponding value, VISA TYPE and docstring

class lantz.visalib.**Constants**
Enumeration of VISA Constants with their corresponding value and docstring

class lantz.visalib.**Events**
Enumeration of VISA Events with their corresponding value and docstring

class lantz.visalib.**ResourceInfo**
Resource extended information

alias
Alias for field number 4

interface_board_number
Alias for field number 1

interface_type
Alias for field number 0

resource_class
Alias for field number 2

resource_name
Alias for field number 3

class lantz.visalib.**ResourceManager**
VISA Resource Manager

Parameters **library_path** – path of the VISA library (if not given, the default for the platform will be used).

list_resources(*query='?*::INSTR'*)
Returns a list of all connected devices matching query.

Parameters **query** – regular expression used to match devices.

list_resources_info(*query='?*::INSTR'*)
Returns a dictionary mapping resource names to resource extended information of all connected devices matching query.

Parameters **query** – regular expression used to match devices.

open_resource(*resource_name*, *access_mode=0*, *open_timeout=0*)
Open the specified resources.

Parameters

- **resource_name** – name or alias of the resource to open.
- **access_mode** – access mode.
- **open_timeout** – time out to open.

resource_info(*resource_name*)
Get the extended information of a particular resource

REGISTER = {}
Holds a mapping between library_path and the default manager

class lantz.visalib.**RichEnum**
Type for rich enumerations.

class lantz.visalib.**StatusCode**
Enumeration of VISA status codes with their corresponding value and docstring.

class lantz.visalib.**Types**
Enumeration of VISA types mapped to ctypes.

class lantz.visalib.**VisaLibrary**
VISA Library wrapper.

Parameters **library_path** – full path of the library. If not given, the default value LIBRARY_PATH it is used.

assert_interrupt_signal(*session*, *mode*, *status_id*)
Asserts the specified interrupt or signal.

Parameters

- **session** – Unique logical identifier to a session.
- **mode** – How to assert the interrupt. (Constants.ASSERT*)

- **status_id** – This is the status value to be presented during an interrupt acknowledge cycle.

assert_trigger (*session*, *protocol*)
Asserts software or hardware trigger.

Parameters

- **session** – Unique logical identifier to a session.
- **protocol** – Trigger protocol to use during assertion. (Constants.PROT*)

assert_utility_signal (*session*, *line*)
Asserts or deasserts the specified utility bus signal.

Parameters

- **session** – Unique logical identifier to a session.
- **line** – specifies the utility bus signal to assert. (Constants.UTIL_ASSERT*)

buffer_read (*session*, *count*)
Reads data from device or interface through the use of a formatted I/O read buffer.

Parameters

- **session** – Unique logical identifier to a session.
- **count** – Number of bytes to be read.

Returns data read.

Return type bytes

buffer_write (*session*, *data*)
Writes data to a formatted I/O write buffer synchronously.

Parameters

- **session** – Unique logical identifier to a session.
- **data** – data to be written.

Returns number of written bytes.

clear (*session*)
Clears a device.

Parameters **session** – Unique logical identifier to a session.

close (*session*)
Closes the specified session, event, or find list.

Parameters **session** – Unique logical identifier to a session, event, or find list.

disable_event (*session*, *event_type*, *mechanism*)
Disables notification of the specified event type(s) via the specified mechanism(s).

Parameters

- **session** – Unique logical identifier to a session.
- **event_type** – Logical event identifier.
- **mechanism** – Specifies event handling mechanisms to be disabled. (Constants.QUEUE, .Handler, .SUSPEND_HNDLR, .ALL_MECH)

discard_events (*session*, *event_type*, *mechanism*)
Discards event occurrences for specified event types and mechanisms in a session.

Parameters

- **session** – Unique logical identifier to a session.
- **event_type** – Logical event identifier.
- **mechanism** – Specifies event handling mechanisms to be disabled. (Constants.QUEUE, .Handler, .SUSPEND_HNDLR, .ALL_MECH)

`enable_event` (*session*, *event_type*, *mechanism*, *context=0*)
Discards event occurrences for specified event types and mechanisms in a session.

Parameters

- **session** – Unique logical identifier to a session.
- **event_type** – Logical event identifier.
- **mechanism** – Specifies event handling mechanisms to be disabled. (Constants.QUEUE, .Handler, .SUSPEND_HNDLR)
- **context** –

`find_next` (*find_list*)
Returns the next resource from the list of resources found during a previous call to find_resources().

Parameters **find_list** – Describes a find list. This parameter must be created by find_resources().

Returns Returns a string identifying the location of a device.

`find_resources` (*session*, *query*)
Queries a VISA system to locate the resources associated with a specified interface.

Parameters

- **session** – Unique logical identifier to a session (unused, just to uniform signatures).
- **query** – A regular expression followed by an optional logical expression. Use '?*' for all.

Returns find_list, return_counter, instrument_description

`flush` (*session*, *mask*)
Manually flushes the specified buffers associated with formatted I/O operations and/or serial communication.

Parameters

- **session** – Unique logical identifier to a session.
- **mask** – Specifies the action to be taken with flushing the buffer. (Constants.READ*, .WRITE*, .IO*)

`get_attribute` (*session*, *attribute*)
Retrieves the state of an attribute.

Parameters

- **session** – Unique logical identifier to a session, event, or find list.
- **attribute** – Resource attribute for which the state query is made (see Attributes.*)

Returns The state of the queried attribute for a specified resource.

`gpib_command` (*session*, *data*)
Write GPIB command bytes on the bus.

Parameters

- **session** – Unique logical identifier to a session.
- **data** – data tor write.

Returns Number of written bytes.

gpib_control_atn(*session*, *mode*)
Specifies the state of the ATN line and the local active controller state.

Parameters

- **session** – Unique logical identifier to a session.
- **mode** – Specifies the state of the ATN line and optionally the local active controller state. (Constants.GPIB_ATN*)

gpib_control_ren(*session*, *mode*)
Controls the state of the GPIB Remote Enable (REN) interface line, and optionally the remote/local state of the device.

Parameters

- **session** – Unique logical identifier to a session.
- **mode** – Specifies the state of the REN line and optionally the device remote/local state. (Constants.GPIB_REN*)

gpib_pass_control(*session*, *primary_address*, *secondary_address*)
Tell the GPIB device at the specified address to become controller in charge (CIC).

Parameters

- **session** – Unique logical identifier to a session.
- **primary_address** – Primary address of the GPIB device to which you want to pass control.
- **secondary_address** – Secondary address of the targeted GPIB device. If the targeted device does not have a secondary address, this parameter should contain the value Constants.NO_SEC_ADDR.

gpib_send_ifc(*session*)
Pulse the interface clear line (IFC) for at least 100 microseconds.

Parameters **session** – Unique logical identifier to a session.

Returns

install_handler(*session*, *event_type*, *handler*, *user_handle=None*)
Installs handlers for event callbacks.

Parameters

- **session** – Unique logical identifier to a session.
- **event_type** – Logical event identifier.
- **handler** – Interpreted as a valid reference to a handler to be installed by a client application.
- **user_handle** – A value specified by an application that can be used for identifying handlers uniquely for an event type.

lock(*session*, *lock_type*, *timeout*, *requested_key=None*)
Establishes an access mode to the specified resources.

Parameters

- **session** – Unique logical identifier to a session.
- **lock_type** – Specifies the type of lock requested, either Constants.EXCLUSIVE_LOCK or Constants.SHARED_LOCK.
- **timeout** – Absolute time period (in milliseconds) that a resource waits to get unlocked by the locking session before returning an error.
- **requested_key** – This parameter is not used and should be set to VI_NULL when lockType is VI_EXCLUSIVE_LOCK.

Returns access_key that can then be passed to other sessions to share the lock.

map_address (*session*, *map_space*, *map_base*, *map_size*, *access=0*, *suggested=0*, *extended=False*)
Maps the specified memory space into the process's address space.

Parameters

- **session** – Unique logical identifier to a session.
- **map_space** – Specifies the address space to map. (Constants.*SPACE*)
- **map_base** – Offset (in bytes) of the memory to be mapped.
- **map_size** – Amount of memory to map (in bytes).
- **access** –
- **suggested** – If not Constants.NULL (0), the operating system attempts to map the memory to the address specified in suggested. There is no guarantee, however, that the memory will be mapped to that address. This operation may map the memory into an address region different from suggested.
- **extended** – Use 64 bits offset independent of the platform.

Returns Address in your process space where the memory was mapped.

map_trigger (*session*, *trigger_source*, *trigger_destination*, *mode=0*)
Map the specified trigger source line to the specified destination line.

Parameters

- **session** – Unique logical identifier to a session.
- **trigger_source** – Source line from which to map. (Constants.TRIG*)
- **trigger_destination** – Destination line to which to map. (Constants.TRIG*)
- **mode** –

memory_allocation (*session*, *size*, *extended=False*)
Allocates memory from a resource's memory region.

Parameters

- **session** – Unique logical identifier to a session.
- **size** – Specifies the size of the allocation.
- **extended** – Use 64 bits offset independent of the platform.

Returns Returns the offset of the allocated memory.

memory_free (*session*, *offset*, *extended=False*)
Frees memory previously allocated using the memory_allocation() operation.

Parameters

- **session** – Unique logical identifier to a session.
- **size** – Specifies the size of the allocation.
- **extended** – Use 64 bits offset independent of the platform.

move (*session*, *source_space*, *source_offset*, *source_width*, *destination_space*, *destination_offset*, *destination_width*, *length*, *extended=False*)
Moves a block of data.

Parameters

- **session** – Unique logical identifier to a session.
- **source_space** – Specifies the address space of the source.
- **source_offset** – Offset of the starting address or register from which to read.
- **source_width** – Specifies the data width of the source.
- **destination_space** – Specifies the address space of the destination.
- **destination_offset** – Offset of the starting address or register to which to write.
- **destination_width** – Specifies the data width of the destination.
- **length** – Number of elements to transfer, where the data width of the elements to transfer is identical to the source data width.
- **extended** – Use 64 bits offset independent of the platform.

move_async (*session*, *source_space*, *source_offset*, *source_width*, *destination_space*, *destination_offset*, *destination_width*, *length*, *extended=False*)
Moves a block of data asynchronously.

Parameters

- **session** – Unique logical identifier to a session.
- **source_space** – Specifies the address space of the source.
- **source_offset** – Offset of the starting address or register from which to read.
- **source_width** – Specifies the data width of the source.
- **destination_space** – Specifies the address space of the destination.
- **destination_offset** – Offset of the starting address or register to which to write.
- **destination_width** – Specifies the data width of the destination.
- **length** – Number of elements to transfer, where the data width of the elements to transfer is identical to the source data width.
- **extended** – Use 64 bits offset independent of the platform.

Returns Job identifier of this asynchronous move operation.

move_memory_in (*session*, *space*, *offset*, *length*, *width*, *extended=False*)
Moves a block of data from the specified address space and offset to local memory.

Parameters

- **session** – Unique logical identifier to a session.
- **space** – Specifies the address space. (Constants.*SPACE*)
- **offset** – Offset (in bytes) of the address or register from which to read.

- **length** – Number of elements to transfer, where the data width of the elements to transfer is identical to the source data width.
- **width** – Number of bits to read per element.
- **extended** – Use 64 bits offset independent of the platform.

Returns Data read from bus.

Corresponds to viIn* functions of the visa library.

move_memory_out (*session*, *space*, *offset*, *length*, *data*, *width*, *extended=False*)
Moves a block of data from local memory to the specified address space and offset.

Parameters

- **session** – Unique logical identifier to a session.
- **space** – Specifies the address space. (Constants.*SPACE*)
- **offset** – Offset (in bytes) of the address or register from which to read.
- **length** – Number of elements to transfer, where the data width of the elements to transfer is identical to the source data width.
- **data** – Data to write to bus.
- **width** – Number of bits to read per element.
- **extended** – Use 64 bits offset independent of the platform.

open (*session*, *resource_name*, *access_mode=0*, *open_timeout=0*)
Opens a session to the specified resource.

Parameters

- **session** – Resource Manager session (should always be a session returned from open_default_resource_manager()).
- **resource_name** – Unique symbolic name of a resource.
- **access_mode** – Specifies the mode by which the resource is to be accessed. (Constants.NULL or Constants.*LOCK*)
- **open_timeout** – Specifies the maximum time period (in milliseconds) that this operation waits before returning an error.

Returns Unique logical identifier reference to a session.

open_default_resource_manager ()
This function returns a session to the Default Resource Manager resource.

Returns Unique logical identifier to a Default Resource Manager session.

parse_resource (*session*, *resource_name*)
Parse a resource string to get the interface information.

Parameters

- **session** – Resource Manager session (should always be the Default Resource Manager for VISA returned from open_default_resource_manager()).
- **resource_name** – Unique symbolic name of a resource.

Returns Resource information with interface type and board number.

Return type :class:ResourceInfo

parse_resource_extended(*session*, *resource_name*)
Parse a resource string to get extended interface information.

Parameters

- **session** – Resource Manager session (should always be the Default Resource Manager for VISA returned from open_default_resource_manager()).
- **resource_name** – Unique symbolic name of a resource.

Returns Resource information.

Return type :class:ResourceInfo

peek(*session*, *address*, *width*)
Writes an 8-bit, 16-bit, 32-bit, or 64-bit value from the specified address.

Parameters

- **session** – Unique logical identifier to a session.
- **address** – Source address to read the value.
- **width** – Number of bits to read.

Returns Data read from bus.

Return type bytes

poke(*session*, *address*, *data*, *width*)
Reads an 8-bit, 16-bit, 32-bit, or 64-bit value from the specified address.

Parameters

- **session** – Unique logical identifier to a session.
- **address** – Source address to read the value.
- **data** – value to be written to the bus.
- **width** – Number of bits to read.

Returns Data read from bus.

Return type bytes

read(*session*, *count*)
Reads data from device or interface synchronously.

Parameters

- **session** – Unique logical identifier to a session.
- **count** – Number of bytes to be read.

Returns data read.

read_asynchronously(*session*, *count*)
Reads data from device or interface asynchronously.

Parameters

- **session** – Unique logical identifier to a session.
- **count** – Number of bytes to be read.

Returns (ctypes buffer with result, jobid)

read_memory (*session*, *space*, *offset*, *width*, *extended=False*)

Reads in an 8-bit, 16-bit, 32-bit, or 64-bit value from the specified memory space and offset. :param session: Unique logical identifier to a session. :param space: Specifies the address space. (Constants.*SPACE*) :param offset: Offset (in bytes) of the address or register from which to read. :param width: Number of bits to read. :param extended: Use 64 bits offset independent of the platform. :return: Data read from memory.

Corresponds to viIn* functions of the visa library.

read_stb (*session*)

Reads a status byte of the service request.

Parameters **session** – Unique logical identifier to a session.

Returns Service request status byte.

read_to_file (*session*, *filename*, *count*)

Read data synchronously, and store the transferred data in a file.

Parameters

- **session** – Unique logical identifier to a session.
- **filename** – Name of file to which data will be written.
- **count** – Number of bytes to be read.

Returns Number of bytes actually transferred.

set_attribute (*session*, *attribute*, *attribute_state*)

Sets the state of an attribute.

Parameters

- **session** – Unique logical identifier to a session.
- **attribute** – Attribute for which the state is to be modified. (Attributes.*)
- **attribute_state** – The state of the attribute to be set for the specified object.

Returns

set_buffer (*session*, *mask*, *size*)

Sets the size for the formatted I/O and/or low-level I/O communication buffer(s).

Parameters

- **session** – Unique logical identifier to a session.
- **mask** – Specifies the type of buffer. (Constants.READ_BUF, .WRITE_BUF, .IO_IN_BUF, .IO_OUT_BUF)
- **size** – The size to be set for the specified buffer(s).

Returns

status_description (*session*, *status*)

Returns a user-readable description of the status code passed to the operation.

Parameters

- **session** – Unique logical identifier to a session.
- **status** – Status code to interpret.

Returns The user-readable string interpretation of the status code passed to the operation.

terminate(*session*, *degree*, *job_id*)
Requests a VISA session to terminate normal execution of an operation.

Parameters

- **session** – Unique logical identifier to a session.
- **degree** – Constants.NULL
- **job_id** – Specifies an operation identifier.

uninstall_handler(*session*, *event_type*, *handler*, *user_handle=None*)
Uninstalls handlers for events.

Parameters

- **session** – Unique logical identifier to a session.
- **event_type** – Logical event identifier.
- **handler** – Interpreted as a valid reference to a handler to be uninstalled by a client application.
- **user_handle** – A value specified by an application that can be used for identifying handlers uniquely in a session for an event.

unlock(*session*)
Relinquishes a lock for the specified resource.

Parameters **session** – Unique logical identifier to a session.

unmap_address(*session*)
Unmaps memory space previously mapped by map_address().

Parameters **session** – Unique logical identifier to a session.

unmap_trigger(*session*, *trigger_source*, *trigger_destination*)
Undo a previous map from the specified trigger source line to the specified destination line.

Parameters

- **session** – Unique logical identifier to a session.
- **trigger_source** – Source line used in previous map. (Constants.TRIG*)
- **trigger_destination** – Destination line used in previous map. (Constants.TRIG*)

Returns

usb_control_in(*session*, *request_type_bitmap_field*, *request_id*, *request_value*, *index*, *length=0*)
Performs a USB control pipe transfer from the device.

Parameters

- **session** – Unique logical identifier to a session.
- **request_type_bitmap_field** – bmRequestType parameter of the setup stage of a USB control transfer.
- **request_id** – bRequest parameter of the setup stage of a USB control transfer.
- **request_value** – wValue parameter of the setup stage of a USB control transfer.
- **index** – wIndex parameter of the setup stage of a USB control transfer. This is usually the index of the interface or endpoint.

- **length** – wLength parameter of the setup stage of a USB control transfer. This value also specifies the size of the data buffer to receive the data from the optional data stage of the control transfer.

Returns The data buffer that receives the data from the optional data stage of the control transfer.

Return type bytes

usb_control_out (*session*, *request_type_bitmap_field*, *request_id*, *request_value*, *index*, *data=''*)
Performs a USB control pipe transfer to the device.

Parameters

- **session** – Unique logical identifier to a session.
- **request_type_bitmap_field** – bmRequestType parameter of the setup stage of a USB control transfer.
- **request_id** – bRequest parameter of the setup stage of a USB control transfer.
- **request_value** – wValue parameter of the setup stage of a USB control transfer.
- **index** – wIndex parameter of the setup stage of a USB control transfer. This is usually the index of the interface or endpoint.
- **data** – The data buffer that sends the data in the optional data stage of the control transfer.

vxi_command_query (*session*, *mode*, *command*)
Sends the device a miscellaneous command or query and/or retrieves the response to a previous query.

Parameters

- **session** – Unique logical identifier to a session.
- **mode** – Specifies whether to issue a command and/or retrieve a response. (Constants.VXI_CMD*, .VXI_RESP*)
- **command** – The miscellaneous command to send.

Returns The response retrieved from the device.

wait_on_event (*session*, *in_event_type*, *timeout*)
Waits for an occurrence of the specified event for a given session.

Parameters

- **session** – Unique logical identifier to a session.
- **in_event_type** – Logical identifier of the event(s) to wait for.
- **timeout** – Absolute time period in time units that the resource shall wait for a specified event to occur before returning the time elapsed error. The time unit is in milliseconds.

Returns Logical identifier of the event actually received, A handle specifying the unique occurrence of an event.

write (*session*, *data*)
Writes data to device or interface synchronously.

Parameters

- **session** – Unique logical identifier to a session.
- **data** – data to be written.

Returns Number of bytes actually transferred.

write_asynchronously (*session*, *buffer*)
Writes data to device or interface asynchronously.

Parameters

- **session** – Unique logical identifier to a session.
- **data** – data to be written.

Returns Job ID of this asynchronous write operation.

write_from_file (*session*, *filename*, *count*)
Take data from a file and write it out synchronously.

Parameters

- **session** – Unique logical identifier to a session.
- **filename** – Name of file from which data will be read.
- **count** – Number of bytes to be written.

Returns Number of bytes actually transferred.

write_memory (*session*, *space*, *offset*, *data*, *width*, *extended=False*)
Reads in an 8-bit, 16-bit, 32-bit, or 64-bit value from the specified memory space and offset. :param session: Unique logical identifier to a session. :param space: Specifies the address space. (Constants.*SPACE*) :param offset: Offset (in bytes) of the address or register from which to read. :param data: Data to write to bus. :param width: Number of bits to read. :param extended: Use 64 bits offset independent of the platform.

Corresponds to viOut* functions of the visa library.

REGISTER = {}
Holds a mapping between library_path and VisaLibrary objects

pint

Pint is Python module/package to define, operate and manipulate **physical quantities**: the product of a numerical value and a unit of measurement. It allows arithmetic operations between them and conversions from and to different units.

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exception lantz.pint.**DimensionalityError** (*units1*, *units2*, *dim1=None*, *dim2=None*)
Raised when trying to convert between incompatible units.

exception lantz.pint.**UndefinedUnitError** (*unit_names*)
Raised when the units are not defined in the unit registry.

class lantz.pint.**UnitRegistry** (*filename=''*)
The unit registry stores the definitions and relationships between units.

Parameters **filename** – path of the units definition file to load. Empty to load the default definition file. None to leave the UnitRegistry empty.

class Quantity
Quantity object constituted by magnitude and units.

Parameters

- **value** (*str, Quantity or any numeric type.*) – value of the physical quantity to be created.

- **units** (*UnitsContainer, str or Quantity.*) – units of the physical quantity to be created.

convert_to_reference()
Return Quantity rescaled to reference units.

ito(*other=None*)
Inplace rescale to different units.
Parameters other (*Quantity or str.*) – destination units.

to(*other=None*)
Return Quantity rescaled to different units.
Parameters other (*Quantity or str.*) – destination units.

dimensionality
Quantity's dimensionality (e.g. {length: 1, time: -1})

dimensionless
Return true if the quantity is dimensionless.

magnitude
Quantity's magnitude.

unitless
Return true if the quantity does not have units.

units
Quantity's units.
Return type UnitContainer

UnitRegistry.**add_from_file**(*filename*)
Add units and prefixes defined in a definition text file.

UnitRegistry.**add_prefix**(*name*, *value*, *aliases=()*)
Add prefix to the registry.

UnitRegistry.**add_unit**(*name*, *value*, *aliases=()*, ***modifiers*)
Add unit to the registry.

class lantz.pint.**UnitsContainer**(**args*, ***kwargs*)
The UnitsContainer stores the product of units and their respective exponent and implements the corresponding operations

lantz.pint.**solve_dependencies**(*dependencies*)
Solve a dependency graph.

Parameters dependencies – dependency dictionary. For each key, the value is an iterable indicating its dependencies.

Returns list of sets, each containing keys of independents tasks dependent

lantz.stringparser

A stand alone module used by lantz. (website)

Motivation

The `stringparser` module provides a simple way to match patterns and extract information within strings. As patterns are given using the familiar format string specification **PEP 3101**, writing them is much easier than writing regular expressions (albeit less powerful).

Examples

You can build a reusable parser object:

```
>>> parser = Parser('The answer is {:d}')
>>> parser('The answer is 42')
42
>>> parser('The answer is 54')
54
```

Or directly:

```
>>> Parser('The answer is {:d}')('The answer is 42')
42
```

You can retrieve many fields:

```
>>> Parser('The {:s} is {:d}')('The answer is 42')
('answer', 42)
```

And you can use numbered fields to order the returned tuple:

```
>>> Parser('The {1:s} is {0:d}')('The answer is 42')
(42, 'answer')
```

Or named fields to return an OrderedDict:

```
>>> Parser('The {a:s} is {b:d}')('The answer is 42')
OrderedDict([('a', 'answer'), ('b', 42)])
```

You can ignore some fields using _ as a name:

```
>>> Parser('The {_:s} is {:d}')('The answer is 42')
42
```

Limitations

- From the format string: *[[fill]align][sign][#][0][minimumwidth][.precision][type]* only *type*, *sign* and *#* are currently implemented. This might cause trouble to match certain notation like:
  - decimal: '-4' written as '- 4'
  - etc
- Lines are matched from beginning to end. {:d} will NOT return all the numbers in the string. Use regex for that.

1.8 Contributing

You are most welcome to contribute to Lantz with code, documentation and translations. Please read the following document for guidelines.

1.8.1 File system structure

The distribution is organized in the following folders:

docs

Documentation in reStructuredText format with Sphinx makefile. Files must have a `.rst` extension

To generate, for example, HTML documentation change into this folder and run:

```
$ make html
```

You will find the generated documentation in `docs/_build/html/index.html`

examples

Root folder for the examples.

lantz

Root folder containing the core functionality

ui

User interface related code.

drivers

There is a package folder for each manufacturer and module file for each instrument model (or family of models). All files are named using lowercase. Class drivers are named according to the model. If the model starts with a number, then the first letter of the manufacturer should be prefixed. Finally, all classes should be imported in the __init__.py of the corresponding package.

scripts

Python scripts to provide simple command line functionality.

tests

Test cases.

1.8.2 Python style

- Unless otherwise specified, follow **PEP 8** strictly.
- Document every class and method according to **PEP 257**.
- Before submitting your code, use a tool like pep8.py and pylint.py to check for style.
- *Feat* and *DictFeat* should be named with a noun or an adjective.
- *Action* should be named with a verb.
- Files should be utf-8 formatted.

1.8.3 Header

All files must have first the encoding indication, and then a header indicating the module, a small description and the copyright message. For example:

```
# -*- coding: utf-8 -*-
"""
    lantz.foreign
    ~~~~~~~~~~~~~

    Implements classes and methods to interface to foreign functions.

    :copyright: (c) 2012 by Lantz Authors, see AUTHORS for more details.
```

```
    :license: BSD, see LICENSE for more details.
"""
```

1.8.4 Version control system

Lantz uses Git as version control system.

There are always at least two branches:

- master: appropriate for users. It must always be in a working state.
- develop: appropriate for developers. Might not be in a working state.

The master branch only accepts atomic, small commits. Larger changes that might break the master branch should happen in the develop branch. The develop branch will be merged into the master after deep testing. If you want to refactor major parts of the code or try new ideas, create a dedicated branch. This branch will merged into develop once tested.

1.8.5 Submitting your changes

Changes must be submitted for merging as patches or pull requests.

Before doing so, please check that:

- The new code is functional.
- The new code follows the style guidelines.
- The new code is documented.
- All tests are passed.
- Any new file contains an appropriate header.
- You commit to the head of the appropriate branch (usually develop).

Commits must include a one-line description of the intended change followed, if necessary, by an empty line and detailed description. You can send your patch by e-mail to *lantz.contributor@gmail.com*:

```
$ git format-patch origin/develop..develop
0001-Changed-Driver-class-to-enable-inheritance-of-Action.patch
0002-Added-RECV_CHUNK-to-TextualMixin.patch
```

or send a pull request.

1.8.6 Copyright

Files in the Lantz repository don't list author names, both to avoid clutter and to avoid having to keep the lists up to date. Instead, your name will appear in the Git change log and in the AUTHORS file. The Lantz maintainer will update this file when you have submitted your first commit.

Before your first contribution you must submit the *Contributor Agreement*. Code that you contribute should use the standard copyright header:

```
:copyright: (c) 2012 by Lantz Authors, see AUTHORS for more details.
:license: BSD, see LICENSE for more details.
```

1.8.7 Finally, we have a small Zen

```
import this
Lantz should not get in your way.
Unless you actually want it to.
Even then, python ways should not be void.
Provide solutions for common scenarios.
Leave the special cases for the people who actually need them.
Logging is great, do it often!
```

1.9 Reporting Bugs

If you have found any error in the code or the documentation, please report it using github issue tracker.

To make you bug report as useful as possible, please add a comprehensive description of what you were trying to do, what you have observed, and what you expected.

Additionally if you have a patch, feel free to contribute it back. Check on *Contributing* for more information.

CHAPTER

TWO

INDICES AND TABLES

genindex
Lists all sections and subsections.

modindex
All functions, classes, terms.

search
Search this documentation.

We thank GlugCEN *for hosting the code, the docs and the mailing list*

PYTHON MODULE INDEX

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